Office of Rail Regulation and Network Rail

Part A Reporter Mandate AO/030: PR13 Maintenance & Renewals Review

Summary Report

AO/030/01

Issue 1 | May 2013

Job number 223767-13

Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

ARUP

Contents

Appendices

Glossary

ADAS Survey	NR Drainage Survey in 2011/2012
AMCL	Asset Management Consulting Limited
AMEM	AMCL Asset Management Excellence Model ¬TM
AMP	Asset Management Plan
ARL	Asset Remaining Life
ARS	Average Risk Score
ASI	Asset Stewardship Indicator
BCAM	Buildings and Civils Asset Management Programme
BCMI	Bridge Condition Marking Index (previously SCMI: Structure Condition Marking Index).
BRE	Building Research Establishment
BSL	Basic Safety Limit
CAF	Cost Analysis Framework
CAPEX	Capital Expenditure
CARRS	Civil Asset Register and electronic Reporting System.
CaSL	Cancelations and Significant Lateness Measure
CECOST/CeCost	Civil Engineering Cost Modelling Structures Model (Tier 1 ICM for bridge structures)
CEFA	Civil Examination Framework Agreement
CET	Controlled Emission Toilet
CM	Coating Metallic / Cracked Masonry
CP4	Control Period 4 – April 2009 – March 2014
CP5	Control Period 5 - April 2014 – March 2019
DAMP	Drainage Asset Management Plan
DC	Direct Current
DfT	Department for Transport
DMP	Drainage Management Plan
DRAM	Director of Route Asset Management
DST	Decision Support Tool
E&P	Electrical and Power
EGT	Equivalent Gross Tonnage
Ellipse	NR planning and works management system
FMECA	Failure mode, effects and criticality analysis
FTN	Fixed Telecommunications Network
GEOGIS	Geographical Information System (track asset database)
GPR	Ground Penetrating Radar
GSM-R	Global Systems for Mobile Communications on the Railway
GTG	Good Track Geometry

HAM	Head of Asset Management (applies for each engineering discipline)
HD GPR	High Definition Ground Penetrating Radar
HLOS	High level Output Specification
HS1	High Speed 1
IDP	Integrated Drainage Project
IIP	Initial Industry Plan 2011
IP	Investment Projects
KPI	Key Performance Indicator
LADS	Linear Asset Decision Support
LMD	Light Maintenance Depot
LMDSM	Light Maintenance Depot Stewardship Measure
LNW	London North Western (Route)
LTSF	Local Track Selection Factor
M&R	Maintenance and Renewal
MAA	Moving Annual Average
MDU	Maintenance Delivery Unit
MUC	Maintenance Unit Cost
NDS	National Delivery Services
NERRP	National Earthworks Risk Reduction Programme
NR	Network Rail
OPAS	Operational Property Asset System
OPEX	Operational Expenditure
ORBIS	Offering Rail Better Information Services
ORR	Office of Rail Regulation
PARL	Percentage Asset Remaining life
PL	Plain Line (track without switches and crossings)
PLBE	Principal Load Bearing Element
PLPR	Plain Line Pattern Recognition
PoaP	Policy on a Page
POG	Planning Oversight Group (a Group which involves representatives of Network Rail, passenger and freight train operators and suppliers)
PPM	Public Performance Measure
PPM	Planned Preventative Maintenance
RA	Route Availability
RAM	Route Asset Manager (applies for each engineering disciplines)
RAMP	Route Asset Management Plan
RDMS	Rail Defect Management System
RSHI	Rock Slope Hazard Index
RSSB	Railway Safety and Standards Board
RUS	Route Utilisation Strategies

S&C	Switches and Crossings
SAF	Service Affecting Failures
SBP	Strategic Business Plan
SCAnNeR	Strategic Cost Analysis for Network Rail (Tier 1 ICM for Earthworks and Drainage assets)
SCMI	Structures Condition Marking Index
SevEx	Severity and Extent (used in bridge condition marking)
SoFA	Statement of Funds Available
SoS	Secretary of State for Transport (England & Wales)
SQUIRE	Service Quality Inspection Regime
SRM	Safety Risk Model
SRS	Strategic Route Section
SSHI	Soil Slope Hazard Index
SSM	Station Stewardship Measure
SSME	Senior Structure Maintenance Engineer
TCMI	Tunnel Condition Marking Index
TfL	Transport for London
TME	Track Maintenance Engineer
TOC	Train Operating Company
TRUST	Train Running System (TRUST) database
TSR	Temporary Speed Restriction
V/T SIC	Vehicle / Track System Interface Committee
VTISM	Vehicle Track Interface System Model
WLCC	Whole Life Cycle Costing

1 Executive Summary

1.1 Introduction

1.1.1 On 7th January 2013 Network Rail submitted their Strategic Business Plan (SBP) for Control Period 5 (CP5) which runs from April 2014 to March 2019.

1.1.2 Arup, as Part A Independent Reporter, have been appointed by the Office of Rail Regulation (ORR) and Network Rail (NR) to consider aspects of NR's SBP submission for Maintenance and Renewals in CP5.

1.1.3 This report summarises our findings from our review of NR's proposed CP5 Asset Policies and their application in developing SBP volume, cost, output and efficiency projections as instructed by Independent Reporter Mandate AO/030 *'PR13 M&R review of asset policies and their application in planning: progressive assurance and SBP submission'*.

1.1.4 We have presented our findings on Mandate AO/030 in a hierarchy of reports.

1.1.5 This report is the overall summary document that draws together the various strands of work we have undertaken. In our accompanying reports we set out detailed findings on NR's specific 'Asset Policies' and their development, NR's overall 'top down' volume and cost modelling, and the detailed meetings that we have held with the central asset teams and the 10 Operating Routes. This Summary Report should be read in conjunction with the detailed findings in those accompanying reports.

1.1.6 The findings detailed herein represent our current understanding based on our work to date. The findings have been reviewed with NR and ORR following submission of our Draft reports.

1.1.7 This Report also should be read in conjunction with our reports under two other Part A Independent Reporter Mandates:

- AO/034: PR13 review of Network Rail's maintenance and renewal unit costs used in planning
- AO/035: PR13 review of Network Rail's CP5 efficiency projections and supporting evidence

These parallel Mandates are reported separately and respectively provide our views on the costs and efficiencies adopted by NR in their SBP submission.

Purpose

1.1.8 The purpose of Mandate AO/030 is to support the ORR in assessing:

- The final CP5 asset policies submitted by NR in support of their SBP; and
- The application of their asset policies in developing SBP cost, volume, output and efficiency projections.

1.1.9 In doing so we have considered:

- Specific ORR tests of robustness, sustainability and minimum whole lifecycle, whole system cost and further criteria for assessing asset policy as shared with NR; and
- General compliance with the Network Licence, particularly Section 1 relating to Network Management.

Scope

1.1.10 The agreed scope of Mandate AO/030 (Appendix A) comprises a review by the Part A Reporter (Arup) of the following asset groups:

- Track;
- Civils (Structures and Earthworks);
- Buildings;
- Drainage;
- Off-track;
- Fleet.

1.1.11 In parallel the Part B Reporter (AMCL) were appointed under Mandate BA/025 to review:

- Electrical Power;
- Signalling;
- Level Crossings; and
- Telecoms.

1.1.12 The scope of our work included review of

- Asset Policy documents;
- Strategic planning tools;
- Whole life cycle cost analysis tools;
- Route Plan documentation; and
- SBP documentation including costs, volumes and outputs tables.

1.1.13 In addition we have reviewed the integrity of NR's Tier 0, 1 and 2 models used in support of SBP for the asset groups within our scope.

1.1.14 We have also reviewed Whole Life Cycle Cost (WLCC) models for signalling and telecoms asset groups. The reviews of the models were provided to AMCL to assist their review of policy for these assets.

1.1.15 As part of Mandate AO/030 we have considered 'pre-efficient' volumes and costs and made qualitative comment on the 'embedded efficiencies' associated with NR's refined asset policies. All other efficiencies including the efficiency overlay are reviewed in our accompanying Mandate AO/35 report[1]. Unless noted otherwise all volumes and costs referenced in this report are 'pre-efficient'.

Approach

1.1.16 We were allocated an 11 week period for our review starting on 7th January 2013 with report delivery (Draft A) on Friday 22nd March 2013.

[1] Mandate AO/035 'PR13 review of Network Rail's CP5 efficiency projections and supporting evidence'

1.1.17 Our aim has been to undertake our review in as much detail as is possible within the agreed time, using the resource available. In some instances this has meant that we have had to adjust the level of detail that we have reviewed to suit the time available. Where we have made significant adjustments we have informed ORR and NR.

1.1.18 We have based our assessment on the SBP submission provided by NR on 7th and 8th January 2013.

1.1.19 The SBP submission, provided on 7th/8th January 2013 comprised over 440 individual documents. In the time available we have not been able to review all of these, so we have had to prioritise our effort and focus on documents that appear to be pertinent to our review. This may mean that we have not fully appreciated some aspects of the SBP submission. It has been assumed that any factual errors will be identified by NR during review of our Draft reports.

1.1.20 In our assessment we have considered the additional explanation and clarification provided by NR in the Central M&R Challenge Sessions and the Asset Specific Route Meetings. Similarly we have considered the written answers provided by NR to specific questions raised in the M&R Question Logs. In some instances as well as a concise answer or as part of an answer to a question, NR have provided additional material such as reports, technical notes, spreadsheets, models etc. We have treated this material as set out in the following paragraph.

1.1.21 A significant volume of additional material has been provided by NR after the 8th January 2013 to explain, supplement or amend details in the SBP submission. This amounts to over 390 individual documents such as reports, technical notes, spreadsheets, models etc. Due to time constraints we have generally not been able to consider this additional material supplied after 7th/8th January 2013 in our assessment. We have explicitly referenced any additional material we have used. This approach has been agreed with ORR.

1.1.22 We adopted the same approach to reviewing the SBP for England & Wales and that for Scotland. We did, however, specifically meet with all asset groups in Scotland in recognition of the status of the Scotland Route Plan.

1.2 General Findings

1.2.1 Our review has identified the following general findings that apply to a greater or lesser extent across all the asset groups that we have reviewed.

SBP Submission and Review

1.2.2 The overall SBP submission has been very clearly and consistently presented. The quality of production is high and we have found the SharePoint site very useful as a means of navigating through the whole submission.

1.2.3 A number of overall elements in our opinion represent best practice, specifically:

- Use of Whole Life Cycle Cost models (Tier 2) in derivation of Asset Policies;
- Application of Asset Policies to derive volumes and costs through strategic models (Tier 1 Modelling);

- Application of 'top down' strategic volumes and costs (from Tier 1 Models) to test and challenge local 'bottom-up' workbank derived volumes and costs, creating a 'comparator' and generating 'competitive tension'.

1.2.4 Two key 'aspects' have significantly increased the level of uncertainty in our overall opinion, namely:

i. We have found it very challenging to clearly identify a 'final' set of volumes and costs that 'represent' the SBP funding request.

ii. We have found it very challenging to understand what outputs / targets are being 'offered' or are associated with specific volumes and costs at an asset group level.

Route Meetings

1.2.5 As part of our review we met with a sample of Route Teams. In total Arup and AMCL held 34 asset specific meetings with Route Teams.

1.2.6 We found these Route Meetings very useful, with open discussion of their application of 'central' SBP guidance, Asset Policies etc.

1.2.7 Overall we found all Routes supportive of the overall SBP process and felt that they had been actively involved in developing the maintenance & renewals plans. We did however identify that there was a wide range of maturity between Routes.

1.2.8 Benefits of a devolved Route structure could be clearly seen in some Routes where the DRAMs had cross-asset knowledge and were actively involved in the overall route asset management planning.

Asset System

1.2.9 NR have also published an overall Asset Management System Document. This is clearly work in progress and as yet not fully implemented or embedded but the direction looks promising.

Output Scenarios and Trade-Offs

1.2.10 At IIP we noted that ORR provided POG[2] with guidance on specific scenarios / options to be considered for the IIP[3] namely:

- Current Railway
- Preferred Plan.

NR in their IIP submission also added the scenario of *'Current Railway plus Investments'*.

1.2.11 ORR were not explicit about the requirement to present specific options in their SBP guidance[4] and in their SBP Submission NR have presented a 'single output' option.

1.2.12 As we stated at IIP, we believe that it would have been useful for NR to present a wider range of Output Scenarios in their SBP Submission with

[2] Planning Oversight Group (a Group which involves representatives of Network Rail, passenger and freight train operators and suppliers)
[3] ORR-#421118-v1-20110719_ORR_PR13_extract_of_draft_guidance_to_POG_on_scenarios
[4] ORR Requirements for Network Rail's January 2013 Strategic Business Plan

associated costs, benefits and risk to facilitate discussion as to 'appropriate' and 'affordable' levels of performance for particular assets. Accordingly it is uncertain whether the presented output option represents best value.

1.2.13 In addition, it is unclear how NR have demonstrated that they have considered 'cross-asset' trade-offs and selected the most effective and efficient ways of delivering the overall HLOS outputs – for example demonstrating that spending more on a particular asset and less on another would be 'best value' or 'most effective'.

'Line of Sight'

1.2.14 There are no specific asset management requirements or output measures set out in HLOS (for England & Wales) or the HLOS for Scotland apart from the statement in the latter relating to SQUIRE[5].

1.2.15 At an asset level, NR seem to have interpreted the HLOS requirement as a general baseline requirement to achieve the outputs in CP5 at least as good as CP4 exit condition. We are unclear whether this represents best value.

1.2.16 In their 'Asset output measures summary' document [SBPT232], NR have identified asset specific output measures and generally 'cascaded' these into the Asset Policies and thereby to the Routes at an asset group level. This is very positive. However, we have had difficulty identifying a clear linkage between the HLOS quantified Metrics (e.g. PPM, CaSL) and Route level asset management.

Asset Outputs and Targets

1.2.17 We have generally found it difficult to ascertain the CP5 Targets / Goals at an Asset Group level. Aspects we have struggled with include:

- What asset outputs will be delivered in CP5?
- Why these have been selected (e.g. how they relate to safety and performance)?
- Their status (target or forecast)
- How these will be monitored and by whom?
- How overall assurance and audit of progress towards these outputs will be undertaken and reviewed, and corrective action taken?

This has generally given rise to uncertainty as to the importance assigned by NR to the delivery of asset management outputs.

Asset Policies

1.2.18 NR have made significant progress with developing their Asset Policies since the CP4 review in early 2010. It is of particular note that they have produced additional Asset Policies for the management of Off Track, Drainage and Earthworks, and that the format of Asset Policies has been standardised.

Risk Based Approach

1.2.19 It is very positive that NR are generally adopting a risk based approach in their Asset Policies.

[5] Service Quality Incentive Regime

1.2.20 However, it is unclear how NR has equated safety risk between the 'principal' asset types such as Buildings vs. Earthworks vs. Structures. This gives rise to a significant uncertainty since Asset Outputs cannot be equated between asset types and that it may be being proposed that assets are funded to achieve different levels of risk.

Application of 'Asset Policy' to Derive SBP Volumes

1.2.21 The relationship between 'Top Down' Tier 1 central modelling and 'Bottom-up' local input has been a key uncertainty during our review. The exact source of volumes varied from asset to asset, and sub-asset line to sub-asset line for a number of assets. This was further complicated by devolution, with variation in approach between Routes.

Route Asset Management Plans

1.2.22 The SBP submission does not include separate copies of the Route Asset Management Plans (RAMPs) mentioned in the overarching Asset Management Documentation [SBPT3001-3003]. Rather the key Route level plans for asset management are set out as a chapter in each Route Plan entitled 'Asset Management Plan'. These present a high level commentary and summary tables for planned maintenance & renewal expenditure.

1.2.23 Our Progressive Assurance work indicates that various formats of RAMPs have been considered by NR but our discussions with Routes did not find any evidence that such plans were available at this stage or an intention to produce them. It is thus unclear how Routes will undertake local asset management planning and optimisation, for example taking enhancements or local efficiencies into account.

Strategic Business Plan Volumes

1.2.24 In the coming year NR will develop their CP5 Delivery Plan and their CP5 workbanks. This will take into account the required outputs and funding allocated by the Determination plus refinement as workbanks are developed. This on-going development means that the SBP renewals and maintenance volumes set out in the individual Route Plans [SBPT 210-219] and summarised in the Data Book [SBPT 3338] are interim forecasts.

1.2.25 At the outset of CP5, it will be important to have a clearly defined and agreed 'volume baseline' and accompanying 'scope baseline' to allow subsequent measurement of the efficiency gains.

Review and Continuous Improvement

1.2.26 For a number of asset groups, new ways of working or techniques are proposed. This is welcomed, however we have seen little evidence of a structured continuous improvement approach which will monitor the effectiveness of any 'new approach', review and evaluate, then take appropriate corrective action during implementation.

Embedded Efficiencies

1.2.27 We understand that no 'embedded efficiencies' have been identified associated with the Track, Structures, Earthworks, Off Track, Drainage and Fleet Policies.

1.2.28 In respect of the Buildings asset, very limited documentation of the claimed 5% renewals embedded efficiency has been received.

Uncertainty Analysis

1.2.29 The NR SBP submission includes a three Stage 'Uncertainty Analysis' [SBPT3297, SBPT3283]. In this report we have reviewed the Stage 1 analysis which relates to renewals expenditure (Appendix C). NR note that their analysis is under development and that results are indicative only

1.2.30 NR conclude that '*Civils contributes the most [to CP5 renewals expenditure uncertainty], primarily due to uncertainties about earthworks and civils-other expenditure.'*

1.2.31 We are very surprised that these items are the 'primary' uncertainties. This requires further review. In the meanwhile we have very low confidence in the overall uncertainty analysis.

1.3 Asset Specific Findings – Track

1.3.1 The principles of the Track Asset Policy [SBPT3010] have been in existence since 2010 when NR introduced the revised CP4 Policy with a new track organisation. The CP5 SBP Policy further develops this work, in particular introducing the concept of WLCC decision making.

1.3.2 The overall aim of the Policy is to maintain the targeted end-CP4 overall track condition through CP5 whilst improving the high criticality / high traffic routes. The other main focus of the Policy is to improve the condition of Switches and Crossings (S&C).

1.3.3 The main challenge to the delivery of plain line heavy refurbishment in CP5 is the increased volume of ballast cleaning required.

1.3.4 The Policy, modelling and bottom up plans result in significantly increased (compared with CP4) volumes of S&C maintenance and heavy refurbishment, and the CP5 outputs are heavily reliant on achieving these at the anticipated cost. In our view this will require:

- The skills and competency to consistently deliver refurbished S&C to the required high standard of initial quality necessary to achieve the desired life extension (the expected reduction in mid-life maintenance interventions is highly dependent on this);
- Robust asset information systems to enable on-going management of the S&C geometry; and
- Adequate and timely compaction of ballast.

In addition we believe there are several other aspects to consider, namely:

- Procurement (where necessary) and operation of appropriate S&C tampers working in tandem; and;
- Procurement of innovative S&C re-ballasting plant.

1.3.5 NR have identified the following high risks and uncertainties in the policy:

- Increased staff competency levels are required to deliver track refurbishment;
- The use of new asset information systems (ORBIS); and
- Sufficient resources to deliver refurbishment.

1.3.6 There is also some uncertainty regarding the volume of maintenance activity that NR are proposing for CP5. No maintenance volumes have been provided and there is little cost breakdown. However, it appears that overall pre-efficient maintenance costs are planned to reduce from £2.317Bn in CP4 to £2.185Bn in CP5. In our experience when a policy of increased refurbishment and reduced renewal is adopted, it is often associated with increased maintenance volumes. This aspect requires further clarification from NR.

Robustness

1.3.7 We consider that it is very likely that the Track Policy will be robust as it has demonstrated a good knowledge of the asset, its current condition and degradation rates, the impact of traffic forecast for CP5 together with a programme of maintenance and renewals that is very likely to deliver the same track performance and safety levels that will be in place at the end of CP4.

1.3.8 Deliverability and quality of renewals, particularly S&C heavy refurbishment, are the biggest challenges.

Sustainability

1.3.9 We consider that it is reasonably likely that the Policy will be sustainable. There is some uncertainty associated with the asset life extension from heavy refurbishment of S&C and plain line on lower criticality routes, which we believe may be optimistic.

Whole System Cost

1.3.10 We consider that there is some uncertainty as to whether the Track Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets. This uncertainty primarily arises from concerns over the ability of NR to deliver the required quality and durability of renewal and refurbishment work.

Outputs, Volumes and Costs

1.3.11 In order to achieve the PPM and improve safety, a set of specific output requirements for track through CP5 have been defined by NR, these are:

- Maintain the targeted end-CP4 overall track condition through CP5, improving the high criticality / high traffic routes;
- Maintain the targeted end-CP4 number of service affecting failures, averaged over CP5;
- Maintain the targeted end-CP4 train delays and costs, consistent with a 92.5% PPM target; and
- Improve the condition of S&C geometry and switch gauge.

The aim is further defined in the Track Asset Policy [SBPT3010]

1.3.12 Maintenance Unit Costs (MUCs) have been used by NR in establishing a pre-efficient baseline with the routes. The routes then use a resource based approach to establish their SBP submissions before applying any efficiency initiatives. We have compared the modelled rates with the latest MUCs and found strong correlation; however, we have not checked the derivation of MUCs

1.3.13 A number of issues were identified in the derivation of track and S&C unit costs during progressive assurance. These items are presently under review and will be updated in the final report for Mandate 34. However, the basis of the unit costs is clear and supporting data has been provided by Network Rail. Unitised cost coverage for track assets is high and provides a reliable basis for the calculation of renewals interventions.

1.4 Asset Specific Findings – Structures

1.4.1 NR have made significant progress with the development of their Structures Asset Policy since IIP. The SBP Structures Asset Policy is fundamentally sound, and is built on risk based principles. This is a significant step forward from the CP4 policies and the Structures Asset Policy at IIP stage.

1.4.2 The overall Structures Asset Policy [SBPT3013] has specific policies for the different Structures asset types. The new policies give much more prescriptive guidance especially in the area of tolerable risk and define what 'should be done' by each Route for each sub-type of asset. Over time this should improve the consistency of policy application between routes.

1.4.3 For the structures assets the key items classed as 'maintenance' relate to examinations / assessments and these are understood to be included in the overall 'civils' 'maintenance' cost of £419m in CP5 and CP6. No totals for CP7-CP11 have been provided.

Underbridges and Overbridges (Bridges)

Outputs, Volumes and Costs

1.4.4 Key areas of uncertainty with respect to Civils volumes and costs relate to Bridges (underbridges and overbridges), which equates to 66% (£1,502m) of the £2,270m for CP5 structures.

1.4.5 The Policy sets clear output / targets in terms of minimum condition Principal Load Bearing Element (PLBE) thresholds for key elements of a structure. NR's analysis of its structures database shows about 9,666 (33%) of bridges contain elements below their '*minimum condition PLBE threshold*'.

1.4.6 As well as bridge condition the other key criteria is bridge 'capability'. Bridge capability is defined as the *'ability of the assets to bear load, pass gauge and allow line speed or available traction power'*. The required capability for each route is defined in NR's licence agreement.

1.4.7 NR's analysis indicates that they have 564 bridges that have been assessed as being sub-standard (assessed categories A3 to F), with 191 of those within categories D-F. NR note that a proportion has no assigned category and that a further 78 assets may also be in categories D-F. NR are targeting interventions at the 191 sub-standard underbridges D-F by the end of CP5, not the estimated number of 269.

1.4.8 NR note that there is a 'backlog' of approximately 12,000 assessments that need to be completed for underbridges and overbridges. We understand that these will be completed by end of CP4. We note that these assessments may

identify further sub-standard bridges over and above the 564 already identified.

1.4.9 NR's first priority for bridge activity is directed at elements in a condition below the '*minimum condition PLBE thresholds*'. We agree this is the correct approach. In addition to this work, NR have several significant programmes of bridge work. We are unclear about the degree of overlap and prioritisation between each of these.

1.4.10 On the basis of condition data that we have seen (Central and Route level) we have little doubt that there is a substantial amount of repair and renewal work to be carried out, primarily on underbridges.

1.4.11 However, there is significant uncertainty (it is highly uncertain) about the makeup of this work. This relates to the fact that to apply the policy, NR asset engineers will have to evaluate each element below the minimum PLBE threshold to determine the type and scale of intervention required. If an intervention is required (as it may not be in some instances) the resulting work may range from 'light' plating work to 'heavier' deck replacement. This introduces a significant cost uncertainty as well as volume uncertainty. The volume of each activity (and hence the cost) will only become clear once the work is better defined and NR have not yet had the opportunity to implement this. This applies to CP5 and beyond.

Robustness

1.4.12 We conclude that from an overall perspective that it is reasonably likely that the CP5 policy for bridges is robust.

Sustainability

1.4.13 The Policy implies a step change improvement in overall bridge condition in CP5/6, which would then be sustained over future Control Periods. There is some uncertainty about the exact definitions of CP4 exit and the targets and measures for CP5, which relate directly to the sustainability of the policy for bridges. In addition, there is some uncertainty about the long term condition requirements.

Whole System Cost

1.4.14 There is some uncertainty that the policies based on the modelling will deliver lowest whole lifecycle cost outputs.

Delivery

1.4.15 NR have concluded that the Structures Policy should be implemented over two Control Periods on grounds of deliverability. We are unclear as to the justification for this and are concerned that it could potentially allow bridges elements to remain below the minimum condition PLBE thresholds for up to a further 10 years. We are concerned that NR does not appear to be seeking resolve this issue more urgently.

1.4.16 In terms of delivery, we note that NR's own Deliverability Review does not see any specific market constraints to delivering increased volumes of work. We would concur with this view and add that the work which NR plan to be carry out in CP5 is similar in overall work mix to the work has been traditionally carried out to maintain railway (and other) bridges.

Major Structures

Outputs, Volumes and Costs

1.4.17 The proposed expenditure on Major Structures in CP5 is reduced compared to CP4 (£102m c.f. £182m) however, the number of Major Structures has been reduced from 283 at IIP to 34 for CP5.

1.4.18 The policy for Major Structures currently appears to be to prepare Asset Management Plans for each structure prior to the start of CP5; NR have submitted little information to support their plans. Specifically there are no clear outputs or volumes for CP5 and CP6-CP11. Accordingly we consider that the CP5 and CP6-CP11 volumes and costs are highly uncertain.

Tunnels

Outputs, Volumes and Costs

1.4.19 The key Policy target / output for tunnels is to reduce the number of poor condition sections over CP5, but according to the condition data for tunnels, this target has already been achieved by a significant margin. A pro-active approach to interventions over recent years has delivered assets in generally fair or good condition, but we are unclear that the policy would continue to apply this philosophy on all route criticalities.

1.4.20 NR have submitted little information to support their plans and we are somewhat uncertain about the robustness and sustainability of the policy for tunnels.

1.4.21 The proposed expenditure on tunnels renewals in CP5 is increased compared to CP4 (£177m c.f. £63m) and NR are proposing to maintain the same level of expenditure (£177m per Control Period) into CP6-CP11. The CP5 expenditure is derived from top down modelling and comprises a modelled TCMI analysis cost (£137m) and an overlay to add specific work planned for CP5 and remove work scheduled for CP4 (net increase of £40m). The CP5 costs and volumes seem to have been 'rolled forward' into CP6-CP11. We have some uncertainty about the CP5 costs and volumes, and moderately high uncertainty about the CP6-CP11 costs and volumes.

Other Assets (Retaining Walls, Footbridges and Culverts)

Outputs, Volumes and Costs

1.4.22 NR have submitted little information to support their plans for these assets. We have moderately high uncertainty about the robustness of the policy for this asset group, and we have an equal level of uncertainty when considering sustainability. There is high uncertainty as to whether the proposed Policy will deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

1.4.23 The Asset Policy includes targets/ outputs for retaining walls, footbridges and culverts but it is unclear if these have been used in the top-down modelling.

1.4.24 Renewal cost items are provided for 'Other Assets' (excluding Coastal Estuarine and River Defences assets) totalling £229m in CP5. NR are proposing to maintain the same level of expenditure (£229m per Control

Period) into CP6-CP11. This compares with £80m in CP4 (including coastal estuarine and river defences assets). It is unclear which assets have increased spend in CP5 as no breakdown for CP4 has been provided.

1.4.25 The volumes and costs have been derived from top-down modelling. We are highly uncertain as to the basis of the forecast volumes made in the model and the renewal costs for CP5 and CP6 - CP11. A potential error in the Tier 1 model could cause an overestimation in CP5 forecast costs.

Other Assets (Coastal Estuarine and River Defences)

Outputs, Volumes and Costs

1.4.26 NR have provided very little information related to coastal estuarine and river defences (CERD) assets. We have high uncertainty as to whether the Asset Policy for CERDs is robust and sustainable.

1.4.27 A Policy objective to prepare asset management plans for CERD assets has been set; however, there are no particular targets / outputs for CERDs.

1.4.28 NR have provided planned volumes for CP5 (14,075m) and 7,800m in CP6-CP11. These compare with 5,832m in CP4. No explanation of the derivation has been provided hence we have high uncertainty in respect of CP5 and CP6-CP11 volumes.

1.4.29 It is unclear how NR have derived the renewal cost items for CERD assets totalling £43m in CP5 and £30m in CP6-CP11. No historic spend data has been provided for CP4. No explanation of the derivation has been provided hence we have high uncertainty in respect of CP5 and CP6-CP11 costs.

Structures Other

Outputs, Volumes and Costs

1.4.30 'Structures Other' comprises a range of 'policy objectives' set to reduce risk and comply with statutory obligations, including, planned preventative maintenance; scour protection; spandrel wall strengthening; hidden shafts; road vehicle incursion (and for neighbouring sites); pigeon proofing; and route specific schemes such as compliance with working at height regulations and contribution to Thameslink.

1.4.31 The tests of robustness, sustainability and lowest possible whole system cost are not applicable to these items as they are simply defined activities. Little evidence has been provided and we are highly uncertain with respect to volumes in CP5and CP6-CP11.

1.4.32 There are no outputs / targets or volumes associated with 'Structures Other'.

1.4.33 NR have included renewal cost items for 'Structures Other' totalling £218m in CP5 and £218m in CP6-CP11. Historic spend data has been provided for CP4 (£536m plus £168m 'enhanced spend'). No explanation of derivation is included in the SBP submission hence we have high uncertainty in respect of CP5 and CP6-CP11 volumes and costs.

1.5 Asset Specific Findings – Earthworks

1.5.1 In developing their CP5 asset policy [SBPT3015], NR has adopted a 'risk based approach' to the identification of sites for remedial work. This is a significant step forward from the CP4 policies and the Earthworks Policy at IIP stage.

1.5.2 The policy implicitly assumes that interventions should be primarily driven by 'safety' issues rather than say 'track performance'. This is very positive.

Robustness

1.5.3 On the basis that the CP5 Policy has a clear linkage to asset outputs (e.g. Risk Index), is based on reasonable inventory and condition information and has an explicit risk based intervention approach, we consider it reasonably likely that the Asset Policy will be robust and will be capable of delivering a reduction in asset risk in the short-term.

Sustainability and Whole System Cost

1.5.4 It is proposed that the volume of pro-active 'maintenance' and 'lighter' 'refurbishment' interventions would be significantly increased and the volume of more 'traditional' 'heavier' 'renew' interventions would be reduced. Whilst we are supportive of the principle of targeting more 'lighter' pro-active intervention activities (such as drainage) to reduce safety risk, in terms of long-term sustainability, we have concerns in relation to the principle of reducing the volume of 'heavy' renewals. We consider that the 'lighter' pro-active activities need to be implemented in conjunction with a continued programme of 'renewal' activities.

1.5.5 Whilst recognising that NR's detailed modelling would indicate that the proposed combination represents best whole life value, we have a number of concerns and therefore consider that there is some uncertainty as to whether the Policy will be sustainable in the long-term. Accordingly we consider it uncertain as to whether the proposed Policy will deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

Outputs, Volumes and Costs

1.5.6 For earthworks, the combination of adopting a risk based approach and the Risk Index as an output measure provides a pragmatic 'line of sight' between the asset performance (earthwork condition, number of failures etc.) and network performance (derailments, delay minutes. Schedule 8 costs etc.).

1.5.7 For the Earthworks asset the only item classed as ‘maintenance’ relates to earthworks CEFA examinations and costs for these are understood to be included in the overall ‘civils’ ‘maintenance’ cost of £419m in CP5 and CP6. No totals for CP7-CP11 are provided.

1.5.8 Renewal cost items are provided for Earthworks totalling £633m in CP5 and in CP6-CP11 ranging from £691m to £728m (all including Mining costs).

1.5.9 In terms of Policy implementation we have concerns related to the constraint of reducing risk and condition at a Route Level but maintaining overall 'average' risk and condition, in that this seems to suggest that the earthworks condition at some Routes will deteriorate and the risk at some Routes (such as Scotland) will increase.

1.5.10 Our concerns in relation to the proposed change in the type of work undertaken to the earthworks asset in CP5 onwards means that we consider that there is moderately high uncertainty associated with the calculated renewal volumes and costs for CP5 and CP6-CP11. We have concerns in relation to the principle of reducing the volume of 'heavy' renewals and consider that the proposed 'lighter' pro-active activities need to be implemented in conjunction with a continued programme of 'renewal' activities.

1.5.11 In general it is unclear how NR has equated safety risk between the 'principal' asset types such as Buildings vs. Earthworks vs. Structures. This gives rise to a significant uncertainty that Asset Outputs cannot be equated between asset types and that it may be being proposed that assets are funded to achieve different levels of risk.

Mining

Robustness, Sustainability and Whole System Cost

1.5.12 The NR Mining Policy stage gate process does not seem an unreasonable way of managing the risk of potential collapse of historic shallow mineworkings. However, we do not consider that there is sufficient information to assess whether the Mining Policy is robust, sustainable or represents lowest possible whole system cost over the lifetime of the asset.

Outputs, Volumes and Costs

1.5.13 There are no proposed output measures relating to mining hazards in the SBP submission.

1.5.14 No renewal volume items are provided for Mining activities. The SBP submission indicates that a number of Shallow mineworkings desk studies, ground investigations and treatments are proposed in CP5. No details of the proposed volumes / activities for CP6-CP11 have been provided. Details of the costs associated with these elements are unclear.

1.5.15 We understand that Mining costs are included within the renewal cost items are provided for 'Other (Earthwork)' in CP5 totalling some £52m and £45m per Control Period in CP6-CP11 however it is unclear what other activity costs are also included in these figures.

1.5.16 NR has identified four operational deep mines that may impact on the railway during CP5 and beyond. The Mining Policy and documents indicates a total financial risk in CP5 between £26.3m -£31.3m. This risk has not been costed into the SBP.

1.6 Asset Specific Findings – Buildings

1.6.1 The Buildings Asset Policy [SBPT3016] sets out the NR policy for the management of a diverse portfolio of building types. Each of the six groups of building type has been treated separately with the individual policy applications largely driven by the level of asset information currently held.

Robustness

1.6.2 The CP5 Buildings Asset Policy for franchised stations and LMDs has been based on good asset knowledge and a combination of WLCC modelling and an assessment of the impact of the policy application in the Tier 1 model on the asset portfolio. We have concerns that the way in which the volumes of work are derived in the modelling leads to higher volumes than would be necessary to maintain asset condition. As a result we consider that the Policy is robust and highly likely to provide the required performance for the asset.

1.6.3 For managed stations there is less evidence to support the approach to deriving work volumes. It is based on the use of bottom-up workbanks, and there has been no modelling. We are unclear about the extent to which specific asset plans have been used. Our view is that the Policy is likely to deliver the required building performance in CP5.

1.6.4 For NR's other building assets (lineside buildings, MDUs etc.) we are less certain that the Policy is robust. Little or no WLCC modelling has been used to understand these assets. There is a lack of evidence to support the outcomes of the expenditure in CP4 resulting in some uncertainty as to impact on asset condition of the proposed maintenance and renewal regime.

Sustainability

1.6.5 We are of the opinion that the management approach proposed for franchised stations and LMDs is likely to be sustainable. Again, the policy approach we believe provides for significant maintenance intervention and the long term performance of the assets should be ensured. For managed stations, NR claim that the sustainability is proved by a back-check of the bottom-up workbank they have carried out using the Tier 1 model. Evidence to support this was received following the meeting on 12 April 2013 but we have not had the opportunity to consider this as part of the review.

1.6.6 For NR's other building assets (lineside buildings, MDUs etc.) the lack of information on condition and impact of maintenance make the long term performance of the Policy less clear.

Whole System Cost

1.6.7 NR have carried out WLCC modelling of their franchised station and LMD assets. This has included modelling of discrete interventions on specific components of the assets. Whilst accepting of the principle we remain concerned regarding the Tier 2 modelling work particularly that associated with the derivation of the asset degradation / intervention curves. We believe these produce greater volumes than necessary to deliver the required outputs.

1.6.8 In general, the approach which has been taken by NR where asset information is limited has been pragmatic and we agree with the methodology employed.

Outputs, Volumes and Costs

1.6.9 The buildings portfolio is subject to two Regulatory output measures – Station Stewardship Measure (SSM) M17, and Light Maintenance Depot Stewardship Measure (LMDSM) M19. Both are reported in the NR Annual Return.

1.6.10 For building assets NR have identified two specific asset output measures as follows:

- Robustness: measured through compliance with an annual reactive faulting level; and,
- Sustainability: defined as the maintenance of asset condition, as measured by PARL, at the exit levels from CP4.

1.6.11 For the Buildings asset, maintenance cost items are provided for each of the sub-asset lines (e.g. managed stations, NDS Depots) but costs for these are not listed. The cost of CEFA examinations for buildings is understood to be included in the overall 'Civils' figure of £419m (post efficient) in CP5 and CP6. No maintenance volumes are provided.

1.6.12 The dominant building type within the building assets is the franchised station (£753m in CP5) which accounts for over half of the planned levels of spend. The policy in this case is based on the outputs from the Tier 2 modelling. Forecasts produced by NR demonstrate that over CP5 the critical assets covered by the modelling will largely maintain their PARL.

1.6.13 For franchised stations and LMDs (£89m in CP5) we have concerns that the way in which the volumes of renewal work are derived in the modelling leads to higher volumes and costs than would be necessary to maintain asset condition. Accordingly there is moderately high uncertainty associated with the CP5 and CP6-CP11 volumes and costs.

1.6.14 In the case of managed stations (£214m in CP5) a bottom-up approach has been used to generate activity volumes. None of the 'bottom-up' Asset Management Plans have been provided and this 'bottom-up' view does not appear to have been constrained by 'top down' direction, which we believe may lead to more work being undertaken than otherwise would have been planned. It is our view that there is moderately high uncertainty with CP5 volume and costs, and high uncertainty associated with the CP6-CP11 volumes and costs.

1.6.15 To develop the policy applicable to lineside buildings (£128m in CP5) the findings of a NR surveyed sample of the portfolio has been extrapolated across the national portfolio. This approach would appear to be reasonable given the lack of asset data; however, the impact on the condition is unclear. There is some uncertainty with CP5 volumes and moderately high uncertainty associated with the CP5 costs and CP6-CP11 volumes and costs.

1.6.16 The remaining building types (e.g. MDU buildings, and NDS depots) rely on historic spend levels. With this group there is a lack of evidence to support the outcomes of the steady-state funding during CP4. This has resulted in some uncertainty in the CP5 renewal volumes as to how this level of activity will impact on condition. There is moderately high uncertainty associated with the CP5 costs and CP6-CP11 volumes and costs.

Delivery

1.6.17 In terms of delivery, we have not seen evidence that the Buildings work would not be deliverable by NR in CP5.

1.7 Asset Specific Findings – Drainage

1.7.1 The NR SBP submission includes a CP5 Drainage Asset Policy document [SBPT3017] which explains NR's proposed management approach for drainage including earthworks, track and tunnel drainage assets. The Asset Policy has progressed significantly since IIP based on improved inventory information which has allowed a more risk based approach to be developed.

1.7.2 It is very positive that the inter-relationship between earthworks, track and drainage are being considered and that the division of responsibilities have been explicitly set out in the Drainage Policy.

Robustness, Sustainability and Whole System Cost

1.7.3 Whilst we support the principle of investment in drainage improvement, we consider that it is still uncertain whether the Drainage Asset Policy is robust and highly uncertain whether the Drainage Asset Policy is sustainable or represents lowest whole life, whole system cost.

Outputs, Volumes and Costs

1.7.4 It is unclear what exactly the output targets are for the Drainage Asset in CP5. However, we consider it very likely that the implementation of the proposed Drainage Policy will help reduce the number of track failures and reduce earthworks risk in the medium to long-term.

1.7.5 We have not identified a clear summary of maintenance or renewal volumes / activities that are to be undertaken in CP5 based on the Drainage Policy. Maintenance volume items are provided for off track drainage but volumes for these are not populated. No maintenance volume items are provided for Earthworks drainage inspections and surveys.

1.7.6 An expenditure of £183m for earthworks drainage costs and £209m for track drainage costs in CP5 appears to be being requested. It is highly uncertain as to what volumes / activity is associated with these figures. The same applies to the £162 -167m costs for earthworks drainage and £129m for track drainage per Control Period in CP6-CP11. It is unclear where Drainage inspections and surveys are costed and also any allowance for preparation of Drainage Management Plans or similar.

1.7.7 In terms of delivery, we have not seen evidence that drainage improvement work would not be deliverable by NR in CP5.

1.8 Asset Specific Findings – Off Track

1.8.1 The off track asset includes vegetation and boundary measures.

1.8.2 We believe that the asset information held by NR for the off track asset to be good. The asset data presented shows a backlog of maintenance and renewals in both vegetation clearance (Opex) and fencing replacement (Capex).

Robustness

1.8.3 In our opinion there is some uncertainty that the proposed policy will be robust for both boundary measures and vegetation management. The policy

will result in increased activity and costs in CP5 but this is not clearly linked to overall asset management objectives or performance targets. The benefit of the proposed policy for CP5 is not clear over the approach taken in CP4.

Sustainability and Whole System Cost

1.8.4 A move from a reactive to a pro-active approach to the management of the off track assets is proposed. However, in the absence of clear performance targets, there is some uncertainty on what it will deliver in the long term and hence the sustainability of the Policy.

1.8.5 Whole life/system costs have not been determined for vegetation management.

1.8.6 The Tier 1 model for fencing considers whole lifecycle costs. However, the assumption in the Tier 1 model for refurbishment of Class III fencing assets possibly overestimates the improvement in asset condition / life span. This may lead to an underestimate of the costs for fencing renewal in CP6-11.

1.8.7 In our opinion, there is some uncertainty whether the overall costs included in the SBP for CP5 may be above the levels necessary to deliver the Policy requirements. This uncertainty stems from the absence of clear performance targets.

1.8.8 We consider that the Policy for both asset groups is likely to be deliverable given the reliance on competent third-party contractors to undertake the work.

Vegetation

Outputs, Volumes and Costs

1.8.9 The proposed Policy approach to vegetation management is robust; however, high volumes of vegetation management are proposed. These are generated by the stated output target for CP5 of clearing the backlog of work within the period. We are not certain whether this target provides additional value as compared to the work carried out in CP4.

1.8.10 No work volumes have been provided for vegetation clearance. It is uncertain what volumes are actually being proposed and how they compare to CP4 historic volumes of work.

1.8.11 NR highlight the risk that the spread of ash dieback may require an increased volume of tree felling as there may be over 200,000 ash trees within the railway boundary. There is no cost contingency in the CP5 Policy for tree felling from ash dieback. NR have advised that such work will be determined by Government policy at the time.

Boundary Measures

Outputs, Volumes and Costs

1.8.12 The NR approach to boundary measures asset management is driven by both security and safety. An output target has been set to refurbish or renew the asset in poor or very poor condition in CP5 across England and Wales.

1.8.13 Information on fencing renewal volumes has been provided by NR in the Tier 1 model but is not included in the Tier 0 database. It is uncertain how the proposed volumes compare to CP4 historic volumes of work. Unit costs

in the Tier 1 model are consistent with those specified in the Policy, but we have not checked their derivation in this audit.

1.8.14 We believe that the overall costs which are included in the plan for CP5 may be above the levels which are necessary to deliver the Policy requirements.

1.9 Asset Specific Findings – Fleet

1.9.1 The proposed expenditure on fleet in CP5 is increased over CP4 (£637m c.f. £345m) primarily due to the procurement of additional high output fleet and the transfer of the road vehicle fleet to owned vehicles rather than leased.

1.9.2 The fleet asset represents a diverse range of plant that in part supports the delivery of maintenance and renewal activities. Our review of the fleet asset has focussed on the intervention and materials delivery fleets as these are the more critical in terms of delivery of the maintenance and renewals works on the wider NR assets including track.

Intervention & Materials Delivery

Outputs, Volumes and Costs

1.9.3 A critical aspect for the management of the NR fleet asset is in our view the understanding of the demand / outputs for the asset in CP5. We are unclear if the requirement and availability levels have been determined or evaluated especially for the plant to support the maintenance and renewals works.

1.9.4 The overall fleet assets required to deliver the defined CP5 outputs will be made up of NR owned and supply chain owned assets. It is recognised that there will be competing demands at peak times for limited resources to deliver the full programme of infrastructure maintenance, renewals and enhancements as set out in the SBP. In addition, it is considered likely that several suppliers will have other railway infrastructure fleet demands from contracted work with other rail infrastructure owners such as HS1 and TfL.

1.9.5 There is some uncertainty that the quantum of resource will be available to deliver the Business Plan. In particular the resource to deliver the plain line heavy refurbishment programme, the S&C heavy refurbishment programme and the S&C tamping programme for maintenance, renewals and enhancements.

1.9.6 Whilst any shortfall identified in the future can be resolved by a procurement programme and leasing, it can take up to three years from identifying the need to actually have new large bespoke equipment delivered.

1.9.7 NR have based their Fleet resource plan on an expectation of an optimum spread of work between weekends and week nights. We consider that a predominantly weekend operation may require further investment on tampers, wagons and locos and will result in midweek under-utilisation.

1.9.8 No maintenance costs or volumes have been provided for CP5 or CP6-CP11.

1.9.9 Renewal volumes are calculated for CP5 and CP6-CP11 in the Wheeled Plant Tier 1 model, but are not reported in the Tier 0 model.

1.9.10 NR are proposing to spend £128m on their intervention fleet in CP5 and between £48m and £160m in each Control Period CP6-CP11.

1.9.11 NR are proposing to spend £12m on their materials delivery fleet in CP5 and between £14m and £21m in each Control Period CP6, CP8-CP11. In CP7 they are proposing to spend £162m due to the anticipated life expiry of many of these assets.

1.9.12 It is not clear what sub fleet by sub fleet reliability and availability targets / outputs have been set. This is a key driver of fleet size and on-going preventative maintenance costs. This leads us to believe that there is not yet a full understanding of fleet asset degradation.

1.9.13 We question NR's confidence that their specification of the bespoke fleet (plant) resources required to deliver the SBP outputs for track assets, including enhancements in CP5, will deliver the Track Policy targets and that they will be available at the planned renewal cost levels. Accordingly, we consider that there is some uncertainty associated with the fleet renewals costs for intervention and materials delivery fleets in CP5.

Robustness

1.9.14 For the NR owned fleet, the policy appears robust, and is an improvement on that produced in 2011 for the IIP. The other uncertainties set out above lead to us having some uncertainty as to the robustness of the overall policy.

Sustainability and Whole System Cost

1.9.15 We have concerns that NR may not have done enough work to date, such that they can be confident that the overall bespoke wheeled plant resources that are required to deliver the SBP outputs for asset management, including enhancements, will be available at the cost levels required to deliver the SBP. We therefore have moderately high uncertainty on the sustainability of the Policy.

1.9.16 A critical aspect for the management of the NR fleet asset is the understanding of the demand for the asset in CP5. As noted above, NR has based their Fleet resource plan on an expectation of an optimum spread of work between weekends and week nights.

Road Vehicles

1.9.17 NR are proposing to spend £114m on road vehicles in CP5 and between £114m and £118m in each Control Period CP6-CP11. These costs have been derived from applying the policy to the national fleet inventory in the Tier 1 model.

1.9.18 We are moderately uncertain as to whether the NR policy to purchase road vehicles and renewal on a four year cycle rather than lease is optimal**.**

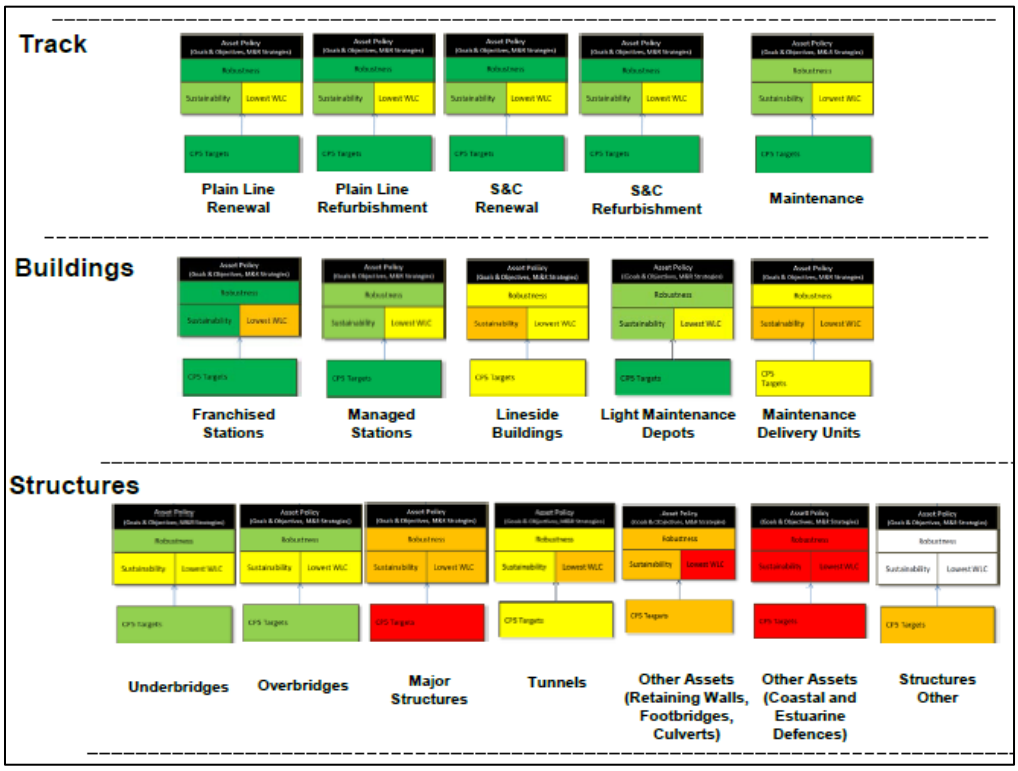
1.10 Overall Summaries by Asset

1.10.1 In our review we have had to consider a complex set of summary documentation in a limited time, accordingly alongside our opinion on the questions posed in the Mandate we have stated our assessed 'degree of confidence / certainty' based on a consistent qualitative scale.

Colour Scale		
	Very Low Uncertainty	High Certainty
	Low Uncertainty	Reasonably High Certainty
	Some Uncertainty	Some Certainty
	Moderately High Uncertainty	Low Certainty
	High Uncertainty	Very Low Certainty
	Not provided for review	Not provided for review
	Not used	Not used

Figure 1-1 Scale of Certainty / Confidence

1.10.2 Our confidence in relation to the Asset Policies that we have reviewed is summarised pictorially in Figure 1-1 below. A larger copy is included in Appendix D.



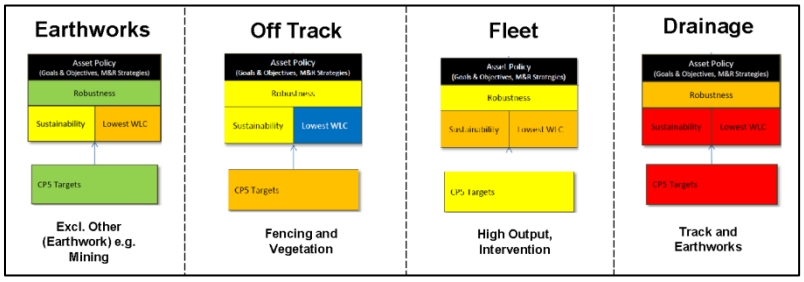


Figure 1-2 Summary of Our Confidence in Asset Policies

1.10.3 Our confidence in relation to the Overall Application of the Asset Policies is summarised pictorially in Figure 1-3 below. A larger copy is included in Appendix D.

Figure 1-3 Summary of Our Confidence in the Application of Asset Policies in the SBP

1.11 Acknowledgement

1.11.1 The Independent Reporter Team would like to thank both NR and ORR staff for their assistance with this study, for providing documents as requested and explaining their future plans.

2 Introduction

2.1.1 Arup have been appointed by the Office of Rail Regulation (ORR) and Network Rail (NR) as Part A Independent Reporter to provide assurance as to the quality, accuracy and reliability of NR's data that is used to report performance to ORR, the Department for Transport (DfT) and the wider industry.

2.1.2 On 7th January 2013 Network Rail submitted their Strategic Business Plan (SBP) for Control Period 5 (CP5) which runs from April 2014 to March 2019.

2.1.3 This report summarises our findings from a review of NR's proposed CP5 Asset Policies and their application in developing SBP volume, cost, output and efficiency projections. The review has been undertaken by Arup in response to Independent Reporter Mandate AO/030 *'PR13 M&R review of asset policies and their application in planning: progressive assurance and SBP submission'*.

2.1.4 The findings detailed herein represent our current understanding based on our work to date. The findings will be reviewed with NR and ORR following submission of this Draft A report.

Purpose

2.1.5 The purpose of Mandate AO/030 is to support the ORR in assessing:

- The final CP5 asset policies submitted by NR in support of their SBP; and,
- The application of their asset policies in developing SBP cost, volume, output and efficiency projections.

In doing so we have considered:

- General compliance with the Network Licence, particularly Section 1 relating to Network Management; and
- Specific ORR tests of robustness, sustainability and minimum whole lifecycle, whole system cost and further criteria for assessing asset policy as shared with NR.

2.1.6 We have presented our findings under Mandate AO/030 in a set of Reports as shown in Figure 2-1.

2.1.7 This Summary Report seeks to present our key findings against the specific questions detailed in the Mandate. The evidence that has allowed us to reach these overall opinions is set out in the other reports shown in Figure 2-1.

2.1.8 In addition, this Report should be read in conjunction with our reports under two other Part A Independent Reporter Mandates:

- AO/034: PR13 review of Network Rail's maintenance and renewal unit costs used in planning
- AO/035: PR13 review of Network Rail's CP5 efficiency projections and supporting evidence

2.1.9 These are reported separately and respectively provide our views on the costs and efficiencies adopted by NR in their SBP submission.

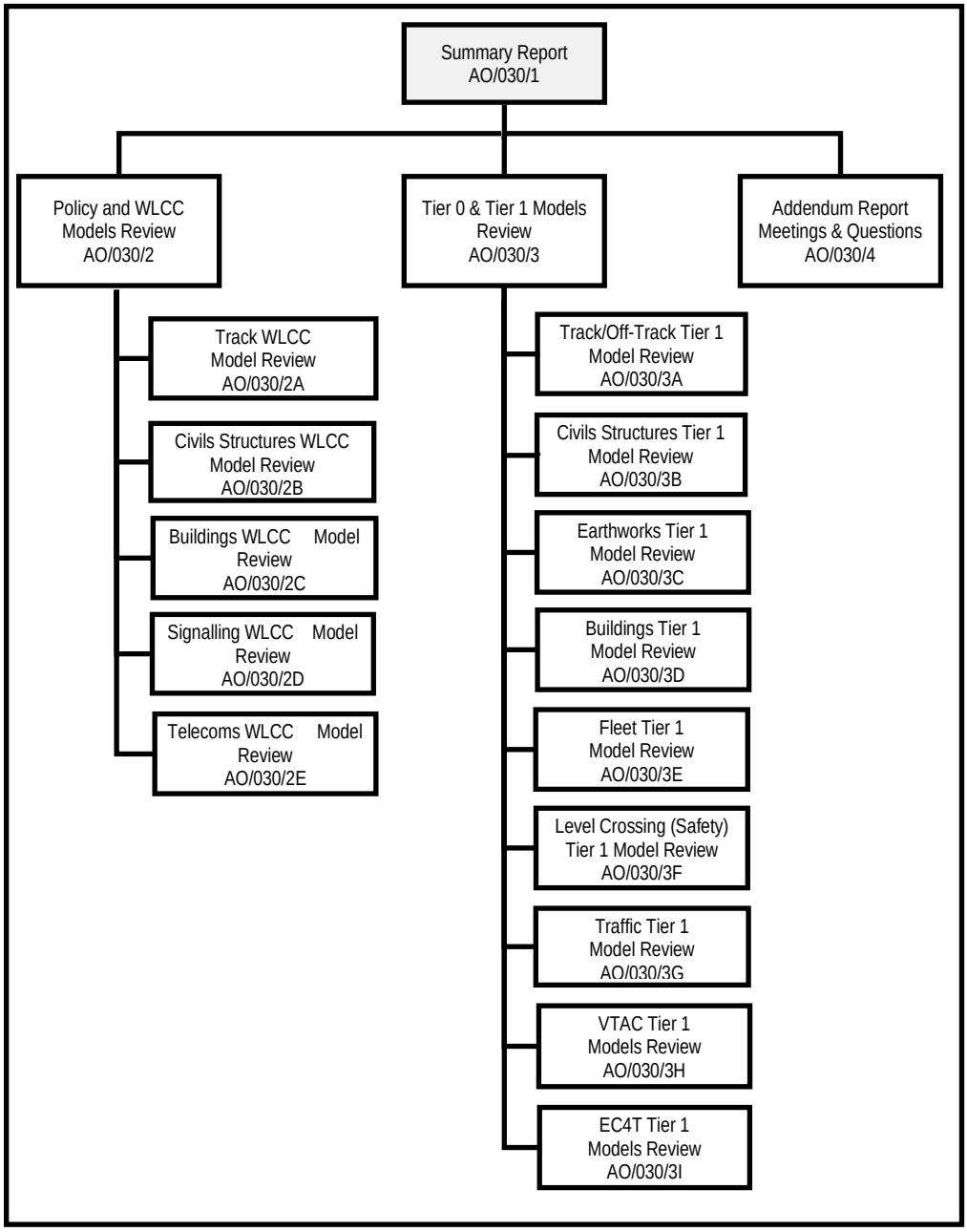


Figure 2-1: Structure of Reports Delivered under Mandate AO/030

Report Structure

2.1.10 This Summary Report is structured as follows:

- Section 3 sets out the scope of our work;
- Section 4 introduces the overall NR Asset Management approach and provides the overall context for our review;
- Section 5 explains our approach to the review;
- Section 6 presents our general findings;
- Sections 7 to 13 set out our asset specific findings:
  - Track (Section 7)

- Structures including Bridges, Tunnels (Section 8)
- Earthworks (Section 9)
- Buildings (stations, lineside buildings) (Section 10)
- Drainage (Section 10)
- Off-track (Section 12)
- Fleet (Section 13)

- Section 14 lists the key references.

Recommendations from Previous Reviews

2.1.11 On 30th September 2011 NR issued the Initial Industry Plans (IIP) for England & Wales and for Scotland. Arup were appointed as Part A Independent Reporter under Mandates AO/017, AO/016, AO/021 to review various Maintenance & Renewal aspects of the IIP. Our review commenced in June 2011 and a summary report was delivered on 16th December 2011 to assist ORR with their advice to Ministers. A report on the Tier 0 and Tier 1 Models was delivered in February 2012 and a report on the Whole Life Cycle Cost Models was delivered in April 2012. Further details are included in Appendix B.

2.1.12 Arup were appointed in April 2012 under Mandate AO/030 to undertake progressive assurance review activity as well as reviewing NR's SBP submission post 7th January 2013. Our Progressive Assurance review concentrated on NR's process for developing the SBP and their interaction with the ten Operating Routes. A summary of the key findings is included in Appendix B and full copies of the presentations are in our accompanying report [Ref AO/030/04].

2.1.13 Where appropriate throughout our Reports we have made reference back to our IIP and Progressive Assurance findings.

3 Scope

3.1 Mandate AO/030

3.1.1 The agreed scope of Mandate AO/030 comprises a review by the Part A Reporter (Arup) of the following asset groups:

- Track;
- Civils (Structures and Earthworks);
- Buildings;
- Drainage;
- Off-track; and
- Fleet.

3.1.2 In parallel the Part B Reporter (AMCL) were appointed under Mandate BA/025 to review:

- Electrical Power;
- Signalling;
- Level Crossings; and
- Telecoms.

3.1.3 The scope of our work included a review of

- Asset policy documents;
- Strategic planning tools;
- Whole life cycle cost analysis tools;
- Route Plan documentation; and
- SBP documentation including costs, volumes and outputs tables.

3.1.4 We have also reviewed Whole Life Cycle Cost (WLCC) models for signalling and telecoms asset groups. The reviews of the models were provided to AMCL to assist their review of policy for these assets.

A copy of the Mandate for this work is included in Appendix A1.

3.2 Additional Scope

3.2.1 In addition, the Part A Reporter (Arup) was requested to review the integrity of NR's Tier 0, 1 and 2 models used in support of SBP. This was a continuation of work undertaken as part of our review of the Initial Industry Plan (IIP).

3.2.2 A copy of the full Mandate is included in Appendix A2.

3.3 Efficiencies

3.3.1 In their 'Efficiency Summary' document [SBPT220] NR have defined two key types of efficiency, namely:

- Scope efficiencies[6]
- Delivery efficiencies[7]

They have then further sub-divided Scope efficiencies into:

- Refined Asset Policies or 'Embedded Efficiencies'; and,
- Asset Information Efficiencies.

3.3.2 Under Mandate AO/030 we have considered 'pre-efficient' volumes and costs and made qualitative comment on the 'embedded efficiencies' associate with NR's refined asset policies.

3.3.3 All other efficiencies including the efficiency overlay are reviewed in our accompanying Mandate AO/35 report[8].

3.4 Key Constraints

3.4.1 Our review of the SBP Submission has built on the previous Progressive Assurance activity (see Appendix B) and has been undertaken subject to the following constraints:

- We were allocated an 11 week period starting from 7th January 2013 with report delivery (Draft A) on Friday 22nd March 2013.
- In the time available we were not able to undertake any site visits or similar activities to verify the material presented by NR. Accordingly the review was primarily desk-top based supplemented by NR presentations and workshops.
- We had a limited opportunity to meet with the Operating Routes, these comprised overall Route Presentations arranged by ORR and a number of asset specific meetings.

3.4.2 In recognition of the limited time and specific resource, we adopted a 'time-box' approach[9] for our review work. Our aim has been to undertake our review in as much detail as is possible within the agreed time, using the resource available. In some instances this has meant that we have had to adjust the level of detail that we have reviewed to suit the time available.

3.4.3 The 'time-box' approach was agreed with both parties based on the need to provide advice to ORR in late March 2013.Where we have made significant adjustments we have informed ORR and NR.

[6] Scope efficiencies – sustainable reductions in scope to deliver required outputs through improved asset information, refined asset policies (including those improvements which are already embedded in the CP5 policies and therefore reflected in the pre-efficient spend projections) and other more project-based value engineering
[7] Delivery efficiencies – a lower cost of delivering a unit of activity.
[8] Mandate AO/035 'PR13 review of Network Rail's CP5 efficiency projections and supporting evidence'
[9] 'Time boxing' is a planning technique where the deadline is fixed, but scope may be reduced.

3.4.4 As noted above, a considerable volume of additional material has been provided after 7th and 8th January 2013. We have had very limited time to review this explanatory material which has led to increased uncertainty associated with our opinion than if a full explanation had been provided in the SBP submission. Specific uncertainties are set out in the following sections as appropriate.

4 Strategic Business Plan Context

4.1 Introduction

4.1.1 The aim of this section is to provide an overall context for our review and introduce the key components of NR's SBP submission that we will refer to in subsequent sections.

4.1.2 Specifically we have summarised our overall understanding as to how NR have created the 'line of sight' between the High Level Output Specification (HLOS) and the proposed Maintenance & Renewal activities at an asset group level.

4.1.3 We have also set out our understanding as to how NR have disaggregated the overall HLOS requirements down to an asset group output level, and applied their Asset Policies via Tier 1 Models and / or Route 'Bottom-up' Plans to derive the pre-efficient volumes and costs in the SBP submission.

4.2 High Level Output Specification (HLOS)

4.2.1 In July 2012, the Secretary of State for Transport[10] (SoS) and the Scottish Ministers[11] published their High Level Output Specifications (HLOS) setting out what they want to be achieved by railway activities during the review period covering 1 April 2014 to 31 March 2019 and the public funds that are or are likely to be available to secure delivery; the Statement of Funds Available (SoFA).

4.2.2 The HLOS (for England & Wales) [Department for Transport 2013a] and the HLOS for Scotland [Transport Scotland 2013a] have been defined in terms of a limited number of quantified Metrics (e.g. PPM, CaSL) and non-quantified Requirements, covering Safety, Reliability, Capacity and Environment. A high level specification of certain major projects and other investments is also provided.

4.2.3 There are no specific asset management requirements or output measures set out in either HLOS apart from the statement in the HLOS for Scotland reproduced below:

"Maintaining Scotland's railway stations

3.10 All stations shall be maintained to an average asset condition as in place at the 31st March 2014 and in a manner that facilitates the operator of the ScotRail franchise to fulfil its obligations under the current or any future Service Quality Incentive Regime (SQUIRE)."

For England & Wales, in July 2012 the SoS also published general guidance to the Office of Rail Regulation[12] [Department for Transport 2013b] which does specifically include a section on asset management as reproduced below:

[10] Department for Transport 2013a Railways Act 2005 Statement for Control Period 5 (HLOS and SoFA) July 2013
[11] Transport Scotland 2013a'The Scottish Ministers' High Level Output Specification'July 2013
[12] Department for Transport 2013b Secretary of State for Transport Guidance to the Office of Rail Regulation July 2013

"Network Rail's asset management

28. The Secretary of State wishes to receive assurance from ORR that Network Rail's asset management strategy secures the best value for money over the whole life of the railway's assets. The Secretary of State also looks to the ORR for assurance that such a strategy is being delivered to a challenging timetable - applying, monitoring and enforcing appropriate obligations through the Network Licence to that end.

29. Information about rail assets and their condition and capability is a cornerstone in the delivery of a safe and efficient railway system. In light of this, the Secretary of State wants Network Rail to secure expeditious improvements in its asset knowledge and wishes the ORR to maintain a strong focus on this aspect of Network Rail's delivery. She also wishes to be assured by the ORR that in developing and maintaining asset information Network Rail has tested alternative models to determine the best outcomes depending on the type of asset, and that any model it employs reflects best practice and the opportunities that new technologies present, in all cases having regard to efficiency, affordability and value for money. The Secretary of State wishes to be assured by the ORR that Network Rail is making appropriate use of this asset information when planning and resourcing its asset stewardship obligations"

4.2.4 At the time of writing (22 March 2013) we are unclear whether or how this additional guidance from the SoS was formally cascaded to NR and its status.

4.3 Overall Development Process

4.3.1 NR's overall approach to developing their Asset Management Plans for Maintenance & Renewal is outlined in the 'Renewals Expenditure Summary' document [SBPT223]. This explains the sequence of stages and a 'line of sight' from the HLOS through Asset Policies to Route Plans (with their sections on Asset Management Plans). The approach is shown diagrammatically in Figure 4-1 below and described qualitatively in Figure 4-2.

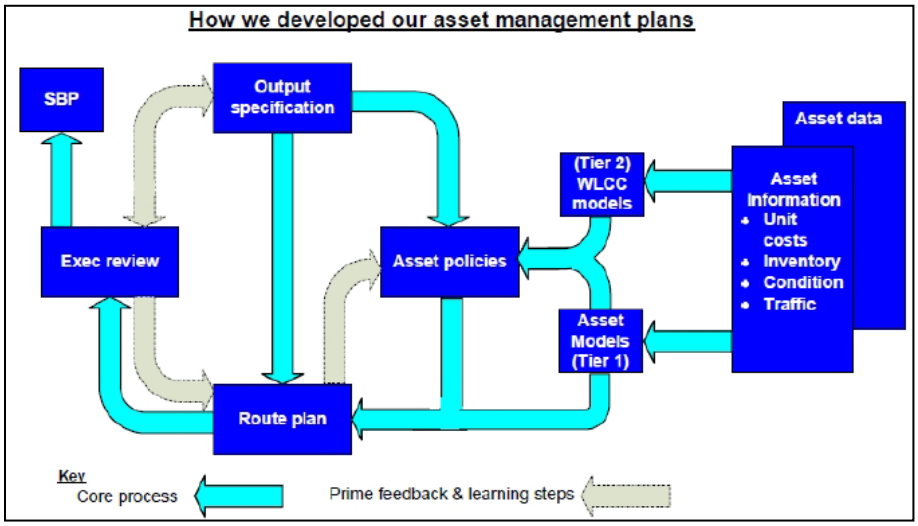


Figure 4-1 NR overall process for development of AM Plans

Output	Network Rail's commitment in response to HLOS	How this is reflected in our Asset Output Specification CP5 to CP11
Safety	We commit to continually reducing the risk to the public, passengers and our workforce. We will reduce risk at level crossings by 8 per cent during CP5.	Retain emphasis on safety provisions. Seek Incremental improvements through better design, refined intervention and modern equivalent asset forms. Specific improvements to be developed and justified for Civils, Level Crossings and Electrification.
Performance	We will broadly maintain performance at end CP4 level, focus on reducing the variability in train service reliability and reduce the gap between the best and worst performing services. Our plan is to deliver 92.5 per cent PPM and 2.2 per cent CaSL by the end of CP5.	Anticipated improvement in reliability from better targeting of sources of risk and criticality in renewals, greater refurbishment and risk based maintenance activity to retain overall levels of reliability while accommodating traffic growth. Detailed 2 yearly Joint Performance Improvement Plans formulated at Route level.
Capacity	We have developed a plan with train operators to accommodate the demand forecasts set out in the HLOS. Our plan sets out the enhancement programme required to support the necessary train service changes. Our plan also sets out for each specific enhancement programme the outputs delivered, scope, cost and key milestones.	Changes in future top down activity modelling adjusted to reflect specified enhancements and change to inventory. Routes required to align enhancement to renewal and maintenance activity in their route plans, and deliver required asset capability
Availability	We develop our access strategies in each route with train operators.	Asset Policy developed to optimise whole life cycle cost, with required changes to access identified. Iterate to form final policy in conjunction with route and industry feedback Detailed and deliverable access requirements to be developed at Route Level in Route Plan
Sustainable Development	We have developed a vision and strategy for sustainable development. The SBP sets out a carbon trajectory. We will commit to including climate change scenarios in our asset policies and investment decisions to protect the future value of our assets.	Asset Policy to be justified on whole life cycle basis and to demonstrate financial sustainability. Policy to cover specific climate change adaptation requirements through specified programmes or changes to design & environmental specifications.

Figure 4-2 Asset Management Outputs- Line of Sight [SBPT223]

4.4 Route Output Specifications

4.4.1 The 'Renewals Expenditure Summary' [SBPT223] states that '*The output requirements were formalised following the publication of the HLOS's for England & Wales and Scotland and were translated into output specifications for each route*.' (emphasis added).

4.4.2 Output Specifications have not been provided for review as part of the SBP submission. Therefore, it is difficult to map the HLOS requirements directly to each Route Plan and to understand how or if the management of an asset at a Route level has been directly influenced by the high level requirements.

4.4.3 During Progressive Assurance in September 2012 we were provided with draft copies of Route Output Specifications[13]. These drafts typically provided disaggregated Route level performance outputs for PPM[14], CaSL, Delay Minutes and Capacity outputs. These disaggregated Route level performance outputs appear to now be included in the individual Route Plans – for example Kent [SPBT212 pages 24, 83 and 84].

4.4.4 In our Progressive Assurance review of 23rd November 2012 (see Appendix B) we noted that the draft Route Output Specifications did not make any explicit reference to asset stewardship. Neither did they provide any asset management targets / output measures or similar to show how management of Maintenance & Renewal was expected to support the delivery of the Route level performance outputs.

[13] Progressive Assurance Documents Reference 0724
[14] Public Performance Measure, Cancelations and Significant Lateness Measure

4.4.5 We have explored the linkage between planned outputs and Maintenance & Renewal volumes with the Routes, both via the written questionnaires sent to the Directors of Route Asset Management (DRAMs), the Heads of Asset Management (HAMs), Route Asset Managers (RAMs) and in the various meetings we have held (Section 5).

4.4.6 In summary we have not been able to clearly identify any direct 'top down' 'cascade' of explicit asset management targets to the Routes via Output Specifications. The primary source of such targets appears to have been through the national Asset Policies. The implications of this are discussed in the rest of this report.

4.4.7 Asset specific outputs / targets are discussed in our accompanying 'Policy and WLCC Model Review' Report [Ref A0/030/02].

4.4.8 In the Asset Policies (for example SBPT3015a) there is regular reference to 'maintaining condition' in CP5 at least as good as CP4 exit condition. The implications of this are discussed in the rest of this report.

4.5 Asset Policies

4.5.1 The overall cycle of NR's asset management decisions and activities is shown in Figure 4-3 below.

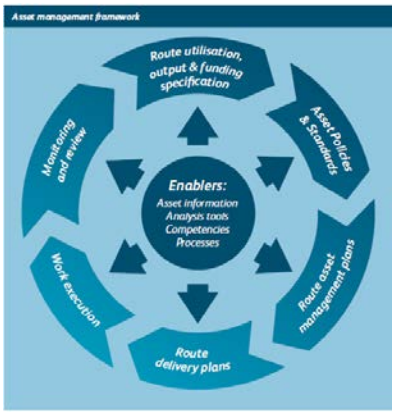


Figure 4-3 NR Asset Management Framework [SBPT3003]

4.5.2 NR Asset Management System (AMS) [SBPT3003] defines the function of 'Asset Policies' as:

> *"A suite of documents that define how the asset groups are to be managed to meet the asset management objectives. They specify the major inspection, maintenance and renewal interventions for each asset, and specifications for new / replacement assets"*

4.5.3 NR Asset Management Policies and the interaction with the Tier 2 Whole Life Cycle Cost (WLCC) Models are described in more detail in our accompanying report [Ref A0/030/02].

4.6 Tier 1 Modelling

4.6.1 NR have developed a hierarchy of modelling tools to facilitate planning and forecasting. The key tools are broadly structured into three 'tiers', namely:

- Tier 0 - single 'presentation layer database' (showing volumes and costs for M&R)
- Tier 1 – Asset group Models that derive *'costs, volumes and outputs'*. (individual asset groups on a national basis)
- Tier 2 - (Whole Life Cycle Costing – WLCC) Tools. (individual asset or asset type basis)

Figure 4-4 shows the hierarchy of models contributing the SBP outputs.

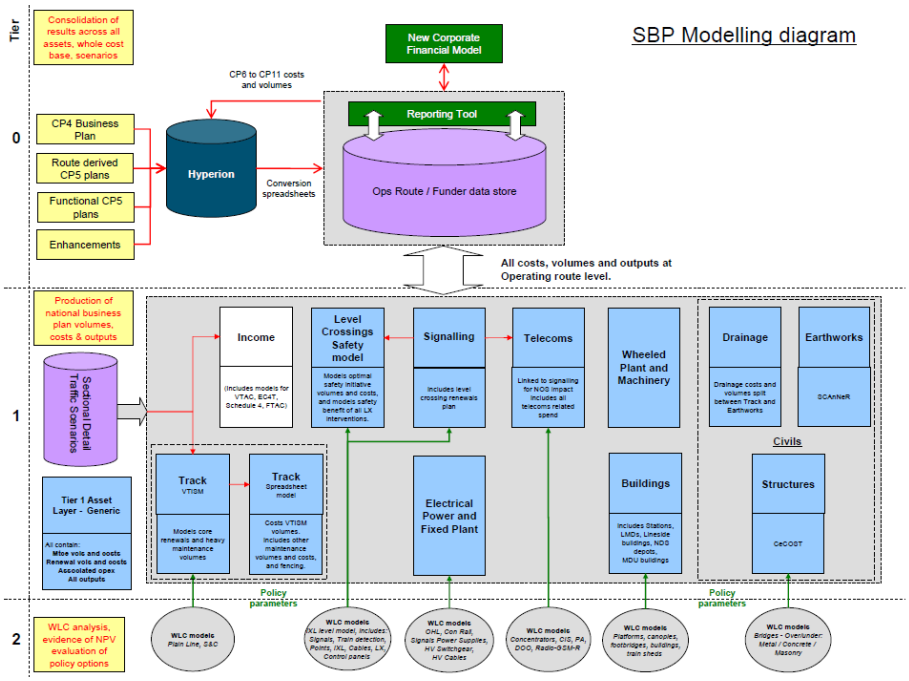


Figure 4-4 SBP Modelling Overview [SBPT3067]

4.6.2 The 'Renewals Expenditure Summary' [SBPT223] describes the Tier 1 Models as follows:

"Asset portfolio 'Tier 1' models: we have used these forecasting models to apply different policy options to evaluate the overall impact on activity, expenditure and outputs. This has informed the iteration of asset policy development, provides a complete set of 'top down' forecast for CP5 and beyond, and provides benchmark forecasts by route that have informed the development of route plans."

The Tier 1 Models are described in more detail in our accompanying report [Ref A0/030/01].

4.7 Route Plans

4.7.1 According to the 'Renewals Expenditure Summary' document [SBPT223] :

"The Route Plans are the mechanism through which the Routes identify the activity and expenditure required to deliver the outputs in accordance with asset policies. The plans utilise current information on the state of the route infrastructure to establish the required future volumes of work activity for renewals and maintenance, that are aligned with planned enhancement activity. As such they are 'bottom up' activity plans that can be compared to the benchmarks provided by the 'top down' modelled forecasts.

The Route plans are supported by workbanks which detail the activity for each asset. The level of detail over the control period varies according to the nature of the asset and the activity, but in general workbanks are more comprehensively defined for the early years of CP5 with less detail later in the control period, reflecting growing uncertainty as to precisely where activity will be necessary. Forecasts are included beyond CP5 for the longer term, which are predominantly based on the output of our Tier 1 asset portfolio models. The defined activity is accompanied by forecast changes to asset condition and relevant, available risk measures."

4.7.2 The extent to which the pre-efficient volumes and costs for CP5 have been derived from the 'top-down' Tier 1 Models, from 'bottom-up' workbanks or from other sources varies significantly from sub-asset to sub-asset and is discussed in the sections on individual assets that follow. Our understanding of the process of policy application is also described and reviewed in the text on individual assets that follows (Sections 7 to 13).

4.8 Route Asset Management Plans

4.8.1 Mandate A0/030 requires us to review and comment on the Route Asset Management Plans (RAMPs). At the time of writing the Mandate in Spring 2012 it was understood that each RAMP would comprise a series of separate documents (by Route or Strategic Route Section, SRS) and a set of accompanying tables with aspects such as costs, volumes, outputs, key performance indicators (KPIs), efficiencies. We understand that the nature of RAMPs has changed since Spring 2012 and that these documents have not been submitted with the SBP.

4.8.2 The key Route level plans for asset management are set out as a chapter in each Route Plan entitled 'Asset Management Plan'. These present a high level commentary and summary tables for planned maintenance & renewal expenditure.

4.8.3 These summary tables are in insufficient detail for our review and so it has been agreed with ORR and NR that we would review the 'pre-efficient' volumes and costs in the Tier 0 Model (Database) [SBPT3038] supplemented with figures from the Data Book [SBPT3338].

4.8.4 We have also agreed that we would review costs and efficiencies on an asset group rather than on a Route basis. This aligns with the fact that NR describes the SBP as a centrally derived plan.

4.9 Uncertainty Analysis

4.8.5 The NR SBP submission includes an 'Uncertainty Analysis' [SBPT3297], which describes the 3-stage uncertainty analysis undertaken by NR, covering the following aspects of SBP development:

- Stage 1: Renewals expenditure;
- Stage 2: Total company expenditure; and,
- Stage 3: Linking performance to expenditure.

4.9.1 In this report we have reviewed the uncertainty analysis associated with the renewals expenditure – i.e. NR's Stage 1 analysis. Commentry on other

aspects of the uncertainty analysis is included in our accompanying reports [A0/034 and AO/035].

4.9.2 Our review of the Stage 1 analysis is set out in Appendix C.

5 Approach

5.1 Basis for Our Assessment

5.1.1 We have based our assessment on the SBP submission provided by NR on 7th and 8th January 2013.

5.1.2 The SBP submission, provided on 7th/8th January 2013, comprised over 440 individual documents. In the time available we have not been able to review all of these, so we have had to prioritise our effort and focus on documents that appear to be pertinent to our review. This may mean that we have not fully appreciated some aspects of the SBP submission. It has been assumed that any such factual errors will have been identified by NR during their review of our Draft reports.

5.1.3 In our assessment we have considered the additional explanation and clarification provided by NR in the Central M&R Challenge Sessions and the Asset Specific Route Meetings. Similarly we have considered the written answers provided by NR to specific questions raised in the M&R Question Logs. In some instances as well as a concise answer or as part of an answer to a question, NR have provided additional material such as reports, technical notes, spreadsheets, models etc. We have treated this material as set out in the following paragraph.

5.1.4 A significant volume of additional material has been provided by NR after the 8th January 2013 to explain, supplement or amend details in the SBP submission. This amounts to over 390 individual documents such as reports, technical notes, spreadsheets, models etc. Due to time constraints we have generally not been able to consider this additional material supplied after 7th/8th January 2013 in our assessment. We have explicitly referenced any additional material we have used. This approach has been agreed with ORR.

5.1.5 The SBP submission was made available by NR on 7th and 8th January 2013 on a SharePoint extranet site for use by the ORR and the Reporter teams. A full list of documents received by Arup is included in our accompanying Addendum Report [Ref AO/030/04].

5.1.6 The additional documents received up until 15th March 2013 are also catalogued in our accompanying Addendum Report [Ref AO/030/04].

Progressive Assurance Findings

5.1.7 We have also taken into account the findings from our Progressive Assurance during the period April – December 2012. Our key findings were presented to ORR and NR on 29th May 2012, 11th September 2012 and 23rd November 2012. These findings are summarised in Appendix B. Copies of our full presentations are included in the accompanying Addendum Report [Ref AO/030/04].

Central Maintenance and Renewals Challenge Sessions

5.1.8 A series of Maintenance and Renewals Challenge Sessions were organised and chaired by the ORR and attended by Arup. Formal Minutes of these were prepared by ORR and have been uploaded to the SBP SharePoint site. We took our own notes at these meetings to support our review and copies are presented in the Addendum Report [Ref AO/030/04]. It should be noted

that these notes do not constitute the official record of the meeting, which was taken by ORR.

5.1.9 We arranged a number of follow-up meetings with NR's central teams, after the initial central route meetings. Our notes from these are also included in the Addendum Report.

Meetings with Operating Routes

5.1.10 During Progressive Assurance we only had very limited discussions with the Operating Routes as to the development and application of the central Asset Policies in practice. This, combined with the devolved Route structure meant that we considered it important as part of our SBP review to understand the SBP process from an Operating Route perspective. To reduce the regulatory burden we issued Questionnaires and undertook follow-up meetings on a sampling basis. Our approach is explained in more detail in Appendix B.

5.1.11 Copies of the completed Questionnaires and our Notes from the Route Meetings are set out in our accompanying Addendum Report [AO/030/04].

5.2 Overall Assessment Approach

5.2.1 Based on our Progressive Assurance work, we have developed a 'System Diagram', shown in Figure 5-1, that reflects our understanding of the inter-relationships between the asset management inputs, documents and models considered in this assessment. This format has been used to compare our relative level of confidence in the development of Maintenance & Renewals costs and volumes for each asset type considered in this Summary Report.

5.2.2 The System Diagrams can also be used to clearly identify those elements associated with our review of asset management policy and those used associated with its application in the SBP, as shown diagrammatically in Figure 5-2.

5.2.3 Our **Policy and Whole Life Cycle Cost Report** [Ref AO/030/02] presents out review of the inter-relationship between, asset targets, asset interventions and timings and how the asset strategies have been selected.

5.2.4 The implementation of the asset strategies in the Tier 1 'top down' models is reviewed in our **Tier 0 / Tier 1 Model Report** [Ref AO/030/03].

5.2.5 The final application of 'top down' modelling and 'bottom up' Route Plans to derive pre-efficient volumes and costs for CP5 and CP6-CP11 is reviewed in the asset specific sections of this Summary Report.

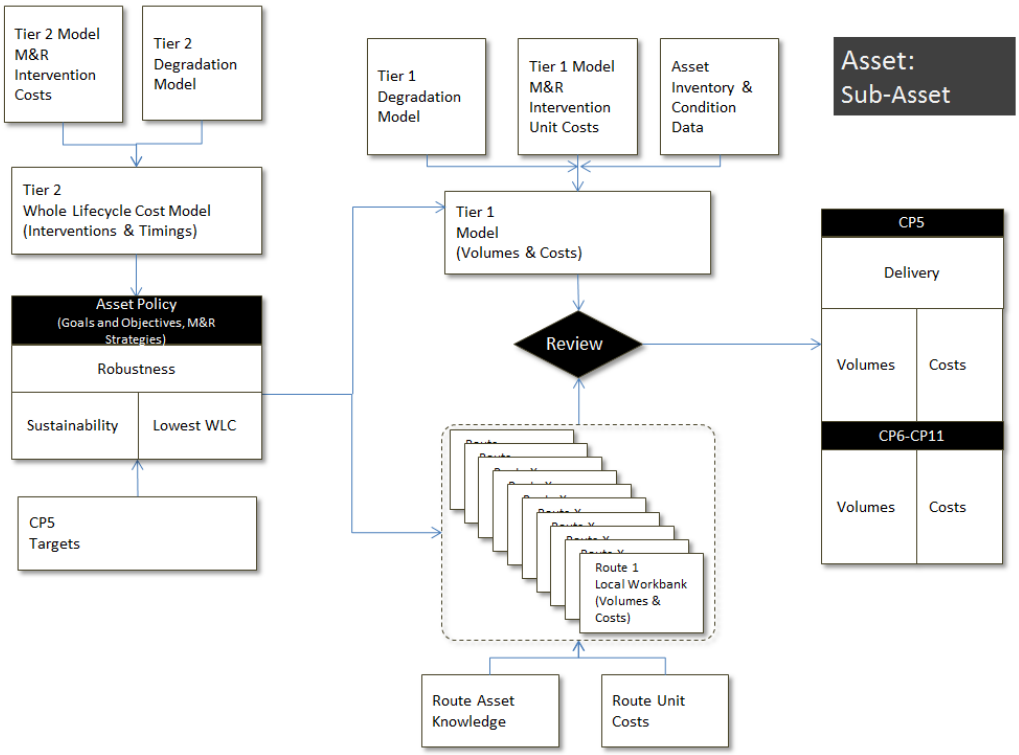


Figure 5-1: Asset System Diagram for SBP Maintenance & Renewals

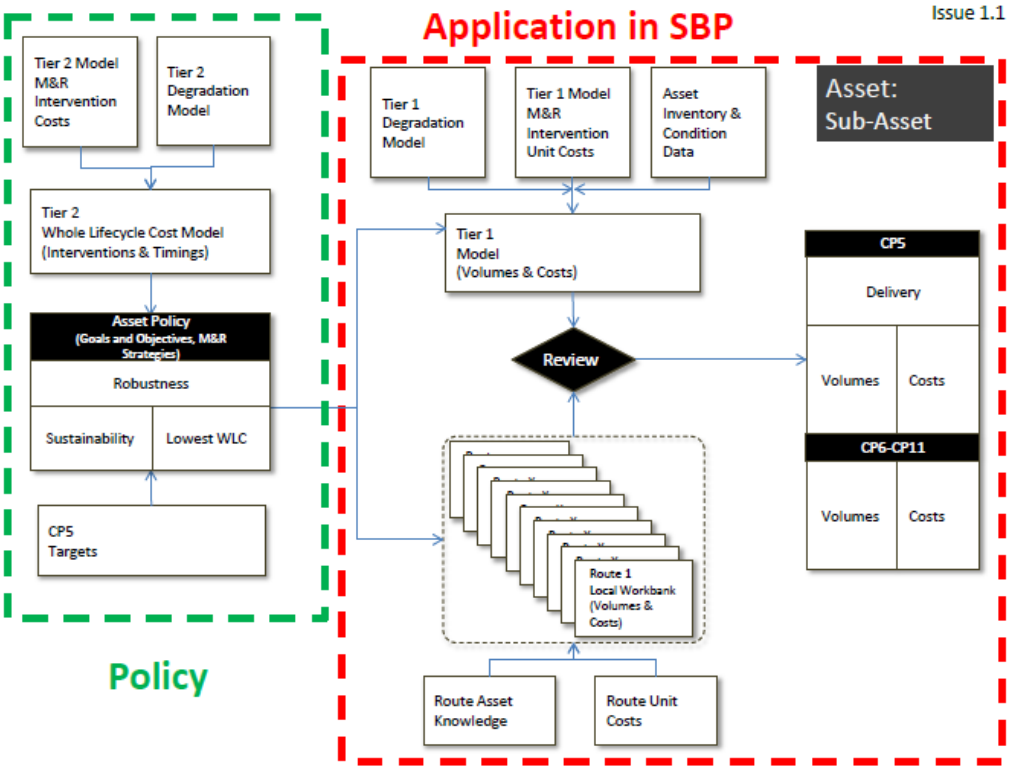


Figure 5-2: Relationship between 'Policy' and 'Application' in SBP

5.3 Maintenance & Renewal Volumes and Costs

Data Provided by Network Rail

5.3.1 The SBP submission includes a number of different sources for maintenance and renewal volumes and costs, including:

- Asset Policies;
- Maintenance & Renewal Summary Documents;
- Route Plans;
- Data Book;
- Tier 0 Model / Database; and
- Detailed Tier 1 Outputs.

5.3.2 Following discussions with NR in January 2013, we have based our assessment of SBP volumes, costs and efficiencies for each asset group on the Tier 0 Database [SBPT3038], as supplied to Arup on 7th January 2013 in digital form and updated on 30th January 2013.

5.3.3 We have supplemented the information in the database with figures from the published Data Book [SBPT3338]. For Structures assets we have updated these with the information supplied on 28th February 2013 and 8th March 2013. We have also made reference to the maintenance costs and a further CP4 breakdown for the other assets as supplied on 8th March 2013.

Assessment Approach

5.3.4 We have reviewed the SBP 'pre-efficient' volumes and costs on an asset group basis not on a Route basis. To achieve this we have distilled the Tier 0 Database and SBP Data Book down to a single sheet for each asset group, which we have used as the definitive sources for our evaluation. These sheets are included in Appendix D of this report and an example is shown in Figure 5-3.

5.3.5 We have made our assessment for each asset group at:

- 'Sub-Asset' level - 'Level 3' - (e.g. Civils Underbridges);
- Control Period total level (i.e. we have not reviewed profile of spend within a Control Period).

5.3.6 Accordingly in our review for each asset we have considered derivation of:

- Volumes in CP5 (Maintenance & Renewal);
- Volumes in CP6-CP11 (Maintenance & Renewal);
- Pre-Efficient Costs in CP5 (Maintenance & Renewal);
- Pre-Efficient Costs in CP6-CP11 (Maintenance & Renewal).

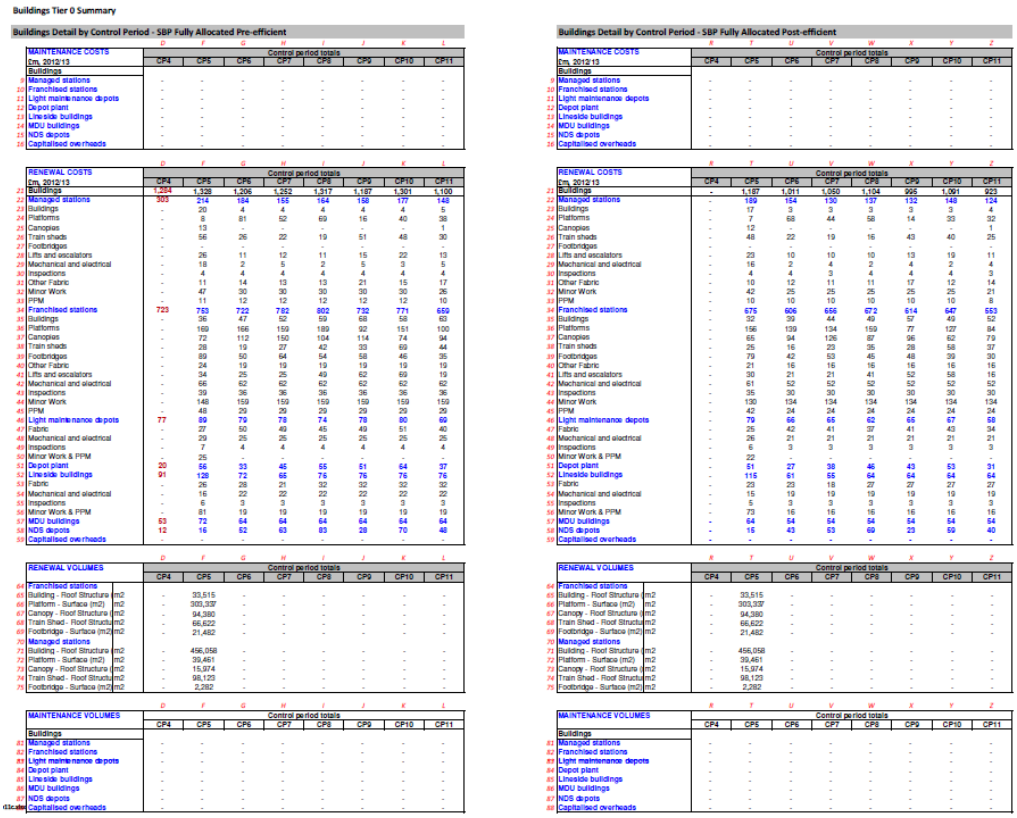


Figure 5-3: Typical Volume and Cost Summary Sheet

5.3.7 We have concentrated on individual cost elements that make up 10% or greater of the total projected cost for the asset type in a single Control Period.

5.3.8 Our assessment on the derivation of pre-efficient volumes and costs for focusses on CP5. Volumes and costs for CP6-CP11 have only been considered in relation to the question of long-term 'sustainability'.

5.4 Presentation of Summary Findings

Review Findings for each Asset Type

5.4.1 Our general, cross-cutting findings and those for each asset type considered in the review are presented in subsequent sections. For each asset type the findings cover the following topics:

- Description of the assets covered by the assessment
- Methodology used in the assessment
- Asset specific performance measures and targets
- Aspects of asset policy relevant to the derivation of Maintenance & Renewals volumes and costs
- The application of asset policy in deriving volumes and costs
- Uncertainty in derivation of volumes and costs

5.4.2 A high level summary of the findings for each asset type has also been provided.

Certainty / Confidence Grading

5.4.3 In our review we have had to consider a complex set of summary documentation in a limited time, accordingly alongside our opinion on the questions posed in the Mandate we have stated our assessed 'degree of confidence / certainty' based on a consistent qualitative scale as set out in Figure 5-4.

Colour Scale			Description
	Very Low Uncertainty	High Certainty	Clearly documented and well evidenced
	Low Uncertainty	Reasonably High Certainty	Relatively clear, information provided supports approach, verification and validation documentation provided
	Some Uncertainty	Some Certainty	General understanding developed based on supporting documentation provided
	Moderately High Uncertainty	Low Certainty	Little understanding developed of approach taken. Limited supporting documentation presented
	High Uncertainty	Very Low Certainty	Little clarity provided, and/or contradictory information provided
	Not provided for review	Not provided for review	Understand that aspect exists but not seen or not reviewed in time available
	Not used	Not used	Aspect not present for asset group

Figure 5-4 Scale of Certainty / Confidence

5.4.4 We have prepared a System Diagram for each Level 3 Sub-Asset Type, using the format shown in Figure 5-1. Using the scale shown in Figure 5-4, an indicative colour code has been allocated to each element, reflecting our relevant level of certainty / confidence in its derivation, based on the detailed findings from this Review. These diagrams are included as Appendix C with the summaries in Sections 7 to 13. An example is provided in Figure 5-5.

5.4.5 The presentation used in the System Diagrams should be read in conjunction with the text in our SBP Review Reports and this Summary Report. The diagrams on their own are not intended to represent our opinion or findings.

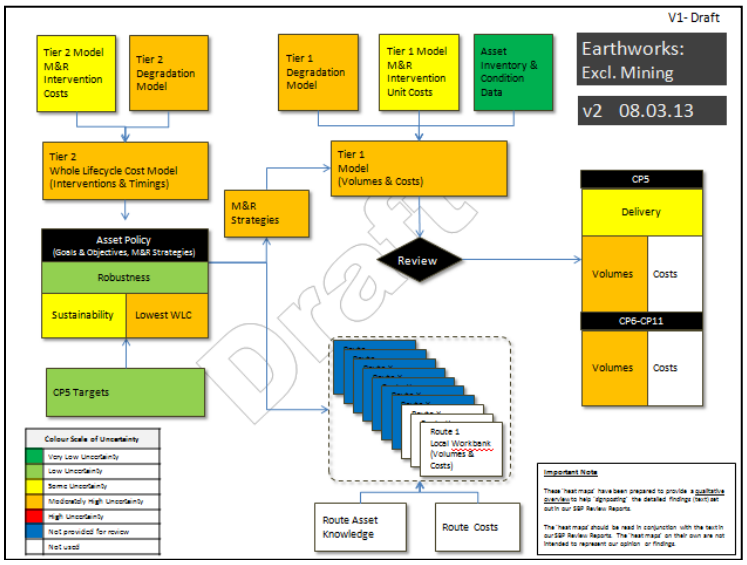


Figure 5-5 Typical 'System Diagram' for Sub-Asset Showing Relative Levels of Certainty / Confidence

6 General Findings

6.1 Overall SBP Submission and Review

6.1.1 The overall SBP Submission has been very clearly and consistently presented. It is a complex 'story to tell' and NR have produced a set of documentation that is well 'signposted' with layers of detail that allows key messages to rise up and readers to drill down into detailed 'back-up'. The quality of production is high and we have found the SharePoint site very useful as a means of navigating through the whole submission.

6.1.2 A number of overall elements are in our opinion represent best practice, specifically:

- Use of Whole Life Cycle Cost models (Tier 2) in derivation of Asset Policies;
- Application of Asset Policies to derive volumes and costs through asset portfolio models (Tier 1 Modelling);
- Application of 'top down' strategic volumes and costs (from Tier 1 models) to test and challenge local 'bottom-up' workbank derived volumes and costs, creating a 'comparator' and generating 'competitive tension'.

6.1.3 However, there are two key 'aspects' that have significantly increased the level of uncertainty in our opinion, namely:

i. As part of our mandate we have been asked to comment on '*the final Route Asset Management Plans (RAMPs)*' in terms of volumes, costs etc. It is accepted that the 'final' volume and cost figures will have been derived in a variety of ways and may vary on an Asset Group and Route basis, however we have found it very challenging to clearly identify a 'final' set of volumes and costs that 'represent' the SBP funding request.

ii. In addition we have found it very challenging to understand what outputs / targets are being 'offered' or are associated with specific volumes and costs at an Asset Group level. This is the 'what do I get for my money' side of the equation.

6.2 Route Meetings

6.2.1 Arup and AMCL attended 34 specific Route Meetings with the NR Route Asset Teams [see AO/030/04].

6.2.2 We found these Route Meetings very useful, with Route Teams being open, transparent and keen to discuss and explain their thinking and application of 'central' SBP guidance, Asset Policies etc. Overall we found all Routes supportive of the overall SBP process and felt that they had been actively involved in the development of the Maintenance & Renewals plans.

6.2.3 As noted in our meeting notes, in some asset disciplines there was a wide range of maturity between Routes. Benefits of a devolved Route structure could be clearly seen in some Routes where the DRAMs had cross-asset

knowledge and were actively involved in the overall route asset management planning.

6.2.4 Where 'new' working practices are potentially required, for example in undertaking refurbishment activity to earthworks assets, there was evidence that a number of Routes were actively identifying alternative delivery mechanisms such as in-house teams. This is very promising.

6.3 General

6.3.1 Our review has identified the following general findings that apply to a greater or lesser extent across all the asset groups that we have reviewed.

Asset System

6.3.2 NR have published an overall Asset Management System Document [SPBT3003] which sets out how NR intend that 'top-down' decisions will be used in practice to influence local asset maintenance and renewal choices. This appears to be work in progress as it is not yet fully implemented or embedded but the direction it sets out looks promising.

Output Scenarios and Trade-Offs

6.3.3 At IIP we noted that ORR provided POG[15] with guidance on specific scenarios / options to be considered for the IIP[16], namely:

- Current Railway; and
- Preferred Plan.

NR in their IIP submission also added the scenario of *'Current Railway plus Investments'*.

6.3.4 ORR were not explicit about the requirement to present specific options in their SBP guidance[17].

6.3.5 In their SBP submission NR seem to have presented a 'single output' option.

6.3.6 As we stated at IIP, we believe that it would have been useful for NR to present a wider range of Output Scenarios in their SBP Submission with associated costs, benefits and risk to facilitate discussion as to 'appropriate' and 'affordable' levels of performance for particular assets. Accordingly it is uncertain whether the presented output option represents 'best value'.

6.3.7 In addition it is unclear how NR have demonstrated that they have considered 'cross-asset' trade-offs and selected the most effective and efficient ways of delivering the overall HLOS outputs – for example demonstrating that spending more on a particular asset and less on another would be 'best value' or 'most effective'.

'Line of Sight'

6.3.8 There are no specific asset management requirements or output measures set out in HLOS (for England & Wales) or the HLOS for Scotland apart from the statement in the latter relating to SQUIRE[18].

[15] Planning Oversight Group (a Group which involves representatives of Network Rail, passenger and freight train operators and suppliers)
[16] ORR-#421118-v1-20110719_ORR_PR13_extract_of_draft_guidance_to_POG_on_scenarios
[17] ORR Requirements for Network Rail's January 2013 Strategic Business Plan

6.3.9 At an asset level, NR seem to have interpreted the HLOS requirement as a general baseline requirement to achieve the outputs in CP5 at least as good as CP4 exit condition. We are unclear whether this represents best value.

6.3.10 NR have identified in their '*Asset output measures summary*' [SBPT232] the asset specific output measures for the seven major asset disciplines. NR have selected these measures to align with the ORR 'robustness' and 'sustainability' tests[19]. These are 'cascaded' into the Asset Policies and thereby to the Routes at an Asset Group level. This is very positive.

6.3.11 However, we have had difficulty identifying a clear relationship from the specific HLOS quantified Metrics (e.g. PPM, CaSL) down to the Routes and understanding how these have influenced management of the assets at a Route level. This might include analysis of Route level reliability data and failures.

Asset Outputs and Targets

6.3.12 It has been clarified by NR at SBP Challenge Meetings [ID 66, 66a, 45 - see Report AO/30/03] that the Asset Output Measures for CP5 and beyond are 'forecasts' based on NR's 'best estimates' and are not targets that NR are proposing to actively use to manage their assets.

6.3.13 In their document *'Asset Management Targets, Indicators, Governance and Assurance'* [Ref 450] NR provide a summary of their existing business processes for asset management at a corporate level including the definition and use of Targets and Indicators. The document lists KPIs under four headings:

- Asset Stewardship Indicator
- Safety
- Performance
- Renewals and Maintenance

NR state that

"A programme of work is underway to establish an improved set of KPIs, providing more detail to complement the high level measures specified in Ref. SBP232. The new KPI suite recognises the need for more leading indicators, for a single point of user access to KPI information, and for monitoring and reporting at route level. The first tranche of new measures will be monitored from the start of the next financial year – the final year of CP4"

6.3.14 In our report *'Review of CP4 Regulated Outputs'* dated August 2012[20] we noted at that time that we had found it difficult to find a clearly articulated purpose and hierarchy for the CP4 indicators. We also suggested that a more defined hierarchy, with clear purposes, a mix of leading and lagging indicators, and explicit Targets / Goals taking into account performance, cost and the penalty of noncompliance would be beneficial for CP5. The SBP submission has provided some improvement in clarity but our view is that additional work is still required.

[18] Service Quality Incentive Regime (SQUIRE)
[19] 'Requirements for Network Rail's January 2013 Strategic Business Plan' issued by ORR on 15 March 2012.
[20] Network Rail and Office of Rail Regulation 'AO/29: Review of CP4 Regulated Outputs' – Ove Arup & Partners Issue, 1 August 2012

6.3.15 Overall we have generally found it difficult to ascertain the CP5 Targets and Goals at an asset group level. Aspects we have specific concerns with include:

- What asset outputs will be delivered in CP5?
- Why these have been selected (e.g. how they relate to safety and performance)?
- Their status (target or forecast).
- How these will be monitored / by whom?
- How overall assurance and audit of progress towards these outputs will be undertaken and reviewed / corrective action taken?

This has generally given rise to uncertainty as to the importance assigned by NR to the delivery of asset management outputs.

Asset Policies

6.3.16 NR have made significant progress with developing their Asset Policies since the CP4 review in early 2010. It is of particular note that they have produced additional Asset Policies for the management of Off Track, Drainage and Earthworks assets, and that all the Asset Policies have been standardised to follow a '10 Step' format as set out in the NR Asset Management Strategy dated Feb 2011 [SBPT3002].

Risk Based Approach

6.3.17 It is very positive that NR are generally adopting a risk based approach in their Asset Policies.

6.3.18 However, it is unclear how NR have equated safety risk between the 'principal' asset types such as Buildings vs. Earthworks vs. Structures. This gives rise to a significant uncertainty since Asset Outputs cannot be equated between asset types and that it may be being proposed that assets are funded to achieve different levels of risk.

Application of 'Asset Policy' to Derive SBP Volumes

6.3.19 The relationship between 'Top Down' Tier 1 central modelling and 'Bottom-up' local input has been a key uncertainty during our review. Specifically discussions with NR identified that the exact source of volumes varied from asset to asset, and sub-asset line to sub-asset line for a number of assets. This was further complicated by devolution, with variation in approach between Routes. This is discussed in further detail in the specific asset sections that follow (Sections 7 to 13).

Route Asset Management Plans

6.3.20 As noted above, the SBP submission does not include separate Route Asset Management Plans (RAMPs) mentioned in the overarching Asset Management Documentation [SBPT3001-3003]. Rather the key Route level plans for asset management are set out as a chapter in each Route Plan entitled 'Asset Management Plan'. These present a high level commentary and summary tables for planned maintenance & renewal expenditure.

6.3.21 In February 2012, as part of Progressive Assurance, we were provided with a comprehensive template document[21] which was to be used as a basis for RAMPs. We are also aware from our work on other Mandates[22] that further more detailed formats for RAMPs have been / are being considered by NR either at a SRS level, or at a Route Asset Group Level (e.g. Draft Structures Route Asset Management Plan - Anglia).

6.3.22 The RAMP template document seen in February 2012 as part of progressive assurance was consistent with 'good practice' for such asset management plans and for example explicitly included for aspects such as asset management goals and objectives, current performance (compared with those objectives), forecast performance, critical assets in relation to performance, investments required to achieve performance and how performance will be monitored and reviewed.

6.3.23 We have explored in our Route meetings whether more detailed RAMP documents have been produced and may 'lie behind' the 'Asset Management Plan' chapter in each Route Plan. We did not find any evidence that there are more detailed Route Plans available at this stage or whether there is an intention to produce such plans.

6.3.24 If this is correct it brings into question the extent to which Routes will be undertaking local asset management planning and optimisation, for example taking enhancements or local efficiencies into account in their planning.

Strategic Business Plan Volumes

6.3.25 In the coming year, NR will develop their CP5 Delivery Plan and their CP5 workbanks. This will take into account the required outputs and funding allocated by the determination plus refinement as workbanks are developed.

6.3.26 With this in mind, we are unclear as to the status and future intended use of the maintenance & renewal volumes in the SBP submission. Our discussions with a number of Routes have indicated a range of interpretations – ranging from '*follow exactly*' to '*these will be superseded by the Delivery Plan*'. We would suggest that this is an aspect that needs to be clarified with the Routes.

6.3.27 At the outset of CP5, it will be important to have a clearly defined and agreed 'volume baseline' and accompanying 'scope baseline' to allow subsequent measurement of the efficiency gains.

6.3.28 This ongoing development means that the SBP renewals and maintenance volumes set out in the individual Route Plans [SBPT 210-219] and summarised in the Data Book [SBPT 3338] are interim forecasts.

Review and Continuous Improvement

6.3.29 For a number of asset groups, new ways of working or techniques are proposed. This is welcomed, however we have seen little evidence of a structured continuous improvement approach which will monitor the effectiveness of any 'new approach', review and evaluate, then take appropriate corrective action during implementation.

[21] Operating Route Asset Management Summary East Midlands Route- 6_Operating Route AMP template draft Feb 2012
[22] Mandate AO/019 Asset Policy, Stewardship and Management of Structures – Independent Review and Assurance of Network Rail Buildings & Civil's Transformation Programme

Embedded Efficiencies

6.3.30 In our IIP Review we identified that it would be useful if the various scope (volume) efficiencies arising from the change from CP4 to CP5 policies were explicitly documented for each asset group to assist with an assessment as to the robustness of the NR assumptions.

6.3.31 We understand that no 'embedded efficiencies' have been identified associated with the Track, Structures, Earthworks, Off Track, Drainage and Fleet Policies.

6.3.32 In respect of the Buildings asset, very limited documentation of the claimed 5% renewals embedded efficiency has been received. This is discussed in Section 10.

Uncertainty Analysis

6.3.33 The overall uncertainty analysis for renewals expenditure [SBPT3297] states that:

'Civils contributes the most [to CP5 renewals expenditure uncertainty], primarily due to uncertainties about earthworks and civils-other expenditure.'

With the civils assets, there are a number of reasons for this increased level of uncertainty:

- *The policies are brand new and untested. The models supporting the policies will take time to validate against future observations, as there are no known comparable models within other rail organisations to perform validation against.*
- *The forecasting models are very sensitive to degradation information, the availability of which over the whole life cycle of the assets is limited, due to a typical asset life of 150 years.*

The first two issues above are exacerbated by the inherent complexity of the models, which is required by the varied nature of the asset base."

6.3.34 We would agree that there are uncertainties associated with the 'earthworks' and 'civils-other' (which we assume refers to 'Other Assets', e.g. footbridges culverts etc. plus 'Structures other') expenditures. However, we are surprised that these items are the 'primary' uncertainties. This requires further review. In the meanwhile we have very low confidence in the overall uncertainty analysis as presented. This is discussed further in Appendix C.

7 Track

7.1 General

7.1.1 We have reviewed the Track Asset Group at Level 3 of the NR Cost Breakdown Structure in the Tier 0 Data Book [SBPT3038] namely:

- Level 2: Track
  - Level 3:
    - Maintenance
      - Direct
      - NDS Delivery
      - Off track
      - Indirect
      - Other
    - Renewal
      - Plain Line Renewal (Conventional Plain Line)
      - High Output Renewal
      - Plain Line Refurbishment
      - S&C Renewal
      - S&C Refurbishment
      - Track Non Volume
      - Off Track – (see Section 12)

7.1.2 The relative split of CP5 'pre-efficient' expenditure is shown in Figure 7-1.

Track					
Asset Type	**CP4**	**CP5 Pre-Efficient SBP**	**CP5 Post-Efficient SBP**	**Variation CP4-CP5 Post-Eff**	**% var**
Conventional plain line renewal	£1,804m	£1,269m	£1,180m	-£624m	-35%
High output renewal	£720m	£594m	£550m	-£170m	-24%
Plain line refurbishment	£63m	£144m	£137m	£74m	+118%
S&C renewal	£863m	£801m	£734m	-£129m	-15%
S&C refurbishment	£34m	£203m	£210m	£176m	+516%
Track non-volume	£182m	£563m	£266m	£84m	+46%
Off track	£96m	£380m	£354m	£258m	+269%
Total Renewals Costs	**£3,762m**	**£3,954m**	**£3,431m**	**-£331m**	**-9%**
Maintenance	*£2,317m*	*£2,185m*	*£1,969m*	-£348m	-15%
Total Renewals + Maintenance	**£6,079m**	**£6,139m**	**£5,400m**	**-£679m**	**-11%**

Figure 7-1a: Track Asset Renewals and Maintenance Summary

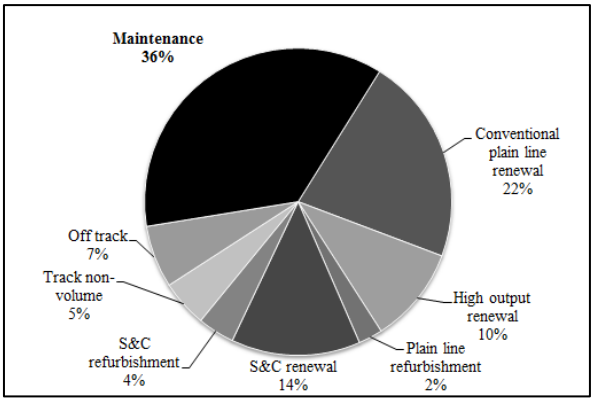


Figure 7-1b: Track Expenditure CP4 –CP5

Asset Description

7.1.3 The track asset system is split between plain line (PL) and switches and crossings (S&C) and then broken down into the following asset type/components (as shown on Figure 7-2):

- Rail;
- Sleepers/bearers;
- Fastenings/Pads;
- Ballast;
- Formation; and
- Drainage.

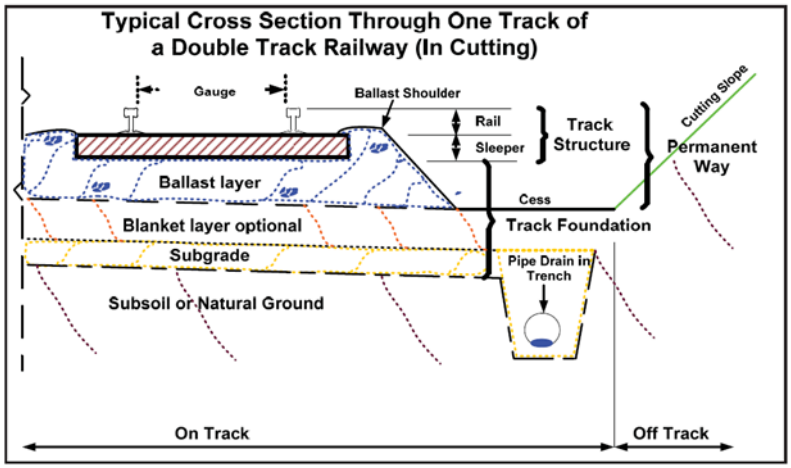


Figure 7-2: Cross Section of the Track System [SBPT3010, Figure 1.3]

7.1.4 The principal interface for track is the rail vehicle. As stated in the Policy, track also interfaces with other infrastructure assets, including signalling, electrification, plant, civil engineering and off track [SBPT3010].

7.1.5 The NR track engineering standards define seven categories of track as a function of speed and tonnage. Dynamic forces on the track are related to the speed and tonnage imposed from all traffic forecast for CP5, travelling over a particular section of the route at the time when a total renewal is to take place or a new line is to be constructed. The track construction standard specifies different types of track system (rail section, sleeper type and ballast depth) appropriate to withstand those forces. The track categories are broadly aligned with the five criticality bands as shown in the Policy [SBPT3010, Section 4.4.3].

7.1.6 NR have divided their network into ten Routes, and within each Route, Strategic Route Sections (SRS) have been created.

7.1.7 The SRSs are discrete sections of the network having largely consistent traffic levels and infrastructure type throughout their length. For the 305 SRSs, NR have analysed historical data for the last five years for track failures causing train delays. This historical data has then been linked to the Schedule 8 payments incurred to produce a ranking of Route Criticality. Based on this a ranking, the mean delay cost per incident has been derived from which NR have defined five separate bands of Route Criticality.

7.1.8 There are several different PL and S&C track system designs in use, each with different whole system and component asset lives. NR have a good

understanding of track asset characteristics and has access to reliable historical data for track performance. This knowledge further informs the key degradation mechanisms and failure modes used in their modelling work.

7.1.9 The data used to inform the Policy for track is largely drawn from records held in GEOGIS (for inventory and condition) and Ellipse (for activity planning). Other sources include rail defects from the Rail Defect Management System (RDMS), fault records, TRUST and geometry recording data from a track quality database of all 220-yard (200m) SD measurements obtained from the track recording cars. It is recognised that there are some areas with less robust age and condition data. These include ballast, formation, drainage and some S&C components.

7.2 Asset Performance and Targets

Historic Performance

7.2.1 NR state in their Track Asset Policy [SBPT3010] that their baseline objective for CP5 is to *"maintain the end of CP4 condition"*, thereby continuing to achieve the key track asset performance indicators as defined in the Asset Stewardship Indices.

7.2.2 Track Asset Performance is a measure of the impact that track has on the Public Performance Measure (PPM). The NR Asset Stewardship Index measures the following track KPIs:

- Broken rails;
- Rail defects;
- Track geometry quality;
- Temporary speed restrictions; and
- Track geometry faults.

7.2.3 We agree that these measures are appropriate, but consider that breaking down the measures by Route Criticality would be of benefit. It is not fully understood how devolution will affect management of track, and it may be appropriate for measures to be also reported at a Route level (if not already planned).

7.2.4 Figure 7-3 below, from the Policy shows delay minutes due to track faults. For track related TSRs and Point Failures it shows an improving trend.

7.2.5 However in 2011/12, delay minutes associated with broken rails and track faults rose; NR state that there were fewer faults causing delay, but delays were longer. No details of the cause of this (e.g. more serious faults) have been submitted in the SBP, and we understand that ORR is discussing this with NR.

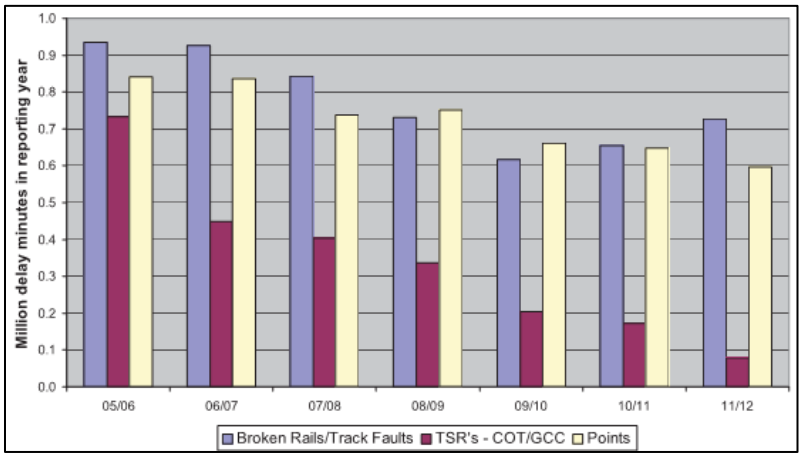


Figure 7-3: Delay Minutes Due to Track Faults [SBPT3010, Figure 2.21]

7.2.6 In the three years 2009/10 to 2011/12 track geometry quality deteriorated, as shown in Figure 7-4, below. NR have implemented a positive action plan in order to achieve their end of CP4 performance targets. These actions include increased tamping and stoneblowing shifts and the establishment of Route Track Geometry Engineers. As a result, Routes have generally reported a reversal in this negative track quality trend.

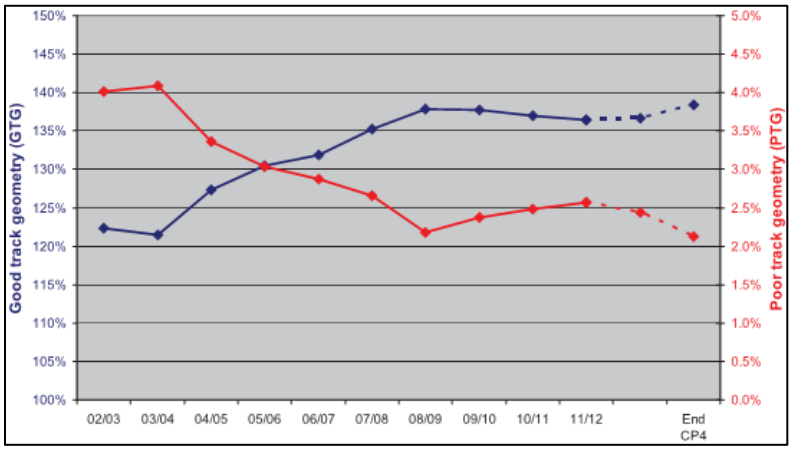


Figure 7-4: Good and Poor Track Geometry: Recent History and Targets [SBPT3010, Figure 2.15]

7.2.7 After a prolonged and significant reduction in the number of actionable geometry defects from 2002/3 to 2008/9 there was a slight reversal in this trend in the first 3 years of CP4, as shown in Figure 7-4. A detailed explanation is given in Section 2.6.1 of the Track Asset Policy. The latest figures are for 2011/12, after which NR expects improvements to be made to meet the end CP4 targets.

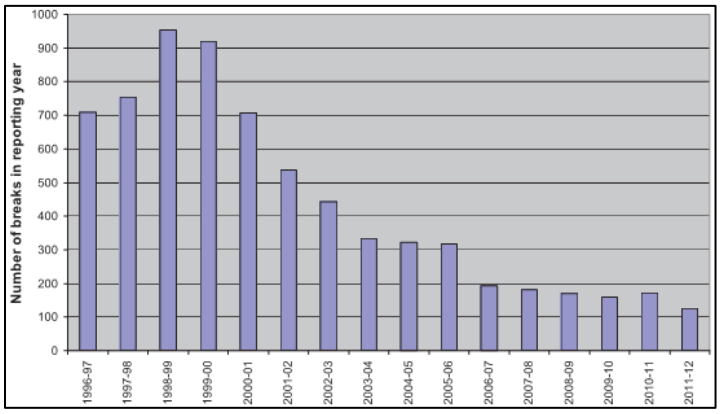


Figure 7-5: Rail Breaks from 1995/96 - 2011/12 [SBPT3010, Figure 2.17]

7.2.8 Figure 5.6 from the Track Policy shows the significant reduction in broken rails that has been achieved since 1998/99. It has been reported, and evidenced at Route meetings, that the 2012/13 broken rail target will not be achieved; however the increase in occurrences is small in comparison to the overall improvement in the last decade.

7.2.9 Overall there has been a significant improvement in track performance (e.g. reduction in rail breaks) over the past decade. We note the slight increase in rail breaks in 2010/11 (Figure 7-5) and understand that ORR is discussing more generally with NR.

Targets

7.2.10 In order to achieve the PPM and improve safety a set of specific output requirements for track thorough CP5 have been defined by NR, these are:

- Maintain the targeted end-CP4 overall track condition through CP5, improving the high criticality / high traffic routes;
- Maintain the targeted end-CP4 number of service affecting failures, averaged over CP5;
- Maintain the targeted end-CP4 train delays and costs, consistent with a 92.5% PPM target; and
- Improve the condition of S&C geometry and switch gauge.

7.2.11 The aim is further defined in the Track Asset Policy [SBPY3010, Chapter 9 page 249] as:

"The above objectives are to be achieved within the context of route criticality. Higher criticality routes are targeted to be in better condition, with associated better reliability, than lower criticality routes, because there is less access for maintenance (due to much higher traffic densities, sometimes for 24 hours a day), and the cost of each track failure is much higher (a factor of more than 8 between Band 1 and Band 5 routes).

Therefore, the aim in CP5, carrying on the policy in CP4, is to improve the condition of routes in Criticality Bands 1 and 2 and maintain the condition in the other Bands to a level that does not degrade overall performance.

In effect, this means that track in the higher bands is more likely to be renewed, while lower criticality track will be more likely to be refurbished in order to prolong its life. As will be seen later, the result in terms of overall performance (i.e. failure

rates) is similar in each criticality band, because the expected traffic increases in Bands 1 and 2 offset the considerable improvements in track condition."

7.3 Asset Policy

7.3.1 In developing their CP5 Asset Policy, NR have built on work done in 2010 when they introduced a revised CP4 Policy based on the development of track criticality. This is an understanding of the recorded or potential impact a section of track has on delivering safety, train performance and expenditure for maintenance and renewal. The sections of track are defined as SRSs of which there are 305 across the network.

7.3.2 The SRSs have been allocated into five criticality bands and a specific track policy has been defined for each band.

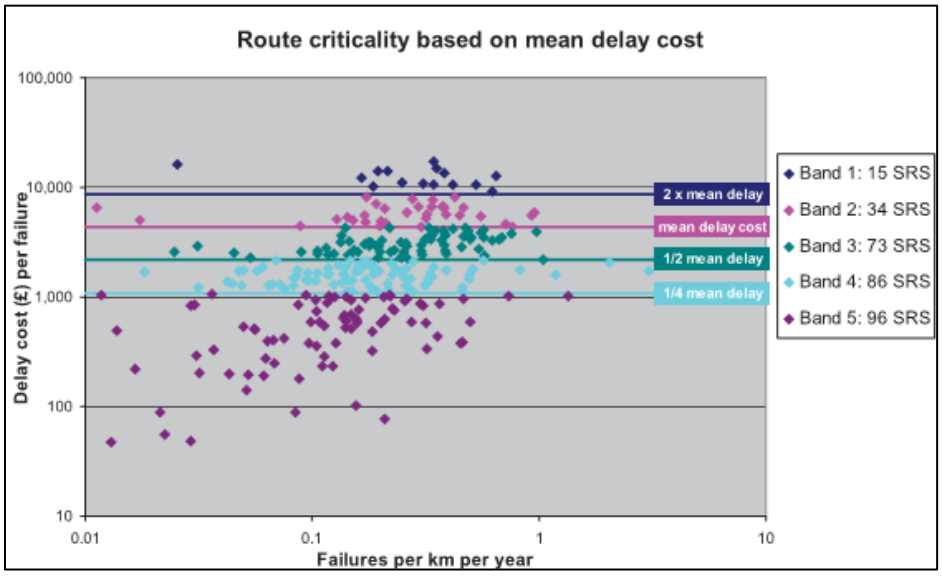


Figure 7-6: Route Criticality Based on Mean Delay Cost [Track Asset Policy Figure 4.2]

7.3.3 A key aspect of the Policy is to maximise the life of track components. It had been the practice to renew track as a complete system when one component, say ballast, had become life expired. This new policy challenges that practice by asking the question "can we extend the useful remaining life in rails and sleepers if we only renew the ballast?"

7.3.4 In order to test the principle of "refurbishment" NR developed a Tier 2 track model with the benefit of good component degradation data and tested 100 examples of PL and S&C across the criticality bands.

7.3.5 The results, which replicated in model form the 100 year life of track and compared total renewal with renewal and heavy refurbishment (ballast renewal), demonstrated that the Policy would deliver a lower WLCC through the selection of component renewal rather than total renewal at a renewal intervention point.

7.3.6 In summary, the Policy promotes the highest specification of both PL and S&C for track in the top criticality band, and gradually introduces heavy refurbishment and medium refurbishment of track in the descending criticality bands down to the lowest criticality band where continued maintenance may be the acceptable policy.

7.3.7 The Policy implies that the quality of the track on Route Criticality 4 & 5 may decline. This use of the remaining asset life of lower criticality bands of track is not unreasonable provided that safety performance is managed.

7.3.8 NR have identified the following high risks and uncertainties in the policy:

- Increased staff competency levels are required to deliver track refurbishment;
- The use of new asset information systems (ORBIS); and
- Sufficient resources to deliver refurbishment.

7.3.9 We agree that these items represent high risks to the delivery of the plan. In particular we believe that there is a requirement to develop the skills and expertise of track at all levels.

Robustness

7.3.10 We consider that it is very likely that the Track Policy will be robust as it has demonstrated a good knowledge of the asset, its current condition and degradation rates, the impact of traffic forecast for CP5 together with a programme of maintenance and renewals that is very likely to deliver the same track performance and safety levels that will be in place at the end of CP4.

7.3.11 We are satisfied that there is a linkage between the HLOS targets and the policy objectives and consider it very likely that their attainment will meet the contribution required from track to achieve the HLOS output requirements.

Sustainability

7.3.12 We consider the network volumes of track maintenance and renewals in the SBP to be those necessary to deliver the stated track performance outputs in the Policy. Deliverability and quality of renewals, particularly S&C heavy refurbishment, are the biggest challenges. However we believe that there are action plans in place to address the majority of issues.

7.3.13 Anticipated asset life extension from heavy refurbishment of S&C and plain line, on lower criticality routes, may be optimistic as a result of our analysis of the WLCC modelling outputs.

7.3.14 We consider that it is reasonably likely that the Policy will be sustainable. There is some uncertainty associated with the asset life extension from heavy refurbishment of S&C and PL on lower criticality routes, which we believe may be optimistic.

Whole System Cost

7.3.15 For a minimum whole system cost maintenance and renewal of track should ensure that the ballast and formation is adequately drained. This is acknowledged in the Track Policy and in the creation of a drainage policy for CP5. We support these developments.

7.3.16 Work on delivering and assuring a uniform track formation stiffness may be critical to achieving this measure when track is renewed. We do not consider sufficient importance has been given to track formation in their asset policies.

7.3.17 We consider that there is some uncertainty as to whether the Track Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets. This uncertainty primarily arises from concerns over the ability of NR to deliver the required quality and durability of renewal and refurbishment work.

7.4 Policy Application

7.4.1 Application of the Policy is through the production of Route Plans. This commences with the Head of Asset Management Track (HAM (T)) sending to each Route Asset Manager Track (RAM (T)) the Tier 1 modelled volumes and costs for their route for both the maintenance and renewal of track.

7.4.2 Route plans are drawn up based on local asset knowledge and the track problem statements from Track Maintenance Engineers. These are reviewed by the RAM who, by making reference to the track policy, enhances the initial plans. Engineers in the RAM's team conduct site inspections and meet with maintenance staff. In some cases detailed consecutive 200 metre long track asset condition diagrams are produced to develop detailed SRS plans for the whole control period.

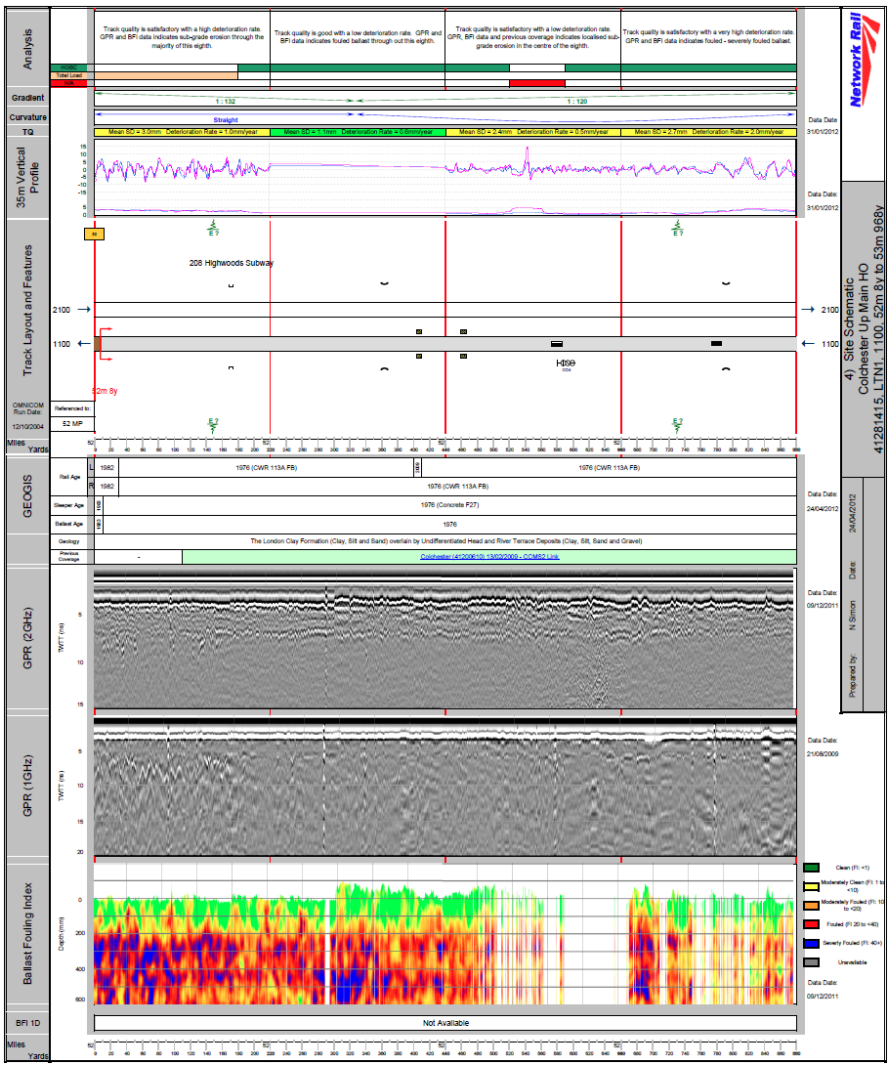


Fig. 7-7 An example of a track asset condition diagram for four 200m sections of track

7.4.3 Bottom up Route track plans for CP5 were finalised, unit rates adjusted for local conditions, and these were submitted to HQ for review.

7.4.4 The next stage in the planning process was for the bottom up volumes proposed by the routes to be reviewed by the HAM. This became a peer review process on each Route involving the HAM, Professional Head of Track and a RAM from another Route. The review of the Route's track M&R plan involved undertaking site inspections and reviewing instances where the Route proposed to carry out work at variance to the policy.

7.4.5 These agreed SBP volumes for Routes were re-run in the Tier 1 model in order to confirm that the required track performance outputs would be met, including used asset lives for the track system components.

7.4.6 We observed acceptance from the Routes to the overall process, including the peer review. The Routes were also satisfied that the final volumes they have put forward have been accepted by the HAM (T).

Activities and Volumes

7.4.7 The physical activities and works which will be carried out during CP5 can be categorised as inspection and examination, maintenance, refurbishment and renewal.

7.4.8 VTISM (Vehicle Track Interaction Strategic Model) is a rail industry-accepted software package that models wear and tear on track over time and estimates the required future maintenance and renewal work for the track. It consists of four sub-models, which are all separate software packages. Given the size and complexity of the models, NR run the sub-models separately as individual programs, rather than through the VTISM interface. The model includes seventeen track renewal / maintenance activities.

7.4.9 The policy generates inputs in the form of engineering rules which are then used in VTISM. These are essentially a set of criteria for when certain types of work should take place.

7.4.10 T-SPA allows S&C to deteriorate up to 60% worse than PL before an intervention. Whilst this seems to be at odds to the stated policy of improving the reliability of S&C, we consider that this is a reflection of current track condition and should not inhibit the improvements NR seek in overall S&C geometry in CP5.

7.4.11 The final outputs from VTISM are input into the Tier 1 Track Renewals and Maintenance spreadsheet which aggregates all the work volumes and applies the unit costs to arrive at final Track costs.

7.4.12 NR have modelled in VTISM the work volumes estimated by the Route Asset Managers to see what impact they would have on track quality. Results of this analysis were then fed back to the Routes and they adjusted their bottom-up work volume forecasts, where necessary, so that the modelled track quality, predicted by VTISM, would be of an appropriate standard as a result of their interventions. The aggregate 'bottom-up' work volumes (from the routes) and 'top-down' work volumes are therefore broadly consistent.

7.4.13 It is encouraging to see that NR have reviewed some of the uncertainties and risks associated with the Tier 1 Track Model. We note that it does not include potential variation on unit costs, which have a significant effect on

the uncertainty on the refurbishment/renewal work balance and therefore the associated costs.

7.4.14 It is unclear to date how this uncertainty analysis has been translated into Tier 0 volumes and we note that the level of uncertainty reported by NR appears to be lower than we would envisage based on the volume of work and overall budget requested.

7.4.15 Although there are shortcomings in asset data, particularly from GEOGIS, we are satisfied that NR have used best available current knowledge. NR are currently in the process of improving asset data collection, storage and presentation as part of the ORBIS project, the LADS system being a tool particularly applicable to track.

7.4.16 Once the current work to improve the understanding of the network's ballast/formation condition using High Definition Ground Penetrating Radar (HD GPR) is suitably advanced, the ballast deterioration models can be re-configured to use measured condition rather than just installation date. The HD GPR data has been seen to be being used by some Routes to identify underlying formation and ballast condition and hence been used to formulate remedial treatments.

7.4.17 The ICM Tier 1 Track Model is used to calculate renewal and heavy maintenance costs derived from volumes imported from VTISM, and to use VTISM track asset volumes to forecast non-heavy maintenance. The model also receives and stores VTISM track condition outputs, as well as non-volume and off – track renewal expenditure forecasts derived offline.

7.4.18 The track renewal and heavy maintenance volumes are the main inputs to the model and are taken from the outputs from VTISM:

- The inputs within the 100_I_VTISMInventoryOutputs tab have been checked against the outputs from VTISM (300 SRS Maintenance FROM HLOS results) and found to match directly.
- Similarly the 200_I_VTISMHeavyMaintVolumes and 400_I_RenewalVols match directly.

7.4.19 Renewal volume items are provided for PL and S&C in CP5 [E129-E149], as follows:

Table 7-1 Track Renewal Volumes

RENEWAL VOLUMES		CP5	CP6	CP7	CP8	CP9	CP10	CP11
Conventional plain line								
Heavy refurbishment (concrete, MO)	km	926	1,159	974	984	1,086	1,162	1,167
Rail renewal	km	1,294	1,047	1,160	1,182	1,191	1,191	1,191
Single rail	km	180	197	218	222	224	224	224
Steel relay	km	70	0	0	0	0	1	2
Complete Trax	km	1,001	1,016	880	892	950	960	884
High output								
High output (ABC)	km	915	639	644	577	623	632	543
Heavy refurbishment (concrete, HO)	km	171	673	658	611	670	685	668

RENEWAL VOLUMES		CP5	CP6	CP7	CP8	CP9	CP10	CP11
High output (rail sleeper relay)	km	757	639	644	577	623	632	543
Plan line refurbishment								
Heavy refurbishment (other)	km	189	107	107	107	107	107	107
Medium refurbishment (concrete)	km	1,054	1,014	1,032	1,051	1,061	1,061	1,061
Medium refurbishment (other)	km	898	512	520	529	533	533	533
S&C								
Abandon	S&C units	399	350	330	319	324	319	319
Full renewal	S&C units	1,510	1,415	1,353	1,301	1,324	1,407	1,386
Heavy refurbishment	S&C units	1,841	1,978	1,861	1,810	1,827	1,815	1,810
Medium refurbishment	S&C units	2,130	2,372	2,360	2,336	2,368	2,367	2,304

7.4.20 We have low uncertainty that the proposed SBP track renewal and refurbishment volumes will deliver the stated performance targets for the end of CP5.

7.4.21 We note that NR have not provided comparative values for CP4.

Costs

7.4.22 A number of issues were identified in the derivation of track and S&C unit costs during progressive assurance. These items are presently under review and will be updated in the final report for Mandate 34. However, the basis of the unit costs is clear and supporting data has been provided by Network Rail. Unitised cost coverage for track assets is high and provides a reliable basis for the calculation of renewals interventions.

Renewal Costs

7.4.23 The Table below sets out the breakdown of renewal costs.

Table 7-2 Track Renewal Costs

RENEWAL COSTS (£m)	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
Track	**3,762**	**3,954**	**3,276**	**3,114**	**3,041**	**3,170**	**3,247**	**3,118**
Conventional plain line renewal ["Plain line" in DBk]	1,804	1,269	1,226	1,105	1,120	1,191	1,216	1,169
High output renewal	720	594	596	596	539	582	593	524
Plain line refurbishment ["Refurbishment" in DBk]	63	144	93	94	96	96	96	96
S&C renewal	863	801	747	714	686	697	740	729
S&C refurbishment	34	203	226	217	213	215	214	212
Track non-volume	182	563	150	150	150	150	150	150
Off track	96	380	238	238	238	238	238	238

7.4.24 Track Renewals forecasts comprise a high proportion of unitised costs. In our discussions with NR and following provision of further data, NR have

fully reconciled the plain line, refurbishment and S&C costs presented in the SBP to a series of centrally derived unit costs. These items, comprise £2.81bn of the £3.38bn projected spend for England, Scotland and Wales.

7.4.25 An important area of best practice was considered to be the derivation of optimised track gangs to test the unit costs developed.

7.4.26 Our key findings relating to the quality of Track unit cost processes include:

- Work mix assumptions for unit cost estimation (CP4 2012/13) must be proven to align with policy assumptions for CP5;
- Further justification is needed of S&C cost increases (6.4-7.5%) in deriving the CP4 exit rate position;
- Outstanding action by Network Rail to clarify the inclusion of IMT contingency of 1.5% in unit cost estimates ;
- Clarification of unit cost performance at CP4 exit is required.
- Regulatory Accounts review indicates these costs are increasing despite a greater volume of work being undertaken to the end of the control period.

7.4.27 Based on the above findings, we consider that NR's approach to the production of unitised and non-unitised costs and their application has a low uncertainty in the derivation of costs.

7.4.28 Off track costs are described in section 12.4 of this report. We have not reviewed Track non-volume costs in detail. From the Tier 0 model, they include components, engineering improvement schemes, long timbers, S&C system improvements, level crossings and slab renewal. We note that they also include 'Other' costs of £341m during CP5 which then fall to £16m in following control periods and we are uncertain what these represent.

Maintenance Costs

7.4.29 Maintenance Unit Costs (MUCs) have been used by NR in establishing a pre-efficient baseline with the routes. The routes then use a resource based approach to establish their SBP submissions before applying any efficiency initiatives. We have compared the modelled rates with the latest MUCs and found strong correlation, however we have not reviewed the derivation of these MUCs.

Delivery

7.4.30 Plans for the delivery of track volumes are summarised for the five principal types of work as follows:

- Delivery of plain line renewals will be made by High Output equipment and conventional means. There is a reduced volume in CP5 as a consequence of the new policy driving mid-life ballast replacement. We do not believe that the full scope of formation renewal is known. This may result in the need for a transfer of funds or the deferral of necessary work.
- The heavy refurbishment of plain line is to be delivered by cleaning and replenishing the ballast. This will be done with either High Output machines or the two Medium Output machines. NR have declared that 62km of work cannot be resourced at the present time. This slight risk may be compounded by a lack of contingency in the delivery plan. NR expects to resolve this by improving the utilisation of High Output machines during CP5.

- The total renewal of S&C units is a slightly lower volume in CP5 and will be delivered in a similar way to the current control period, with a mix of traditional weekend possessions and shorter mid-week possessions using modular techniques.
- The largest challenge for NR in track volume delivery is the heavy refurbishment programme for S&C. This is a new work specification to be executed by new equipment yet to be procured. It also requires new skills and delivery techniques to be designed and learned. We therefore see this element of the track delivery programme to have a high risk..
- Maintenance delivery is focussed around new techniques for track inspection using train borne technologies that have only recently been developed. We consider this to be the right approach; however, there may be delays in achieving full implementation, which is key to delivery of the forecast efficiencies in the plan.

7.4.31 We believe that the 50% increase in asset life for S&C Heavy Refurbishment to be a challenging target. The industry does not have a proven track record in this area. NR see the shortage of skills and experience as a risk.

7.4.32 We believe there are the key concerns with the delivery plan for S&C heavy refurbishment:

- The need to procure specialist novel plant to undertake re-ballasting. We have been assured that an action plan is in place. NR have twelve months to determine the solution and two years to procure equipment to achieve the backend loaded programme.
- The skills and competency to deliver the work to a high standard and achieve the desired life extension.
- The adequate and timely compaction of ballast and subsequent management of TSRs following re-ballasting.

We have not been provided with satisfactory information by NR to confirm that there are sufficient S&C tampers, of the right type, to meet the policy aspirations of tandem tamping for maintenance, renewals and enhancements in the UK.

7.4.33 There is also some uncertainty regarding the volume of maintenance activity that NR are proposing for CP5. No maintenance volumes have been provided and there is little cost breakdown. However, it appears that overall pre-efficient maintenance costs are planned to reduce from £2.317Bn [D8] in CP4 to £2.185Bn [D9] in CP5. In our experience when a policy of increased refurbishment and reduced renewal is adopted, it is often associated with increased maintenance volumes. We have been advised that the principal maintenance efficiencies will come from the introduction of new inspection procedures and more accurate asset data gathering, we consider that proposed maintenance activities require further clarification from NR.

7.4.34 NR have identified the following high risks and uncertainties in the policy:

- Increased staff competency levels are required to deliver track refurbishment;
- The use of new asset information systems (ORBIS); and
- Sufficient resources to deliver refurbishment.

7.4.35 We agree that these represent high risks to the delivery of the plan. In particular we believe that there is a requirement to develop the skills and expertise of track at all levels.

7.5 Summary

7.5.1 The principles of the Track Asset Policy have been in existence since 2010 when NR introduced the revised CP4 Policy with a new track organisation. The CP5 SBP Policy further develops this work, in particular introducing the concept of WLCC decision making.

7.5.2 The overall aim of the Policy is to maintain the targeted end-CP4 overall track condition through CP5 whilst improving the high criticality / high traffic routes. The other main focus of the Policy is to improve the condition of S&C.

7.5.3 For each of the 305 Strategic Route Sections (SRS), NR have defined the criticality banding of track by linking the impact of track failure to the historic costs of delay measured by Schedule 8 payments. There is an indirect relationship between this measure and speed and tonnage – the most heavily trafficked routes are those most likely to result in high delay costs in the event of a failure. This is a significant and positive change to the Policy.

7.5.4 We believe that in general, the Routes have adopted and challenged the Policy. The Policy is generally considered to demonstrate a good understanding of the behaviour of the track system.

7.5.5 NR recognise that there are some areas with less robust age and condition data. These include ballast, formation, drainage and some S&C components. NR are planning significant asset data improvements to address these issues. This is a positive development and should enable further modelling improvements to be made, particularly related to ballast and formation condition and formation stiffness.

7.5.6 We consider NR's knowledge of rail and track geometry degradation to be good; NR acknowledge, and we concur, that S&C degradation is less well understood compared with plain line and they are taking action to address this. NR’s estimates of an effective increase in asset life for heavy refurbishment will only be realised if the underlying problems causing poor track geometry are understood.

7.5.7 The Track Tier 2 WLCC model indicates that by following the Track Asset Policy, the introduction of timely (and track category specific) heavy and medium track refurbishment, rather than total renewal, can provide a minimum WLCC for track asset management.

7.5.8 Based on our Route meetings, it appears that Route Plans take into account the new Track Asset Policy. Refurbishment of track is a more complex process and will require new techniques to be developed and new skills learned by NR staff and those in the supply chain. This appears to have been taken into account by the Routes in that they are generally planning the increased volumes of refurbishment work in the latter years of CP5.

7.5.9 The main challenge to the delivery of plain line heavy refurbishment in CP5 is the increased volume of ballast cleaning required.

7.5.10 The Policy, modelling and bottom up plans result in significantly increased (compared with CP4) volumes of S&C maintenance and heavy refurbishment, and the CP5 outputs are heavily reliant on achieving these at the anticipated cost. In our view this will require:

- The skills and competency to consistently deliver refurbished S&C to the required high standard of initial quality necessary to achieve the desired life extension (the expected reduction in mid-life maintenance interventions is highly dependent on this);
- Robust asset information systems to enable on-going management of the S&C geometry; and
- Adequate and timely compaction of ballast.

In addition we believe there are several other aspects to consider, namely:

- Procurement (where necessary) and operation of appropriate S&C tampers working in tandem;
- Procurement of innovative S&C re-ballasting plant.

7.5.11 There is also some uncertainty regarding the volume of maintenance activity that NR are proposing for CP5. No maintenance volumes have been provided and there is little cost breakdown. However, it appears that overall pre-efficient maintenance costs are planned to reduce from £2.317Bn [D8] in CP4 to £2.185Bn [D9] in CP5. In our experience, when a policy of increased refurbishment and reduce renewal is adopted, it is often associated with increased maintenance volumes. This aspect requires further clarification from NR.

Robustness

7.5.12 We consider that it is very likely that the Track Policy will be robust as it has demonstrated a good knowledge of the asset, its current condition and degradation rates, the impact of traffic forecast for CP5 together with a programme of maintenance and renewals that is very likely to deliver the same track performance and safety levels that will be in place at the end of CP4.

7.5.13 Deliverability and quality of renewals, particularly S&C heavy refurbishment, are the biggest challenges.

Sustainability

7.5.14 We consider that it is reasonably likely that the Policy will be sustainable. There is some uncertainty associated with the asset life extension from heavy refurbishment of S&C and plain line on lower criticality routes, which we believe may be optimistic.

Whole System Cost

7.5.15 We consider that there is some uncertainty as to whether the Track Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets. This uncertainty primarily arises from concerns over the ability of NR to deliver the required quality and durability of renewal and refurbishment work.

7.5.16 As noted in Section 5 above, we have prepared a ‘System Diagram’ for each ‘Sub-Asset’ (‘Level 3’) and ‘allocated’ an uncertainty ‘colour’ to each element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. The summary for Track is presented in Figures 7-8 to 7-12 below. Larger copies are included in Appendix D.

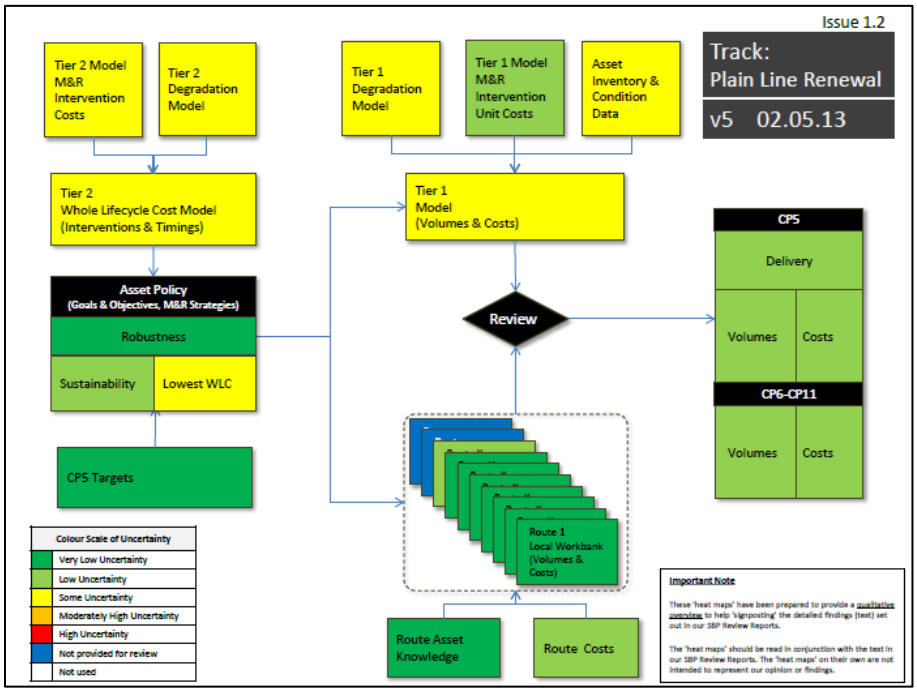


Figure 7-8 'System Diagram' for Plain Line Renewal

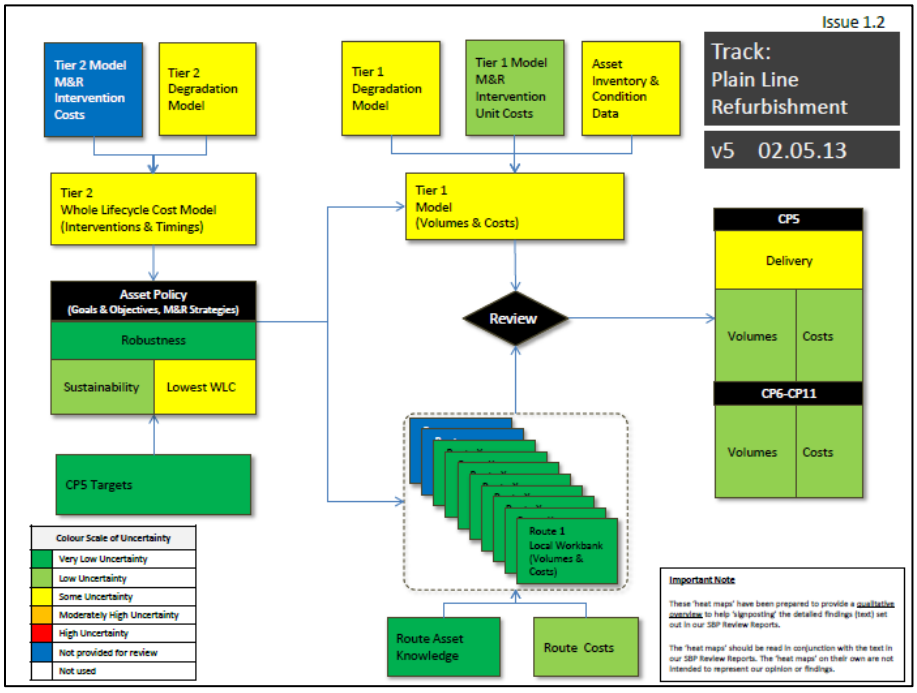


Figure 7-9 'System Diagram' for Plain Line Refurbishment

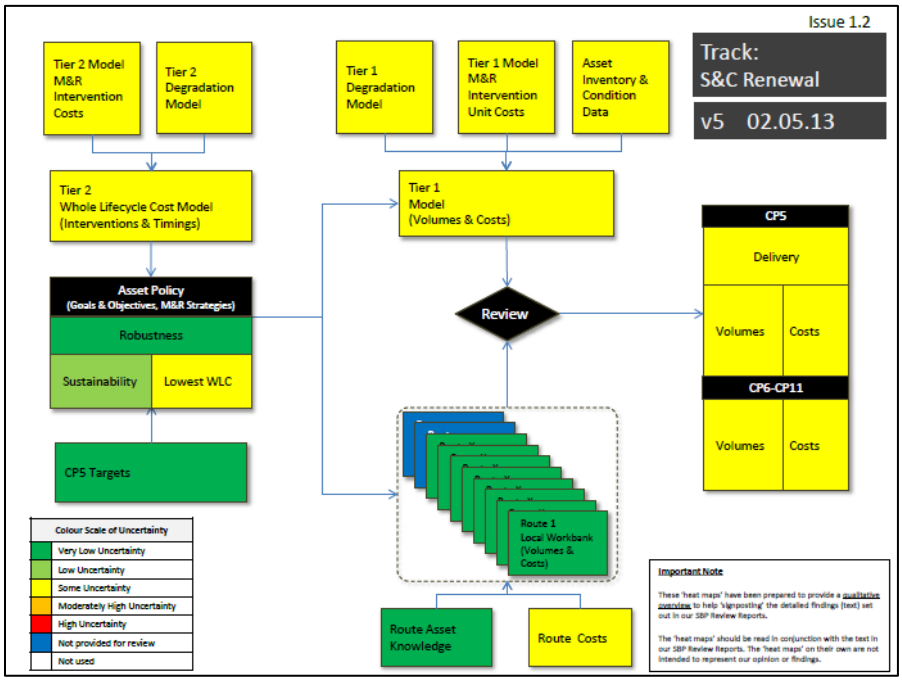


Figure 7-10 'System Diagram' for S&C Renewal

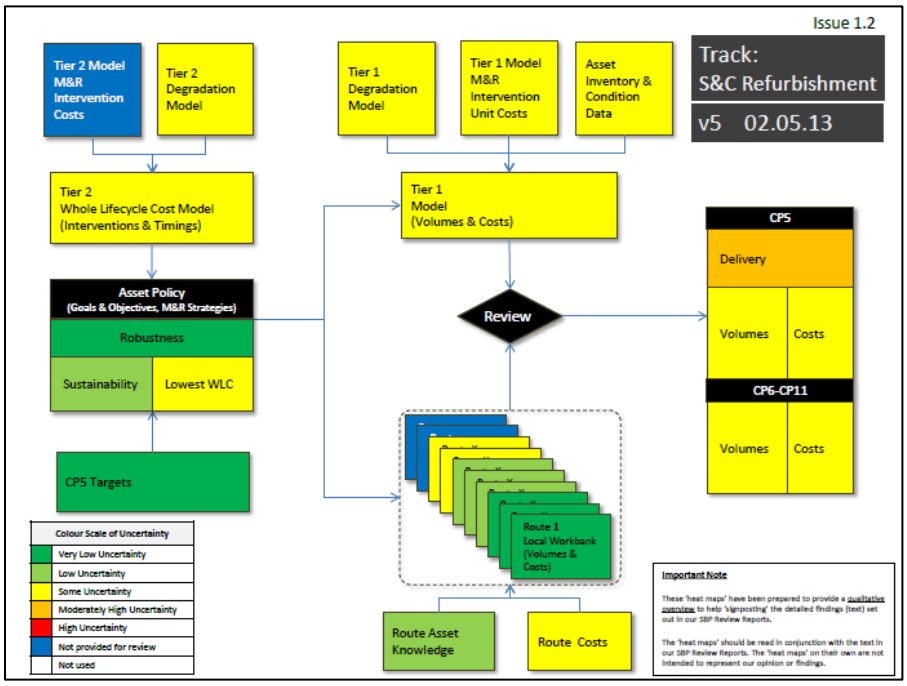


Figure 7-11 'System Diagram' for S&C Refurbishment

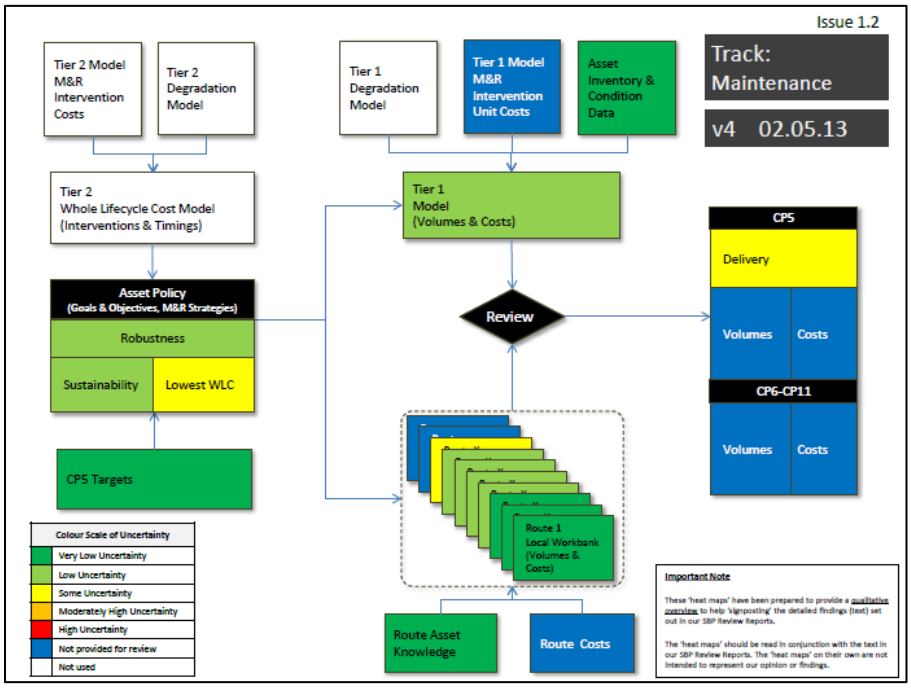


Figure 7-12 'System Diagram' for Maintenance

8 Structures

8.1 General

8.1.1 A summary of the structures asset inventory is presented in Table 8-1 below:

Table 8-1: Structures Asset Count Data [Ref.SBPT3013, Section 1.4]

Asset Type	Asset Count
Underline bridges	19,483
Overline bridges	9,337
Major Structures	34
Parent tunnels	617
Footbridges	1,353
Culverts	21,997
Retaining walls	20,812
Coastal, estuarine and river defences	559

8.1.2 We have reviewed the Civils Asset Group at Level 3 of the NR Cost Breakdown Structure in the Tier 0 Data Book [SBPT3038] namely:

- Level 2: - Civils
  - Level 3:
    - Underbridges
    - Overbridges
    - Bridgeguard 3
    - Major Structures
    - Tunnels
    - Other Assets
    - Structures Other
    - Earthworks (see Section 9)

8.1.3 The relative split of CP5 'pre-efficient' expenditure is shown in Figure 8-1 below.

Civil Structures					
Asset Type	**CP4** ***(Excluding Enh. Spend)***	**CP5 Pre-Efficient SBP**	**CP5 Post-Efficient SBP**	**Variation CP4-CP5 Post-Eff**	**% var**
Underbridges	£526m	£1,296m	£1,175m	£649m	+123%
Overbridges	£72m	£206m	£187m	£115m	+160%
Bridgeguard 3	£24m	£0m	£0m	-	-
Major structures	£182m	£102m	£93m	-£90m	-49%
Tunnels	£63m	£177m	£161m	£98m	+154%
Other assets	£80m	£272m	£247m	£168m	+210%
Structures other	£536m	£218m	£197m	-£339m	-63%
Earthworks	£460m	£633m	£583m	£123m	+27%
Total Renewals Costs	**£1,944m**	**£2,903m**	**£2,642m**	**£699m** *	**+36%**
Maintenance	*£217m*	*£419m*	*£408m*	£191m	+88%
Total Renewals + Maintenance	**£2,161m**	**£3,322m**	**£3,050m**	**£890m**	**+41%**

Figure 8-1a: Civils Asset Renewals and Maintenance Summary**

** Does not include the £24m for Bridgeguard 3 which will be completed in CP4*

*** Note – figures for 'maintenance' between CP4 and CP5 not compatible*

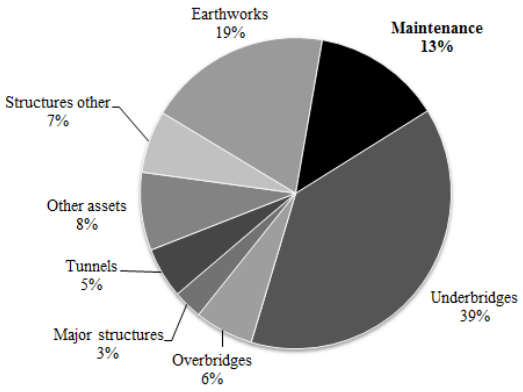


Figure 8-1b: **Civil Asset Renewals and Maintenance (CP5)**

8.1.4 For the structures asset the items classed as 'maintenance' relate to examination / assessments and these are understood to be included in the overall 'civils' 'maintenance' cost of £419m in CP5 and CP6. No cost breakdown is provided, and no totals for CP7-CP11.

8.1.5 In the following sections we summarise our findings for the Level 3 asset types as follows:

- Underbridges and overbridges (Section 8.2)
- Major Structures (Section 8.3)
- Tunnels (Section 8.4)
- Retaining walls, footbridges and culverts (other assets) (Section 8.5)
- Coastal estuarine and river defences (Section 8.6)
- 'Structures other' (Section 8.7)

Embedded Efficiency

8.1.6 NR have not assumed any Civils maintenance efficiencies ('embedded' or otherwise) associated with CEFA or other maintenance expenditure.

8.1.7 For the Civils asset no renewals 'embedded efficiency' has been assumed by NR. This reflects NR's view that although the Civils policies have been revised, '*the elevated level of uncertainty related to this asset makes it impossible at this time for us to assess any level of embedded efficiency that may result from the new asset policies.*' [SBPT220].

8.2 Underbridges and Overbridges (Bridges)

Asset Description

8.2.1 Bridges are a diverse group of assets. The main groupings are by type – underbridges and overbridges – and by material – metallic, masonry, and concrete.

8.2.2 Regular detailed examinations produce information about bridge condition, which is measured using the Bridge Condition Marking Index (BCMI); BCMI scores are derived at element, span and structure level for each

bridge. Scores are also recorded at a Principal Load Bearing Element (PLBE) level.

8.2.3 The Policy sets minimum condition PLBE thresholds for key elements of a structure. NR's analysis of their structures database shows about 9,666 (33%) of bridges contain elements below this minimum condition PLBE threshold.

8.2.4 As well as bridge condition the other key criteria is bridge 'capability'. Bridge capability is defined as the *'ability of the assets to bear load, pass gauge and allow line speed or available traction power'*. The required capability for each route is published in the National Sectional Appendix and is defined in NR's licence agreement.

8.2.5 Bridge assessments are undertaken to assess the capability of structures. For underline bridges there are nine assessed categories – see Figure 8-2 below.

Assessed category	Definition
A1,A2,A3	Overall factor of safety no less than 2.0. This is the desirable target for robustness of the structures.
A3, B, C	Overall factor of safety no less than 1.6. Time periods for intervention defined in the standard.
D,E,F	Overall factor of safety less than 1.6. These structures require interventions to raise capability to at least category C.

Figure 8-2: **Assessment Categories for Underline Bridges[SBPT3013 Table 2.1]**

8.2.6 NR's analysis indicates that they have 564 bridges that have been assessed as being sub-standard (assessed categories A3 to F), with 191 of those within categories D-F. NR note that a proportion has no assigned category and that a further 78 assets may also be in categories D-F.

8.2.7 NR note that there is a 'backlog' of approximately 12,000 assessments that need to be completed for under- and over-line bridges. We understand that these will be completed by end of CP4. We note that these assessments may identify further sub-standard bridges over and above the 564 already identified.

8.2.8 In relation to overbridges, Bridgeguard 3 is a government funded project to assess public road carrying bridges against a capacity of 40 tonne vehicle loading. This is in compliance with EU directive 96/53/EC.

8.2.9 Bridges within the Bridgeguard 3 remit are structurally assessed for ability to carry 40 tonne vehicles. Bridges that fall short of this capacity are checked for meeting NR's minimum liability for load capacity and where necessary, interim mitigation measures are provided. When strengthening or replacement is required, the costs are apportioned between NR and the highway authority to an agreed formula in accordance with respective liability. NR note that at 2010/2011 year end there were 741 bridges (2010/2011 year end) requiring strengthening to meet the requirements of Bridgeguard 3.

8.2.10 We understand that there is no funding allocated in CP5 for Bridgeguard 3, though there may be some 'carry-over' work caused primarily by delays in funding from the highway authority.

8.2.11 Bridges are the largest group of structures assets in terms of expenditure. NR's proposed CP5 expenditure for bridges is £1,502m, about 66% of the total Structures expenditure of £2,270m (Figure 8-1).

Asset Performance and Targets

Historic Performance

8.2.12 NR Structures Asset Policy [SBPT3013] provides details of safety events post 2000, by reference to NR Standard NR/L3/CIV/028 [Ref S1], which defines how safety related events are reported. The number of CIV/028 reports has increased sharply over the last12 months, from a quarterly average of about 3 to 12, shown in Figure 8-3 [SBPT3013, Fig 2.1].

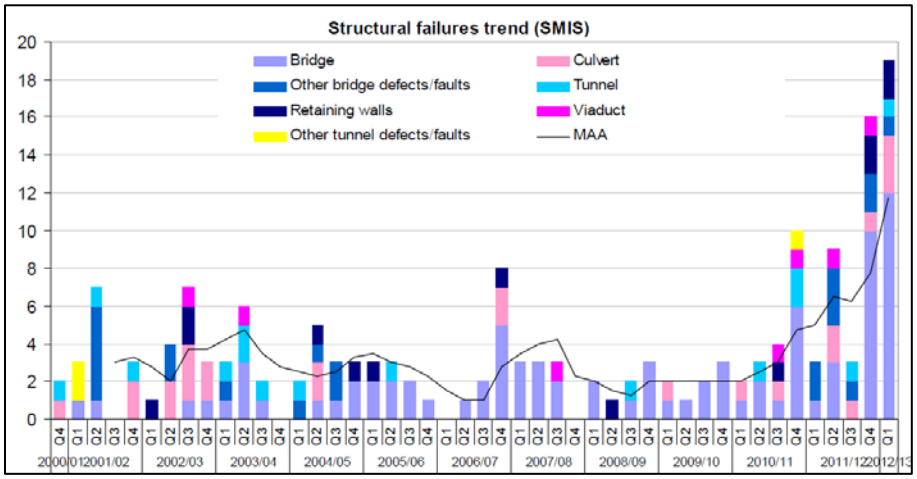


Figure 8-3: Structures Failures Trend 2000-2012

In addition, NR have listed twelve major structural failures which have occurred between 2009 and 2012 including Stewarton, Balcombe Tunnel and Enterkin Burn.

8.2.13 NR have reviewed this data and concluded that '*structures assets would likely fall within the Tolerable Region of risk' as defined in the HSE Tolerability of Risk Framework'*, as shown in Figure 8-4 below. Although this appears to be a partially subjective conclusion and NR have not provided any detailed analysis to support it, we consider it is a reasonable assessment of the current position at population level. We consider this conclusion is the main driver of the increased volume of work which is planned for bridges.

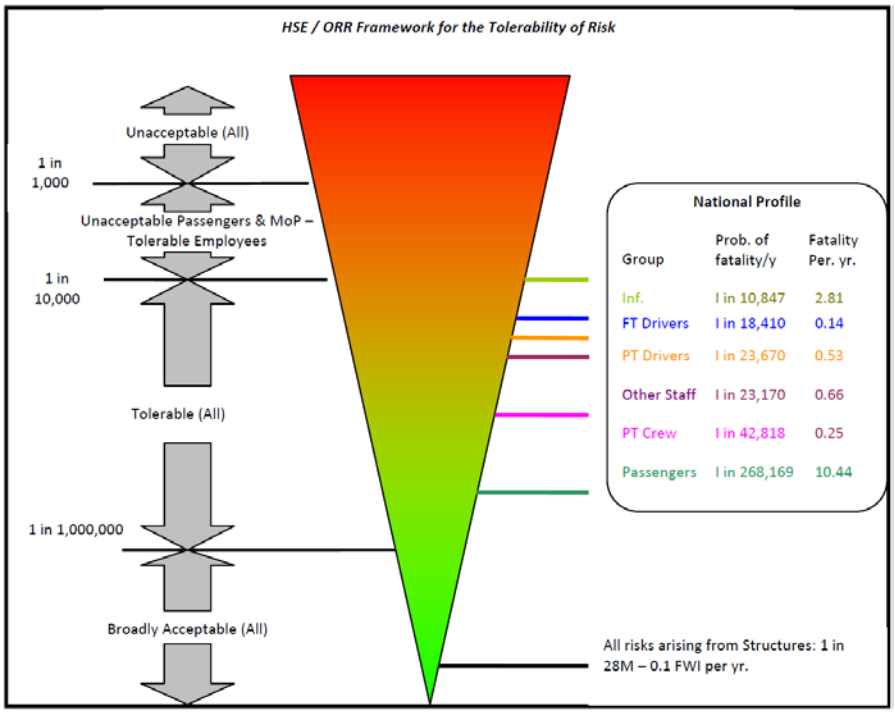


Figure 8-4: Overlay of Tolerable Risk and Structures SRM score

Targets

8.2.14 Asset Output Measures are defined by NR in SBPT232 '*Asset Output Measures Summary*'. These measures for 'robustness' and 'sustainability' are not referred to in the Structures Policy, and we consider that as written in SBPT232 these lack clear definition. We consider that the Policy should clearly and consistently define, justify and relate the targets to the objectives of the Policy for the principal asset sub-groups, for both CP5 and the longer term (CP6-CP11).

8.2.15 NR sets out Targets and Measures in paragraph 10.11 of SBPT3103. In total there are 19 targets (A-N) defined in the Policy.

8.2.16 Targets are identified for asset subgroup. For bridges, the Policy states:

*"**Target A**: To reduce the poor condition PLBE of under and overline bridges.*
The percentage remaining is an estimation of the elements that have a low BCMI score but do not pose a safety risk due to the location of the recorded defect. Targets for CP6 will be set once the asset data systems improve, allowing greater definition and refinement."

We consider that this target, whilst commendable in principle is a somewhat vague statement. Our discussions with Routes indicate that they are in agreement and are seeking further definition from the HAM.

Table 8-2: Bridge Measures

Material	Route Criticality	PLBE BCMI test	Target for end CP5 (% remaining)
Metallic	1,2	<40	<6%
Metallic	3-5	<40	<8%

Material	Route Criticality	PLBE BCMI test	Target for end CP5 (% remaining)
Concrete	1,2	<50	<2%
Concrete	3-5	<50	<2%
Masonry	1,2	<50	<7%
Masonry	3-5	<50	<8%

8.2.17 The introduction of defined attributes to measure is a positive step. However, we are unclear about several key aspects about how outcomes will be verified.

8.2.18 The values for concrete need further detail to reflect the different characteristics of reinforced, pre- and post-tensioned concrete structures, some of which appear to us to require (numerically) higher test levels. We note that the values are the same for all route criticalities because they represent what NR have termed as the *'basic safety limits'*, and which we in our report have referred to as *'minimum condition PLBE thresholds'*.

Policy

8.2.19 In our opinion, the Asset Policy is fundamentally sound, and is built on risk based principles. For underbridges and overbridges (bridges) it sets minimum condition PLBE thresholds for elements of a structure.

8.2.20 The minimum condition PLBE thresholds and interventions apply equally for all Route Criticalities for all sub-groups. Performance interventions, set at higher thresholds may vary according to route criticality. Routes have local flexibility in other cases. This is a balanced approach to the intervention philosophy, but it is overridden by the bridge measures criteria, which will dominate intervention requirements in CP5/6.

8.2.21 The focus for the CP5 bridges Policy is at element level in contrast to current policy which operates at structure level. It is to reduce the number of bridge elements in a condition which are below the target levels. We note that NR have permitted typically 6% of bridges to be 'below' the minimum condition PLBE thresholds. We are unclear as to the detailed rationale for this.

8.2.22 NR have concluded that the Policy should be implemented over two Control Periods on grounds of deliverability. As noted later, we are confused by this as we have seen no evidence of deliverability constraints.

8.2.23 In our opinion, the Policy should provide a clear statement of CP5 outputs – numbers and volumes – to deal with known and emerging sub-threshold PLBE issues, and other specific topics from the list of activities given in paragraph 10.2.2. of the Policy.

Robustness

8.2.24 We conclude that from an overall perspective that it is reasonably likely that the CP5 Policy for bridges is robust.

8.2.25 There is a clear linkage to asset outputs and is based on reasonable inventory and condition information and has an explicit risk based intervention approach.

8.2.26 Evaluation and prioritisation of the required interventions to comply with the Policy is incomplete and on-going work, primarily at Route level.

Sustainability

8.2.27 The Policy implies a step change improvement in overall bridge condition in CP5/6, which would then be sustained over future Control Periods. There is some uncertainty about the exact definitions of CP4 exit and the targets and measures for CP5, which relate directly to the sustainability of the policy for bridges. In addition, there is some uncertainty about the long term condition requirements.

Whole System Cost

8.2.28 NR have developed a Tier 2 WLCC model to identify long term lowest WLCC strategies for bridge interventions. This approach is good practice, however such tools are more helpful where the owner has a reasonably steady state bridge population which is in satisfactory condition, and are less applicable in NR's immediate position.

8.2.29 We have concerns about the unit costs used in the WLCC model. This relates to the relative costs between intervention options.

8.2.30 Cost uncertainty and other factors leads us to consider that there is low certainty that the most cost effective option is always suggested by the model.

8.2.31 Overall there is some uncertainty that the policies based on the modelling will deliver lowest whole lifecycle cost outputs.

Policy Application

8.2.32 We note that NR have permitted typically 6% of bridges to be 'below' the minimum condition PLBE thresholds at the end of CP5. We are unclear as to the detailed rationale for this. As noted above further explanation of the Policy targets is required.

8.2.33 For bridges, focusing the targets and measures on the area which has been identified as the first priority for CP5 provides a pragmatic 'line of sight' between interventions and asset risk, which is linked to performance (bridge condition, number of failures etc.) and network performance (derailments, delay minutes. Schedule 8 costs etc.). We are unclear about the practical implementation of the measure, including the CP4 exit condition.

8.2.34 NR's first priority for bridge activity is directed at elements in a condition below the minimum condition PLBE thresholds. We agree this is the correct approach. In addition to this work, NR have several programmes of work to address capability shortfalls, hidden critical elements etc. We are unclear about the degree of overlap and prioritisation between each of these criteria and also the major enhancement programmes planned for CP5.

8.2.35 On the basis of condition data that we have seen (central and Route level) we have little doubt that there is a substantial amount of repair and renewal work to be carried out, primarily on underbridges.

8.2.36 However, there is significant uncertainty about the makeup of this work. This relates to the fact that to apply the policy, NR asset engineers will have to evaluate each element below the minimum PLBE threshold to determine the type and scale of intervention required. If an intervention is required (as it may not be in some instances) the resulting work may range from 'light' plating work or 'heavier' deck replacement. This introduces a significant

cost uncertainty as well as volume uncertainty. The volume of each activity will only become clear once the work is better defined.

Activities and Volumes

8.2.37 The physical works which will be carried out will be a mix of replacements, renewals, and maintenance activities consistent with policy. NR is proposing a programme of planned preventative maintenance to generate condition improvements.

8.2.38 Renewal volume items are provided for underbridges and overbridges in CP5 [F59-F60], as shown in Table 8-3.

Table 8-3: Volumes of Work to Overbridges and Underbridges

Renewal Volumes		Control period totals		
		CP4	CP4 incl. enhanced spend	CP5
Structures				
Overbridges - major works	m^2	46,707	-	50,062
Underbridges - major works	m^2	384,766	-	774,337

8.2.39 We note that the increase in volume of work from the Enhanced Spend has not been provided. The significant increase in volume of underbridge work between CP4 and CP5 is apparent.

8.2.40 NR have developed a sophisticated modelling approach to derive their short-term and long-term intervention policy for structures, using CeCost. There are aspects of the modelling assumptions which give rise to some uncertainty. The CeCost model was found to have a generally reliable level of computational accuracy. CeCost model outputs have not been reviewed due to the late supply of information by NR.

8.2.41 There is significant uncertainty about the bridges input data used in the CeCost model and we are unclear about how the unit costs have been decided.

8.2.42 NR have derived the majority of their forecast CP5 and CP6-CP11 renewal volumes and costs for bridges on a 'top-down' basis using their CeCost Tier 1 Model. Work required to manage capability issues has generally been derived bottom-up by the Routes.

8.2.43 As noted above, due to late supply of information, we have not reviewed the derivation of CeCost outputs, however the predicted volumes for CP6-11 are between 661and 10,841 m^2 for overbridges and between 171,563 and 233,511 m^2 for overbridges. The volumes for underbridges seem to be very low (for a population of over 9,000 bridges).

Costs

8.2.44 Unit rates for underbridges and overbridges, footbridges, culverts and retaining walls have been derived by NR from historic data or actual cost information (from CAF and Monitor). Some external audit of these rates has been undertaken and rates are aligned with repeatable work types and

represent average costs for types of activity. The methodology and estimating assumptions used to develop unit rates has been reviewed under Mandate AO/034, which has identified and reported on a number of significant issues.

8.2.45 Cost data has been provided for the range of maintenance and renewal interventions used in the modelling; however, it is unclear whether the same principles (inclusion of inflation, efficiency etc.) apply to the modelled rates.

8.2.46 We have not been able to trace all costs used in the structures modelling back to the data presented in 'Structures Unit Rates and Assumptions' [SBPT3074]. Therefore, we have concerns as to the accuracy and reliability of the intervention costs used in the modelling.

Delivery

8.2.47 NR have concluded that the Policy should be implemented over two Control Periods on grounds of deliverability. We are unclear as to the justification for this and are concerned that it could potentially allow bridges below the '*minimum condition PLBE thresholds'* for up to another 10 years.

8.2.48 In terms of delivery, we note that NR's Deliverability Review [SBPT 3302] states for Building and Civils:

'The level of expenditure as set out above [£1.9Bn in CP5 for Structures and £3.6Bn for Building and Civils] is not significant within the context of the overall UK Building and Civil Engineering market size, where levels of expenditure are in excess of £10Bn per annum ..'

8.2.49 We would concur with this view and add that the work which NR plan to be carry out in CP5 is similar in overall work mix to the work has been traditionally carried out to maintain railway (and other) bridges.

8.3 Major Structures

Asset Description

8.3.1 The number of 'Major Structures' has been reduced from 283 at IIP stage to 34 for CP5. Historically the intent was that each Major Structure would have its own 'Asset Management Plan'. We are unclear how the 'retired' Major Structures will be managed.

8.3.2 The proposed expenditure on Major Structures in CP5 is reduced compared to CP4 (£102m c.f. £182m). NR's proposed CP5 expenditure for Major Structures is £102m, about 4% of the total Structures expenditure of £2,270m.

Asset Performance and Targets

8.3.3 NR have not proposed any asset performance Policy targets for Major Structures. This is a significant omission for assets which are vital for the performance of the rail network and creates a high level of uncertainty.

Policy

8.3.4 The Policy for Major Structures currently appears to be to prepare Asset Management Plans for each structure prior to the start of CP5. No Asset Management Plans were included with the SBP submission – this lack of

evidence makes us uncertain about the robustness of the Policy for Major Structures.

Sustainability

8.3.5 NR intends to apply a risk based approach policy for Major Structures. We are unclear how this will be applied and have concerns that NR may be prepared to allow the overall condition of Major Structures to deteriorate. We consider this would be a retrograde approach to assets which are vital to the long-term performance of the network. We are consequently uncertain about the sustainability of the Policy for Major Structures.

Whole System Cost

8.3.6 NR have not supplied any explicit WLCC analyses for Major Structures, hence no lifecycle options have been presented for these assets. It is therefore uncertain as to whether the Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

Policy Application

Activities and Volumes

8.3.7 NR have not provided any volume information for Major Structures.

Costs

8.3.8 NR have allowed for Major Structures costs of £102m for CP5 and for successive Control Periods through to CP11. According to SBPT0305 the costs have been derived bottom up; there is no further information provided in the document and no other documents have been provided. Accordingly we consider that the CP5 and CP6-CP11 volumes and costs are highly uncertain.

8.4 Tunnels

Asset Description

8.4.1 Tunnels are grouped according to construction – lined or unlined – and then according to construction material.

8.4.2 The proposed expenditure on tunnel renewals in CP5 is increased compared to CP4 (£177m c.f. £63m). NR's proposed CP5 expenditure for tunnels is £177m, about 8% of the total Structures expenditure of £2,270m (Figure 8-1).

Asset Performance and Targets

8.4.3 The key Policy target for tunnels is to reduce the number of poor condition sections over CP5; however, we are confused by this target in that according to the condition data for tunnels, this target has already been achieved by a significant margin.

8.4.4 The other tunnels Policy target is to complete the hidden shaft identification programme by 2020. Hidden shafts are a serious hazard for tunnels assets; we have not seen evidence to explain why a completion date of 2020 is considered to be acceptable. Therefore we are somewhat uncertain as to whether the targets proposed by NR for tunnels are reasonable.

Robustness

8.4.5 For tunnels, NR hold reasonable inventory and condition data. The Policy for tunnels interventions appears to be mainly condition based. We are unclear about the outputs which NR intend to deliver for tunnels, whether NR aim to maintain or improve tunnel condition and reduce risk over CP5. Accordingly there is some uncertainty about the robustness of the Tunnel Policy.

Sustainability

8.4.6 A pro-active approach to interventions over recent years has delivered assets in generally fair or good condition; we are uncertain if the Policy would continue to apply this approach for all route criticalities. For these reasons we consider there is some uncertainty about the sustainability of the Tunnel Policy.

Whole System Cost

8.4.7 NR have not supplied any explicit WLCC analyses for tunnels, hence no lifecycle options have been presented for these assets. It is therefore uncertain as to whether the Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

Policy Application

8.4.8 Policy on a Page (PoaP) is incomplete and therefore we are unable to form an opinion on the intervention strategies.

8.4.9 We understand that many tunnels now have Tunnel Management Plans; however, none have been provided or seen in our visits to the Routes.

Costs

8.4.10 NR have derived costs for tunnels in CP5 using a simple analysis, based on previous business plans and available condition data. Cost estimates for major schemes, derived by Routes have been overlaid on these costs.

Activities and Volumes

8.4.11 Interventions are detailed in PoaP. It appears that intervention thresholds are still being developed and that the activities are a generally a continuation of current practice. These are based on minimum TCMI intervention levels, in a similar way to bridges.

8.4.12 We are unclear if the intervention thresholds proposed will maintain the good condition which has been achieved by the philosophy adopted in CP4 (that tunnels are irreplaceable assets) for all route criticalities.

8.4.13 Renewal volume items are provided for tunnels in CP5 [F63], as shown in Table 8-4.

Table 8-4: Volumes of Work to Tunnels

Renewal Volumes		Control period totals		
		CP4	CP4 incl enhanced spend	CP5
Tunnels - major works	m2	77,894	-	123,136

8.4.14 The CP5 expenditure is derived from top down modelling and comprises a modelled TCMI analysis cost (£137m) and an overlay to add specific work planned for CP5 and remove work scheduled for CP4 (net increase of £40m). The CP5 costs and volumes seem to have been 'rolled forward' into CP6-CP11. We have some uncertainty about the CP5 costs and volumes, and moderately high uncertainty about the CP6-CP11 costs and volumes.

8.5 Other Assets (Retaining Walls, Footbridges and Culverts)

8.5.1 NR's proposed CP5 expenditure for retaining walls, footbridges and culverts is £229m in CP5, about 10% of the total Structures expenditure of £2,270m.

Asset Performance and Targets

8.5.2 The particular targets for culverts, footbridges and retaining walls are to "reduce" the number of assets which are currently in poor condition in these groups. NR have plans for data improvement for these assets.

Policy

8.5.3 For this group of structures assets, the condition rating is currently relatively simplistic. NR have plans to improve asset knowledge during CP5. The targets are poorly defined and it is unclear if these have been used in top-down modelling. We are consequently uncertain about the robustness of the Policy for this asset group, and in the absence of any forecast condition we consider that sustainability is uncertain.

8.5.4 Considering the assumptions made and the available data, the model methodology is appropriate for forecasting minor assets costs; however, there is insufficient detail in the SBP documentation to provide an opinion on the accuracy or currency of input data.

8.5.5 NR have not supplied any explicit WLCC analyses for retaining walls, footbridges and culverts and hence no lifecycle options have been presented for these assets. It is therefore highly uncertain as to whether the Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

Activities and Volumes

8.5.6 Renewal volume items are provided for retaining walls, footbridges and culverts in CP5 [F62,F64,F65], as follows:

Table 8-5: Volumes of Work to Retaining Walls, Footbridges and Culverts

Renewal Volumes		Control period totals		
		CP4	CP4 incl enhanced spend	CP5
Footbridges - major works	m2	8,264	-	11,620
Culverts - major works	m2	8,377	-	8,637
Retaining walls - major works	m2	23,492	-	32,703

8.5.7 NR are proposing to maintain the same level of expenditure (£229m per Control Period) into CP6-CP11. This compares with £80m in CP4 (including coastal estuarine and river defences assets). It is unclear which assets have increased spend in CP5 as no breakdown for CP4 has been provided.

8.5.8 The volumes and costs have been derived from top-down modelling. The model forecasts cost based on 'Total Volume' rather than 'Total CP4 Volume'. The consequence of this potential error could cause an overestimation in CP5 forecast costs.

8.5.9 The model has been developed for CP5 only. No evidence has been provided to demonstrate that the outcomes from the model are deliverable, sustainable or will achieve Policy targets.

8.5.10 No sensitivity testing of the model has been provided by NR. Our own analysis indicates that the model does not appear to be sensitive to uncertainties in the asset count.

Costs

8.5.11 The unit rates for culverts, footbridges and retaining walls appear to consider the aspects required to develop an accurate rate.

8.5.12 We are highly uncertain as to the basis of the forecast volumes in the model and the renewal costs for CP5 and CP6 - CP11. A potential error in the Tier 1 model could cause an overestimation in CP5 forecast costs.

8.6 Other Assets (Coastal Estuarine and River Defences)

Asset Description

8.6.1 NR have not provided us with any information related to asset type, location or condition relating to coastal estuarine and river defences (CERD assets).

Asset Performance and Targets

8.6.2 There are no targets in the Policy for CERDs and therefore we are highly uncertain about the intended outputs for this group of assets.

Policy

8.6.3 NR have provided very little information related to CERD assets. A policy objective to prepare Asset Management Plans for CERD assets has been set; however, there are no particular targets / outputs for CERDs. There is no clear line of sight and therefore we have high uncertainty that the Policy for CERDs is robust.

Policy Application

8.6.4 NR's proposed CP5 expenditure for Coastal Estuarine and River Defences (CERD) is £43m, about 2% of the total Structures expenditure of £2,270m.

8.6.5 NR have not supplied any explicit WLCC analyses for CERD and no lifecycle options have been presented for these assets. It is therefore highly uncertain as to whether the Policy will deliver the outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

Costs, Activities and Volumes

8.6.6 CP5 costs for CERD assets have been developed 'bottom up' by Routes. The same values have been used for CP6-CP11. Volumes are the same for each Control Period. NR have not provided details of planned activities for these assets.

8.6.7 NR have provided planned volumes for CP5 (14,075m) and 7,800m in CP6-CP11. These compare with 5,832m in CP4. No explanation of the derivation has been provided hence we have high uncertainty in respect of CP5 and CP6-CP11 volumes.

8.6.8 It is unclear how NR have derived the renewal cost items for CERD assets totalling £43m in CP5 and £30m in CP6-CP11. No historic spend data has been provided for CP4. No explanation of the derivation has been provided hence we have high uncertainty in respect of CP5 and CP6- CP11 costs.

Table 8-6: Volumes of Work to Coastal Estuarine and River Defences

Renewal Volumes		Control period totals		
		CP4	CP4 incl enhanced spend	CP5
Coastal / estuary defences - major works	m	5,832	-	14,075

8.7 Structures Other

Asset Description

8.7.1 'Structures Other' comprises a range of 'Policy objectives' set to reduce risk and comply with statutory obligations, including, planned preventative maintenance; scour protection; spandrel wall strengthening; hidden shafts; road vehicle incursion (and for neighbouring sites); pigeon proofing; and route specific schemes such as compliance with working at height regulations and contribution to Thameslink.

Asset Performance and Targets

8.7.2 There are no outputs / targets or volumes associated with 'Structures Other'. NR have included renewal cost items for 'Structures Other' totalling £218m in CP5, about 10% of the total structures expenditure of £2,270m, and £218m in CP6-CP11. Historic spend data has been provided for CP4 (£536m plus £168m 'enhanced spend'). No explanation of derivation is included in

the SBP submission hence we have high uncertainty in respect of CP5 and CP6-CP11 volumes and costs.

Policy

8.7.3 The tests of robustness, sustainability and lowest possible whole system cost are not applicable to these items as they are simply defined activities.

8.8 Summary

8.8.1 NR have made significant progress with the development of their Structures Asset Policy since IIP. The SBP Structures Asset Policy is fundamentally sound, and is built on risk based principles. This is a significant step forward from the CP4 polices and the Structures Asset Policy at IIP stage.

8.8.2 The policy, particularly for bridges, implicitly requires that for CP5 interventions should be primarily driven by 'safety' issues rather than say 'bridge performance', based on the condition of the assets. The new policies give much more prescriptive guidance especially in the area of tolerable risk and define what 'should be done' by each Route for each sub-type of asset. Over time this should improve the consistency of bridge condition between routes.

8.8.3 For Structures, NR have linked to HLOS performance requirements for safety by focusing the Policy objectives on understanding and managing safety and performance risks. Climate change has not been considered in detail at this stage.

8.8.4 We acknowledge that NR have made a significant investment in preparing PoaP which provides detailed guidance to Routes on interventions in accordance with Policy for each of the asset groups except Major Structures. This is a significant advance. As part of NR's planned further development work, there needs to be a thorough reconciliation of intervention criteria, minimum condition PLBE thresholds, PoaP and target values.

8.8.5 As noted in Section 5 above, we have prepared a 'System Diagram' for each 'Sub-Asset' ('Level 3') and 'allocated' an uncertainty 'colour' to each element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. Larger copies are included in Appendix D.

Underbridges and Overbridges (Bridges)

8.8.6 Key areas of uncertainty with respect to Civils volumes and costs relate to Bridges (underbridges and overbridges), which equates to 66% (£1,502m) of the £2,270m for CP5 structures (all pre-efficient).

8.8.7 The Policy sets minimum condition PLBE thresholds for key elements of a structure. NR's analysis of their structures database shows about 9,666 (33%) of bridges contain elements below their 'minimum condition PLBE threshold'.

8.8.8 As well as bridge condition the other key criteria is bridge 'capability'. Bridge capability is defined as the *'ability of the assets to bear load, pass gauge and allow line speed or available traction power'*. The required

capability for each route is published in the National Sectional Appendix and is defined in NR's licence agreement.

8.8.9 NR's analysis indicates that they have 564 bridges that have been assessed as being sub-standard (assessed categories A3 to F), with 191 of those within categories D-F. NR note that a proportion has no assigned category and that a further 78 assets may also be in categories D-F. NR are targeting interventions at the 191 sub-standard underbridges D-F by the end of CP5, not the estimated number of 269.

8.8.10 NR note that there is a 'backlog' of approximately 12,000 assessments that need to be completed for underbridges and overbridges. We understand that these will be completed by end of CP4. We note that these assessments may identify further sub-standard bridges over and above the 564 already identified.

8.8.11 NR's first priority for bridge activity is directed at elements in a condition below the minimum condition PLBE thresholds. We agree this is the correct approach. In addition to this work, NR have several significant programmes of work address capability shortfalls, hidden critical elements etc. We are unclear about the degree of overlap and prioritisation between each of these and also the major enhancement programmes planned for CP5.

8.8.12 On the basis of condition data that we have seen (central and Route level) we have little doubt that there is a substantial amount of repair and renewal work to be carried out, primarily on underbridges.

8.8.13 The Policy implies a step change improvement in overall bridge condition in CP5/6, which would then be sustained over future Control Periods. There is some uncertainty about the definitions of CP4 exit and the targets and measures for CP5, which relates directly to the sustainability of the policy for bridges. In addition, there is some uncertainty about the long term condition requirements.

8.8.14 However, there is significant uncertainty about the makeup of this work. This relates to the fact that to apply the policy, NR asset engineers will have to evaluate each element below the minimum PLBE threshold to determine the type and scale of intervention required. If an intervention is required (as it may not be in some instances) the resulting work may range from 'light' plating work or 'heavier' deck replacement. This introduces a significant cost uncertainty as well as volume uncertainty. The volume of each activity will only become clear once the work is better defined and NR have not yet had the opportunity to implement this yet.

8.8.15 NR proposes that 'Scenario 2 – Phase in Policy over CP5-CP6' should be adopted. We do not agree with this selection in relation to bridges as it potentially means that there could be bridges with individual PLBE scores below their 'minimum condition PLBE threshold' for the next 10 years. We are surprised that NR does not appear to be seeking resolve this issue more urgently.

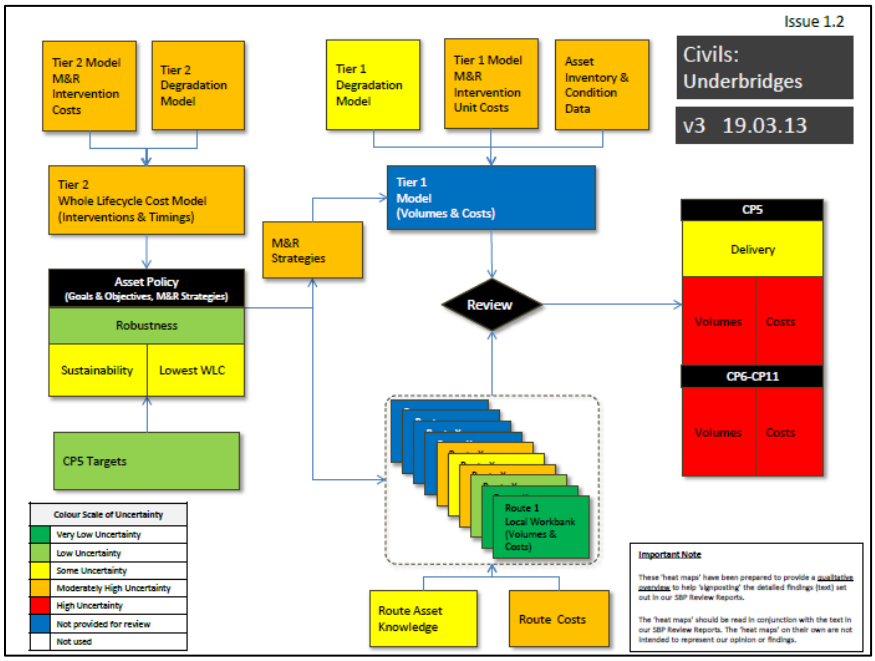


Figure 8-5 'System Diagram' for Underbridges

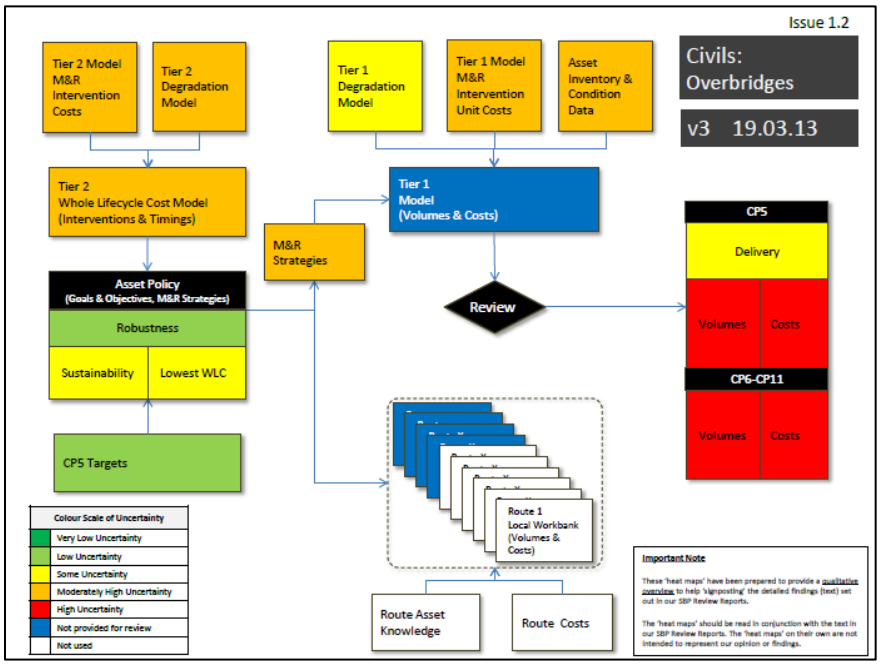


Figure 8-6 'System Diagram' for Overbridges

Major Structures

8.8.16 The number of Major Structures has been reduced from 283 at IIP to 34 for CP5. The policy for Major Structures currently appears to be to prepare Asset Management plans for each structure prior to the start of CP5; NR have submitted little information to support their plans.

8.8.17 NR intend to apply a risk based approach policy for Major Structures, which is yet to be developed, raising concerns that NR may be prepared to allow the overall condition of Major Structures to deteriorate. We consider this would be a retrograde approach to assets which are vital to the long-term performance of the network.

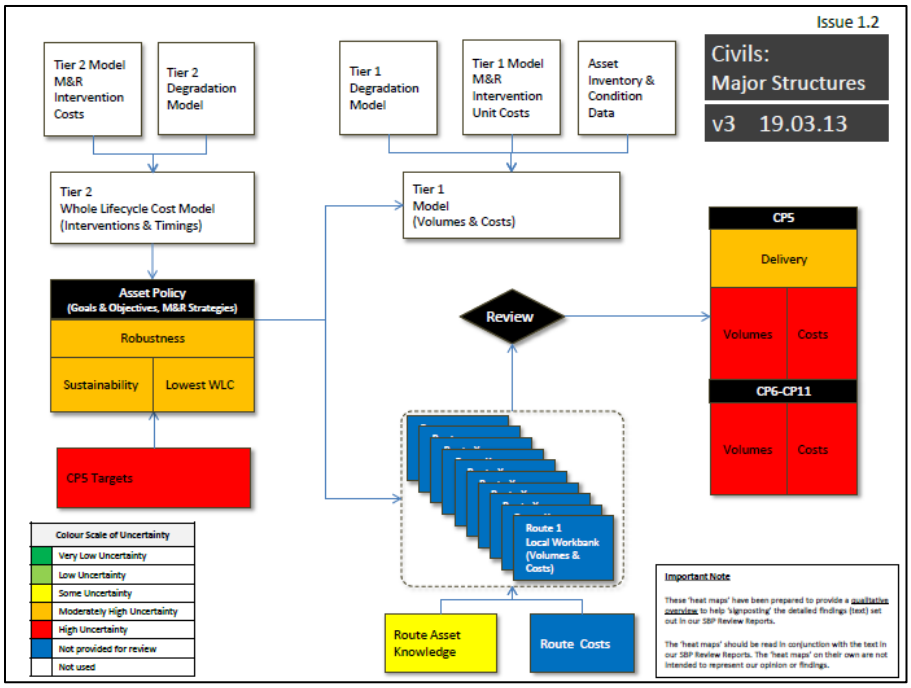


Figure 8-7 'System Diagram' for Major Structures

Tunnels

8.8.18 The key Policy target for tunnels is to reduce the number of poor condition sections over CP5, but according to the condition data for tunnels, this target has already been achieved by a significant margin. A pro-active approach to interventions over recent years has delivered assets in generally fair or good condition, but we are unclear that the policy would continue to apply this philosophy on all route criticalities. In addition NR have submitted little information to support their plans.

8.8.19 We are somewhat uncertain about the robustness and sustainability of the Policy for tunnels.

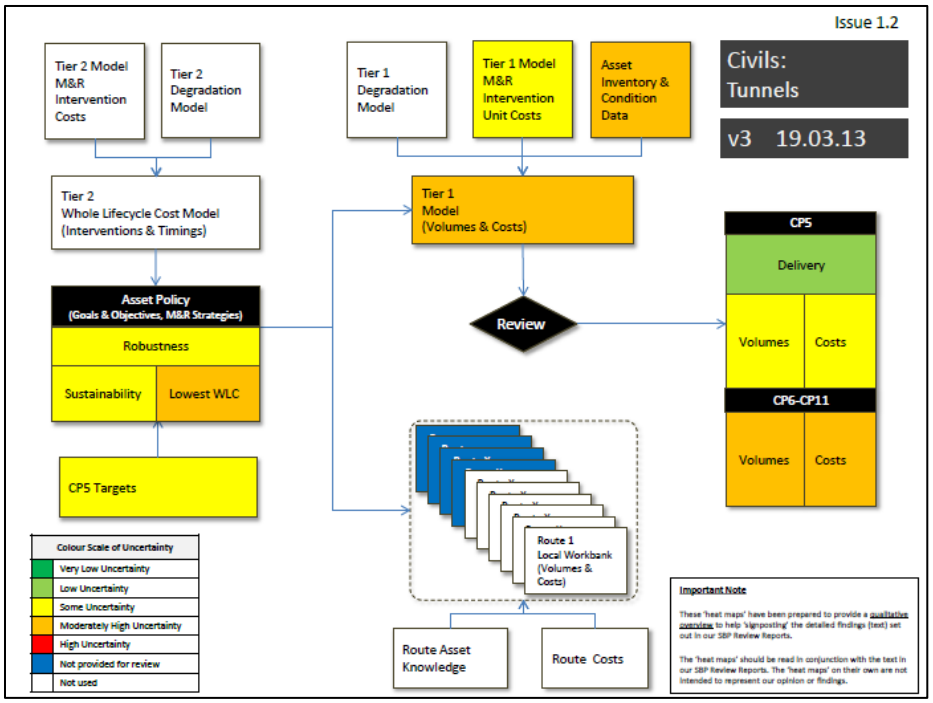


Figure 8-8 'System Diagram' for Tunnels

Other Assets (Retaining Walls, Footbridges and Culverts)

8.8.20 NR have submitted little information to support their plans for these assets.

8.8.21 For this group of structures assets, the condition rating is currently relatively simplistic. NR have a stated intent to improve asset knowledge and condition assessment systems during CP5. The targets are poorly defined. Consequently we have moderately high uncertainty about the robustness of the Policy for this asset group, and we have an equal level of uncertainty when considering sustainability.

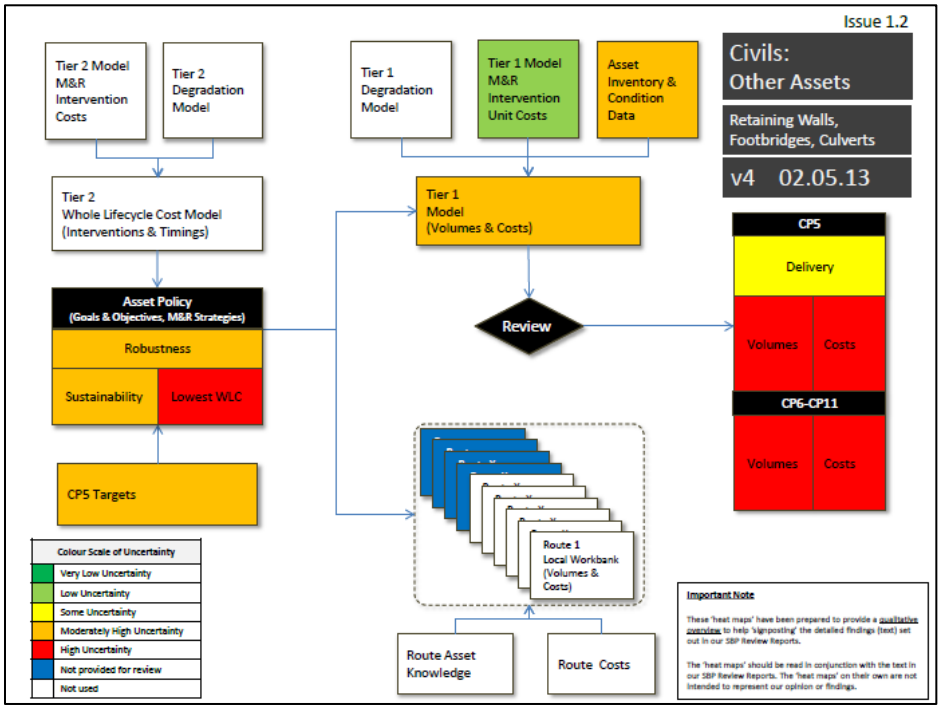


Figure 8-9 'System Diagram' for Other Assets (Retaining Walls, Footbridges and Culverts)

Other Assets (Coastal Estuarine and River Defences)

8.8.22 NR have provided very little information related to CERD assets.

8.8.23 A policy objective to prepare asset management plans for CERD assets has been set; however, there are no particular targets for CERDs. There is no clear line of sight and therefore we have high uncertainty as to whether the Asset Policy for CERDs is robust and sustainable.

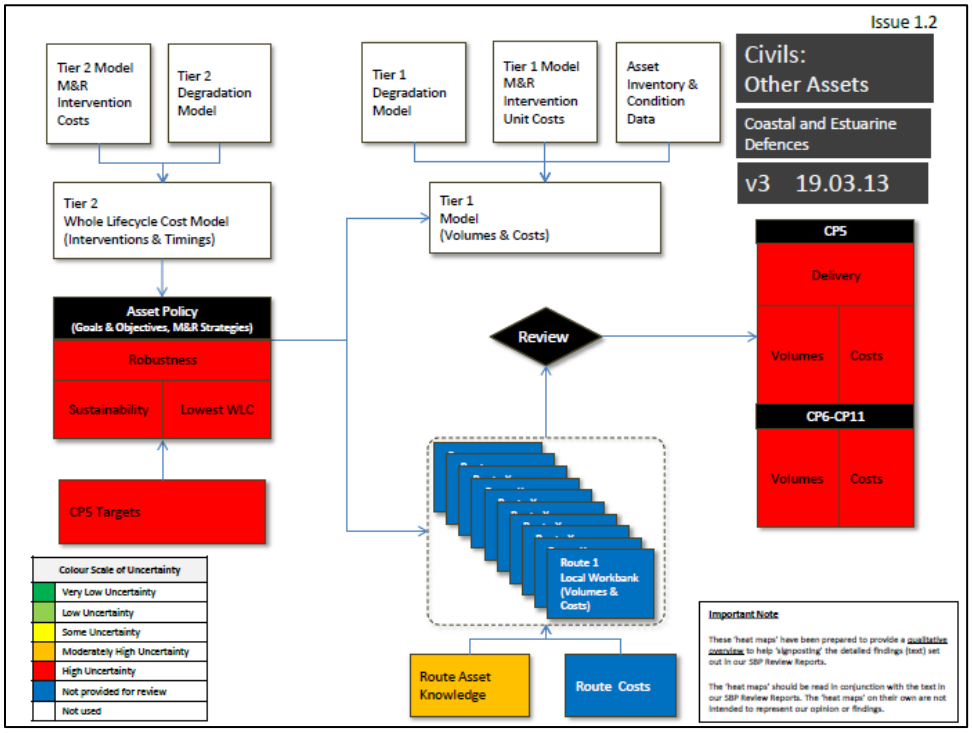


Figure 8-10 'System Diagram' for Other Assets (Coastal Estuarine and River Defences)

Structures Other

8.8.24 ‘Structures Other’ comprises a range of ‘Policy objectives’ set to reduce risk and comply with statutory obligations, including, planned preventative maintenance; scour protection; spandrel wall strengthening; hidden shafts; road vehicle incursion (and for neighbouring sites); pigeon proofing; and route specific schemes such as compliance with working at height regulations and contribution to Thameslink.

8.8.25 The tests of robustness, sustainability and lowest possible whole system cost are not applicable to these items as they are simply defined activities. NR's proposed CP5 expenditure on these is £218m, about 10% of the total Structures expenditure of £2,270m.

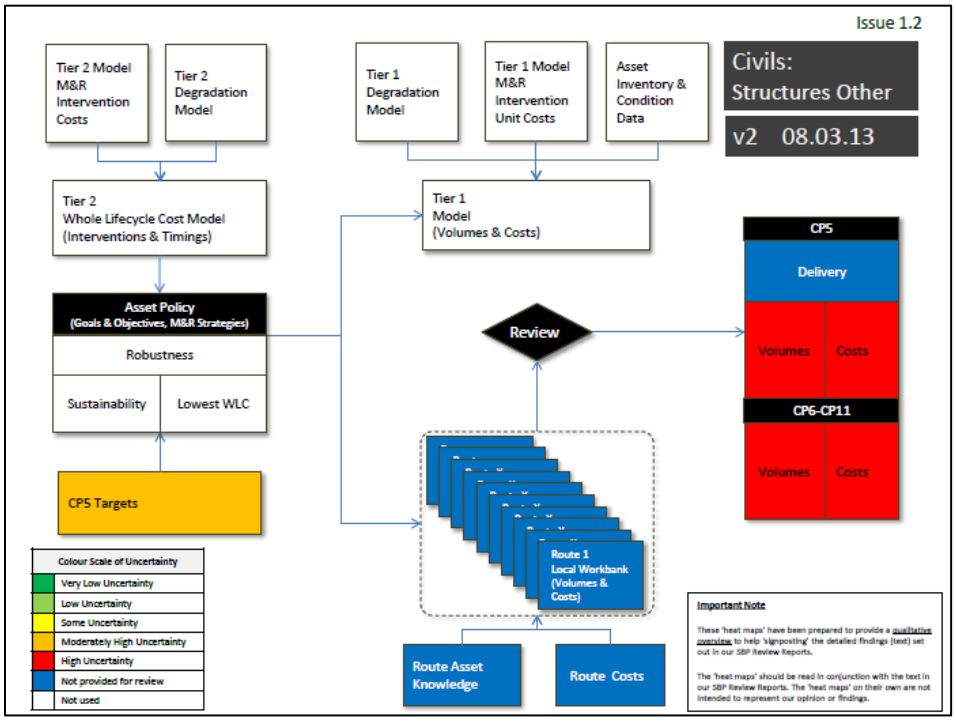


Figure 8-11 ‘System Diagram’ for Structures Other Assets

9 Earthworks

9.1 General

9.1.1 The NR SBP submission includes a CP5 Earthworks Asset Policy [SBPT3015a] which explains NR's proposed management approach for embankments, soil cuttings and rock cuttings. The management of earthworks is intimately linked to the management of drainage as outlined in the NR CP5 Drainage Asset Policy Document [SBPT3017].

9.1.2 Earthworks Maintenance & Renewal volumes and costs include works related to mining, waste disposal and landfill sites that may pose a hazard to railway operation. Unless noted otherwise the text in Sections 9.1 to 9.4 relates specifically to earthworks assets (embankments and cuttings). Our views on the Mining Policy [SPBT3015b] and its application are set out in the Section 9.5.

9.1.3 The earthworks asset inventory is defined in terms of 5 chain (110 yard) or 100m segments. In total NR have 175,123no. 5 chain lengths split between the three primary asset types as shown in Figure 9-1 below. They are distributed by Route as Figure 9-2.

9.1.4 Condition is represented using a Soil Slope Hazard Index (SSHI) or a Rock Slope Hazard Index (RSHI) and four condition categories (Serviceable, Marginal, Poor, Top Poor).

	Asset 5 Chain Lengths				
	Serviceable	Marginal	Poor	Top Poor	Total
Embankment	54959 (56.2%)	36800 (37.6%)	5295 (5.4%)	761 (0.8%)	97815 (100%)
Soil Cutting	39222 (57.6%)	25981 (38.2%)	2033 (3.0%)	849 (1.2%)	68085 (100%)
Rock Cutting	4388 (47.6%)	3788 (41.1%)	762 (8.3%)	285 (3.1%)	9223 (100%)
Total	98569	66569	8090	1895	175123

Figure 9-1: Earthworks Condition Data (as at 15/02/12)

9.1.5 The distribution of earthworks assets by Route is shown in Figure 9-2.

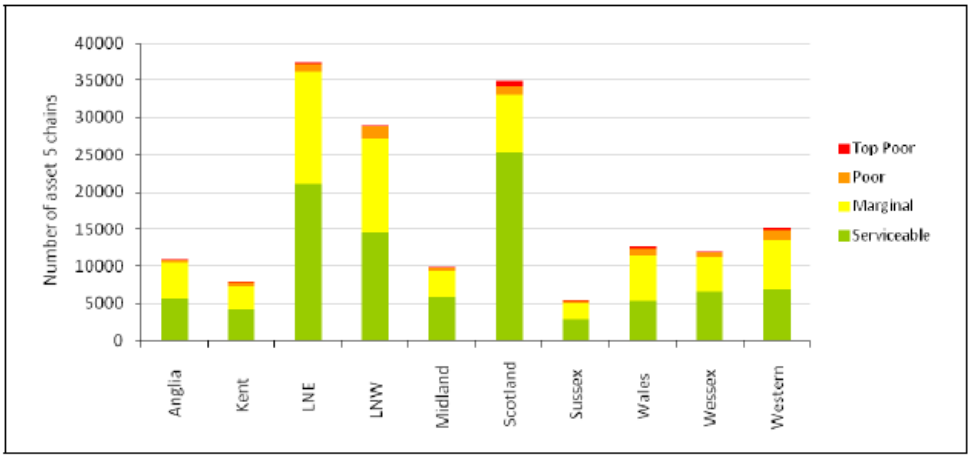


Figure 9-2: Distribution of Earthworks Assets by Condition and Route (as at 15 December 2012)

9.1.6 Since our IIP Review in December 2011 [Arup 2011a], NR have continued to improve their asset knowledge. NR indicate that only about 1% of the national database of assets remains to be examined. The majority of NR earthworks 5 chain lengths have had at least one examination. We note that there is some variability in asset data between Routes. We consider that at a National Level there is low uncertainty associated with the overall NR earthworks inventory.

9.2 Asset Performance and Targets

Historic Performance

9.2.1 NR Earthworks Asset Policy [SBPT3015a] presents analysis of historic earthworks reliability trends considering performance indicators of earthwork failures, derailments, delay minutes (Schedule 8 costs) and Temporary Speed Restrictions (TSRs) due to asset failures.

9.2.2 A summary plot of earthworks failure data between 2004 and 2012 is shown in Figure 9-3 below.

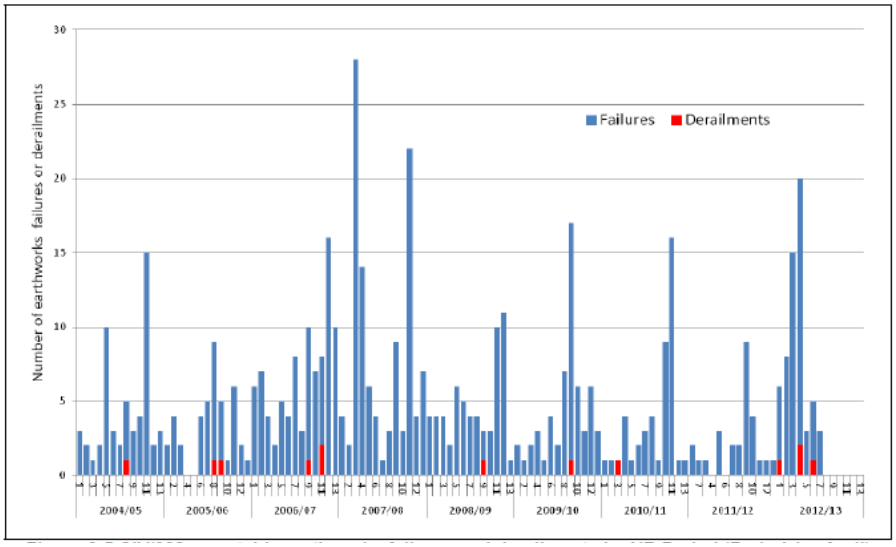


Figure 9-3: Reportable Earthworks Failures and Derailments 2004-2012

9.2.3 NR have recognised that the number of derailments is only broadly related to peaks in the number of earthworks failures and specifically that the consequence of a failure needs to be explicitly considered in their approach to earthworks management – i.e. the need for a 'risk based approach'.

9.2.4 NR analysis of Train Running System (TRUST) database data indicates that in 2010/2011, earthworks failures were responsible for 4.7% of reported delay incidents, and 7.8% of the total delay time.

9.2.5 NR note that the Schedule 8 delays and TSRs mainly relate to restrictions imposed on poorly performing embankments. NR note that these show a general reducing trend since active management of earthworks began in 2000 and specific focus on embankment performance issues as shown in Figure 9-4 below.

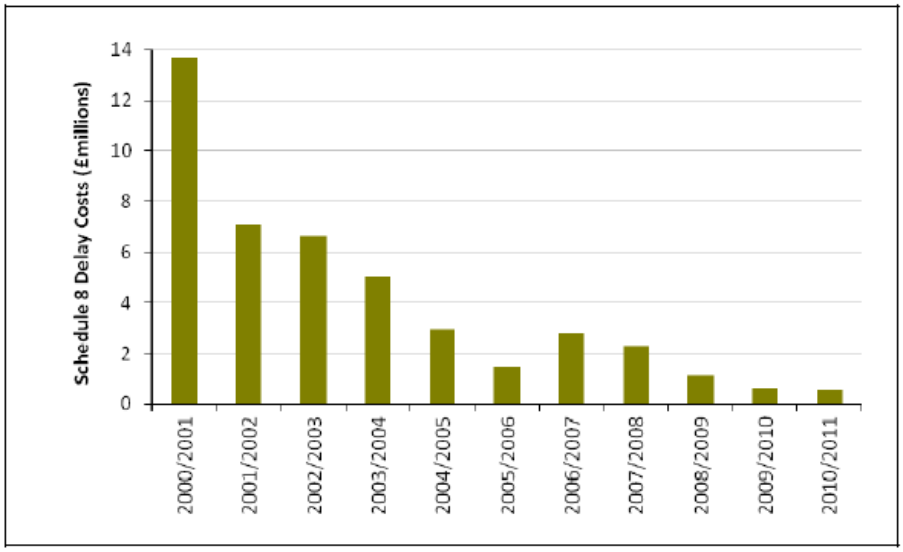


Figure 9-4: Delay (Schedule 8) Costs Attributed to Earthworks Incidents

9.2.6 In summary, NR have undertaken a comprehensive review and analysis of their historic asset data to determine deterioration relationships for earthworks. It is noted that there is still limited data available and that the

rate of deterioration of earthworks is one of the most difficult variables to determine, however the NR analysis of available data has been comprehensive.

Targets

9.2.7 NR have developed a set of a series of asset output measures for the major asset disciplines (track, signalling, electrical power, buildings, structures and earthworks)[Ref. SBPT101, 102] . These measures have been proposed by NR to assess:

- *"Robustness: whether our assets will deliver the required outputs; and*
- *Sustainability: whether our asset policies continue to deliver the outputs over the longer term."*

9.2.8 For earthworks the 'robustness' measure is noted as being 'under development'. In terms of earthworks 'sustainability' NR are proposing to adopt a 'Risk Index' based on their existing measure of 'earthwork condition' (Soil Slope Hazard Index (SSHI) or a Rock Slope Hazard Index (RSHI)) as a proxy for 'likelihood' of failure and an 'asset criticality' based on line speed, track layout, route importance and track quality (embankments) to give a proxy for 'consequence'.

9.2.9 The combination of the adopting a risk based approach and the Risk Index as an output measure provides a pragmatic 'line of sight' between the asset performance (earthwork condition, number of failures etc.) and network performance (derailments, delay minutes. Schedule 8 costs etc.).

9.3 Policy

9.3.1 In developing their CP5 asset policy NR have adopted a 'risk based approach' to the identification of sites for remedial work. This is a significant step forward from the CP4 polices and the earthworks policy at IIP stage.

9.3.2 NR have explicitly recognised the important linkage between earthworks failures and to improved drainage and included this in the Earthworks Policy. This is very positive.

9.3.3 The policy implicitly assumes that interventions should be primarily driven by 'safety' issues rather than say 'track performance'. This is very positive.

9.3.4 The Asset Policy indicates that there has been extensive dialogue between the Central NR Head of Asset Management (HAM) team and the Route Asset Managers, with an 'expert panel' being used to inform aspects such as effect of interventions and deliverability of the policy. This has been confirmed in our discussion with the Routes and again is very positive.

9.3.5 In terms of overall approach, we consider the method adopted by NR for policy selection to be logical and well executed, with the Earthworks SCAnNeR tool being used extensively by NR to explore the output vs cost trade-offs.

9.3.6 NR's analysis indicates that the lowest whole life cost combination of interventions will be achieved by significantly increasing the volume of pro-active 'maintenance' and 'lighter' 'refurbishment' interventions at the expense of more 'traditional' 'heavier' 'renew' interventions. This is a

significant change of approach from the current and historic earthworks policies.

Robustness

9.3.7 The CP5 Policy has a clear linkage to asset outputs (e.g. Risk Index), is based on reasonable inventory and condition information and has an explicit risk based intervention approach. Accordingly we consider it reasonably likely that the Asset Policy will be robust and will be capable of delivering a reduction in asset risk in the short-term.

Sustainability

9.3.8 NR have adopted a sophisticated modelling approach to derive their short-term and long-term intervention policy for earthworks. However, in terms of long-term sustainability, we have concerns in relation to principle of reducing the volume of 'heavy' renewals. This primarily stems from the 'equivalence' of 'lighter' refurbishment and 'heavier' renewals.

9.3.9 Whilst we are supportive of the principle of targeting more 'lighter' pro-active intervention activities (such as drainage) to reduce safety risk, we consider that this needs to be in conjunction with a continued programme of 'renewal' activities.

9.3.10 Whilst recognising that NR's detailed analysis would indicate that the proposed combination represents best whole life value, we have a number of concerns and therefore consider that there is some uncertainty as to whether the Policy will be sustainable in the long-term.

Whole System Cost

9.3.11 It is very positive that the Earthworks Asset Policy considers earthworks and drainage as a whole system. Investment in drainage works will undoubtedly contribute to improving the earthworks condition and reducing failures.

9.3.12 We have concerns about the long-term effectiveness of the proposed 'lighter' pro-active intervention activities at maintaining asset condition, together with the uncertainty of the cost of these 'lighter' interventions means that we consider it uncertain whether the proposed Policy will deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

Embedded Efficiency

9.3.13 NR have not assumed any Civils maintenance efficiencies ('embedded' or otherwise) associated with CEFA or other maintenance expenditure.

9.3.14 For the Civils asset no renewals 'embedded efficiency' has been assumed by NR. This reflects NR's view that although the Civils policies have been revised, *'the elevated level of uncertainty related to this asset makes it impossible at this time for us to assess any level of embedded efficiency that may result from the new asset policies.'* [SBPT220].

9.4 Policy Application

9.4.1 For earthworks 'sustainability' NR are proposing to adopt a 'Risk Index' and to target maintaining this at the CP4 'baseline' of 100 and that a reduction in

risk to 99.6 will be achieved by CP5 exit. NR suggests that this will result in fewer high criticality earthworks in poor condition which is very positive.

9.4.2 We note that one key implication of applying a constraint of improving condition in CP5 whilst maintaining overall 'average' condition leads to Routes with 'poor' start condition earthworks improving and Routes with 'better' start condition earthworks being allowed to deteriorate. Whilst this does not seem unreasonable for a Route like Western – which has historically had a higher number of failures than other Routes (Figure 9-5), we are concerned that this constraint seems to suggest that the condition of earthworks in Scotland (which have the second highest number of failures) will overall deteriorate in CP5 – CP11. This 'convergence' of condition is shown in Figure 9-6.

9.4.3 We have similar concerns related to the constraint of reducing risk at a Route Level but maintaining overall 'average' risk, in that this seems to suggest that the earthworks risk at some Routes (such as Scotland) will increase.

9.4.4 In addition we are unclear as to whether the proposed policy / intervention mix would comply with Statutory Obligations under ALARP principles[23].

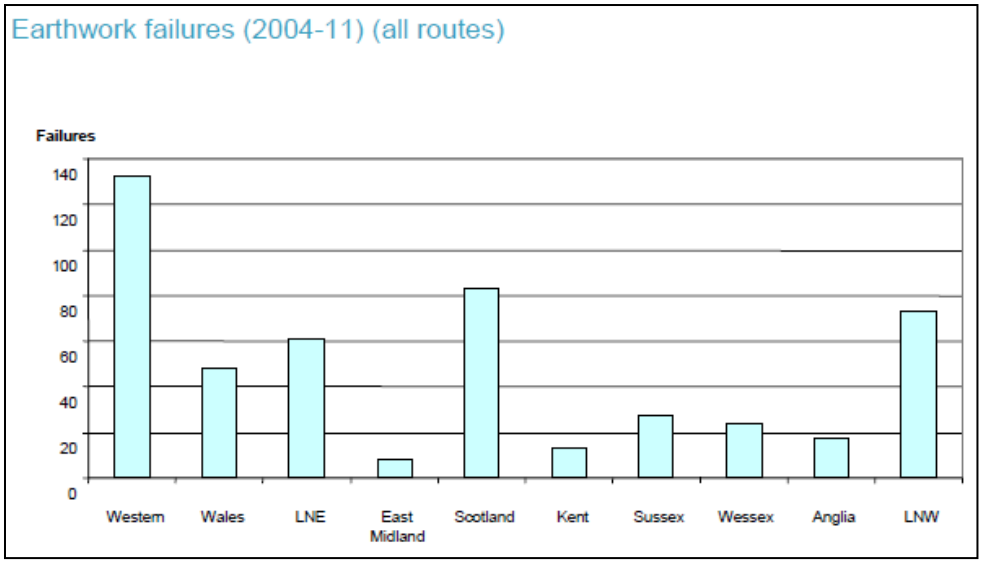


Figure 9-5: Earthworks Failures (2004-2011) [SBPT219 – Western Route Plan]

9.4.5 The apparent 'mismatch' between observed failures and 'calculated risk' makes it uncertain as to the potential acceptability and effectiveness of the selected asset intervention mixes. Further work is required to enable us to comment further.

9.4.6 In general it is unclear how NR have equated safety risk between the 'principal' asset types such as Buildings vs. Earthworks vs. Structures. This gives rise to a significant uncertainty since Asset Outputs cannot be equated between asset types and that it may be being proposed that assets are funded to achieve different levels of risk.

[23] NR have a duty under the Health & Safety at Work etc. Act (1974) to manage safety risks to a level as low as reasonably practicable (ALARP). Our interpretation of this is that safety improvements should be implemented unless the costs are grossly disproportionate to the safety benefits.

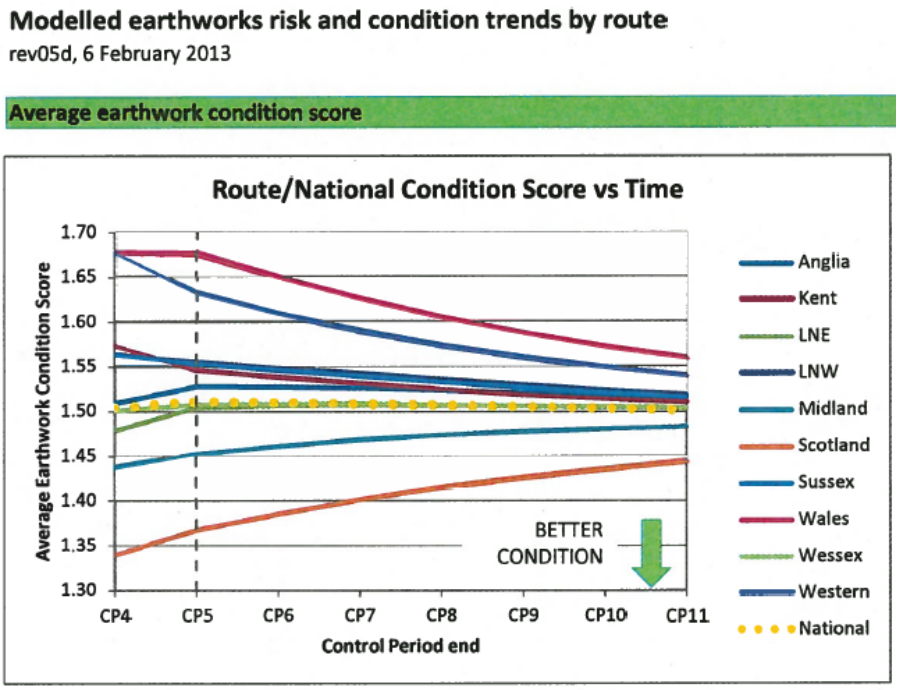


Figure 9-6: Modelled Earthworks Condition Score Trends by Route [NR 2013a]

Activities and Volumes

9.4.7 Renewal volume items are provided for Earthworks in CP5 [F70-F78] totalling some 17,757 no. 5 chain lengths, split:

- 1,510no. 5-chain lengths of renewal
- 6,163no. 5-chain lengths of refurbishment
- 10,084no. 5-chain lengths of maintenance.

- 39% embankments
- 7% rock cuttings
- 55% soil cuttings

9.4.8 It is noted that comparison with CP4 volumes is difficult due to the change from 'm^2' unit to '5 chain' unit. However, the split was 49% embankments, 30% rock cuttings and 21% soil cuttings [D70, D73, D76].

9.4.9 NR have derived the majority of their forecast CP5 and CP6-CP11 renewal volumes and costs on a 'top-down' basis using their Earthworks Tier 1 Model (Earthworks SCAnNeR - Strategic Cost Analysis for Network Rail). Earthworks asset outputs / performance are also determined in the model together with and the volumes and costs of associated drainage maintenance and renewal.

9.4.10 For CP6-CP11 [G70-L78] increasing volumes of renewal are forecast reaching 1,984 in CP11. Volumes of refurbishment over the same period are 6,960 (CP6) falling to 6,744 in CP11. These volumes match the total volumes provided by the Earthworks SCAnNeR Tier 1 model although we have not been able to trace the split of works between earthwork types (cuttings and embankments). There is a discrepancy between the volumes of

refurbishment and maintenance for CP5 which we believe are related to additional works specified by the routes to include committed enhancements and HLOS targets.

9.4.11 SCAnNeR is different to the majority of the other NR Tier 1 models in that it is a strategy evaluation tool. The tool and model within has been used to determine the optimum policy by varying intervention strategy combinations considering the output of the asset population as a whole. The costs and volumes for the SBP are then determined for the preferred intervention strategy. As such the model fulfils the requirements of the Tier 1 models to develop volumes and costs, and some aspects of the WLCC asset model (Tier 2).

9.4.12 The SCAnNeR application is an effective optioneering Decision Support Tool (DST) for use as part of a policy development process. Model outputs are presented in a clear and effective manner and the tool promotes policy comparison. The model has been presented for review with clear and concise documentation. The approach to summarising the portfolio performance using condition and risk indices is considered appropriate and consistent with CP5 policy. However, we have a number of concerns about some of the values used in the modelling.

9.4.13 NR have assumed that the asset portfolio condition at February 2012 is representative of the portfolio condition at the end of CP4. It is noted that considerable additional investment monies were allocated in CP4 under the Enhanced Spend Programme / National Earthworks Risk Reduction Programme (NERRP) in England and Wales. This would suggest that the SCAnNeR modelling may slightly over-estimate the volume of work to be undertaken in CP5 onwards. It is noted that NR have not explicitly allowed for the degradation of earthworks since the last examination when setting the start condition for their SCanNeR model (i.e. CP4 exit) and that the last examination, in some instances, may be up to 10 years ago. This may slightly under-estimate the volume of work to be undertaken in CP5 onwards. Accordingly the 'baseline condition' for the SCanNeR Modelling is an area of some uncertainty.

9.4.14 There is some uncertainty whether the representation of renewal interventions are conservative. Once renewed to a serviceable condition grade, asset degradation continues according to the same degradation transition probabilities as an unrepaired asset. This may undervalue the performance of the renewed asset and accordingly the benefits of renewing assets compared with refurbishment. It is considered that there may be some degree of conservatism in the asset degradation matrices used within SCAnNeR leading to a higher prediction of required volumes that might otherwise have been calculated.

9.4.15 The deliverability matrix we understand has been derived from expert opinion on the mix and amounts of work types that can be deployed on the network within any control period. We are uncertain as to the impact of this constraint and would question whether such constraints may unnecessarily affect the outcome produced by the strategic modelling.

9.4.16 For the Earthworks asset the only item classed as ‘maintenance’ relates to earthworks examinations. It is highly uncertain what the impact of the proposed maintenance optimisation during CP5 [SBPT3004] will entail and its potential impact on the effectiveness of the earthworks examinations.

9.4.17 Our concerns in relation to the proposed change in the type of work undertaken to the earthworks asset in CP5 onwards means that we consider that there is moderately high uncertainty associated with the calculated volumes for CP5 and CP6-CP11.

Costs

9.4.18 Since the IIP submission, NR have undertaken much more detailed analysis of earthworks and derived updated unit costs for the SBP submission. This work is summarised in the Control Period 5 Earthworks Unit Rates Submission [SBPT3076].

9.4.19 The methodology in units rates pricebook [SBPT3076] regarding process and scope included with the rates appears logical and consistent. In meetings with NR they have demonstrated how these rates were derived from the historical data. However, at the time of writing the database has not yet been provided to enable a desktop study check.

9.4.20 The final earthworks unit costs used in the SBP are 'all inclusive' average unit rates for a five chain unit length and are 'national rates'. The Earthworks SCAnNeR model unit rates are consistent with these rates. Based on our sampling they seem to have been uniformly adopted for all Routes.

9.4.21 It is noted that there is much less historic cost data available for 'maintenance' and 'refurbishment' interventions than the 'renew' interventions. This is primarily because 'maintain' and 'refurbish' are 'new' activities not previously regularly used by NR on their earthworks. Accordingly there is more uncertainty associated with the unit cost of these activities.

9.4.22 For the Earthworks asset the only item classed as 'maintenance' relates to earthworks examinations. Maintenance cost items are provided for Earthworks examinations [F10 – L10] but costs for these are not listed. The cost of these CEFA examinations is understood to be included in an overall 'civils' figure of £419m in CP5 and CP6 [F8-G8]. No totals for CP7-CP11 are provided. It is also noted that the figure in the Maintenance Expenditure Summary [SBPT222] is different at £407.9m in CP5.

9.4.23 Renewal cost items are provided for Earthworks in CP5 [F50-F52] totalling £398m and in CP6-CP11 [G50-L52] ranging from £484m to £517m (all excluding Drainage costs – F49-L49] . The forecast cost for CP5 is £8m higher than the SCAnNeR Tier 1 model output [AO/030/3C]. We understand this is related to additional enhancement and HLOS capability works indicated by the routes but details have not been provided. The costs for CP6-CP11match the total cost outputs from the Earthworks SCAnNeR Tier 1. As stated above we are not able to verify the split of costs by earthwork type as this information has not been provided for review.

9.4.24 Our concerns in relation to the proposed change in the type of work undertaken to the earthworks asset in CP5 onwards means that we consider that there is moderately high uncertainty associated with the proposed costs for CP5 and CP6-CP11.

Delivery

9.4.25 The Earthworks Policy is proposing a significant change in the type of work undertaken to the earthworks asset in CP5 onwards. It is proposed that the volume of pro-active 'maintenance' and 'lighter' 'refurbishment' interventions would be significantly increased and the volume of more 'traditional' 'heavier' 'renew' interventions would be reduced. This is a significant change of approach from the current and historic earthworks policies.

9.4.26 Whilst we are supportive of the principle of targeting more 'smaller' intervention activities to reduce safety risk and the focus on drainage works, the fact that many failures may be driven by 'non condition related' aspects makes us uncertain that NR have the required data / information to effectively implement the CP5 policy. Accordingly a key area of uncertainty relates to the degree to which the Routes will be able to effectively target 'the right slopes' for the proposed maintenance and refurbishment activities. This will impact on both the performance improvement that can be achieved, and the cost of achieving that improvement.

9.5 Mining

Asset Description

9.5.1 Since IIP, NR have also prepared a specific Mining Policy [SBPT 3015b]. The Mining Policy explains their approach to mining, waste disposal and landfill sites that may pose a hazard to railway operation. Costs associated with Mining are included as part of the Earthworks asset Maintenance & Renewals volume and costs.

9.5.2 The Mining Policy [SBPT 3015b] considers four key areas of mining hazard that present a potential risk to the railway:

- Deep mining operations – 4 no;
- Surface mining operations – 694 no;
- Waste disposal and landfill sites – 3,870 no; and,
- Historic shallow mining hazard sites- 5049 no.

Asset Performance and Targets

9.5.3 Mine workings under or adjacent to the railway can present a risk to railway operation which is managed as part of the earthworks portfolio. The historic trend in shallow mine working failures is shown in Figure 9-7 as recorded instability incidents affecting the railway per five year period from 1859 onwards. A projected total for the end of CP4 is also shown. No data on other types of mining incident is provided.

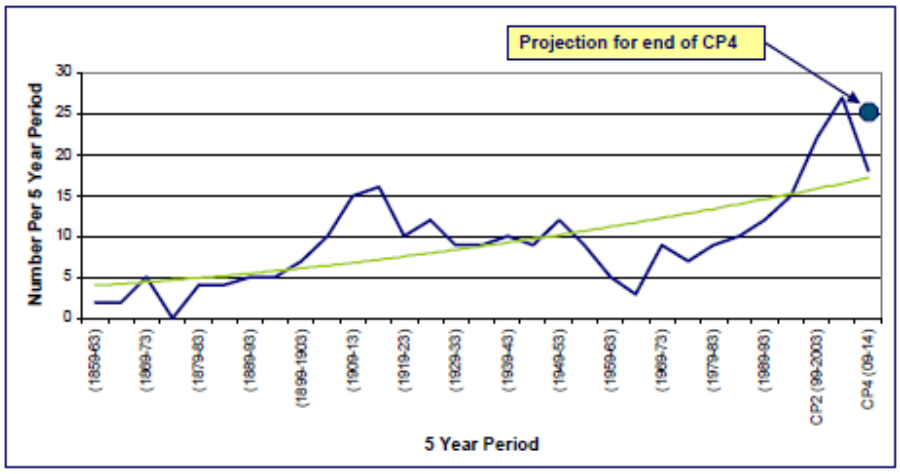


Figure 9-7: Shallow Mine Working Railway Incidents (per 5 year period)

9.5.4 There are no proposed output measures relating to mining hazards in the SBP submission.

Policy

9.5.5 NR have made significant progress since IIP in defining the extent of mining hazards that they need to manage in CP5.

9.5.6 NR have focussed on the potential collapse of historic shallow mineworkings. They have used the Mineworkings Residual Hazard Index (MRHI) as a proxy for the likelihood that a collapse will occur, and a Mineworkings Criticality calculated based on location of feature in relation to railway, line speed, and railway constraints (such as earthwork or tunnel). A stage gate risk assessment process is then followed namely:

- Identification;
- Desk Study;
- Ground Investigation; and
- Treatment.

9.5.7 NR have not supplied any explicit strategic lifecycle costing analyses for mining interventions. This is probably not unreasonable given that each mining site will be highly individual. It would be expected that on a site by site basis various treatment options would be considered in terms of whole life costing.

9.5.8 The NR mining policy stage gate process does not seem an unreasonable way of managing the risk of potential collapse of historic shallow mineworkings. However, we do not consider that there is sufficient information to assess whether the Mining Policy is robust, sustainable or represents lowest possible whole system cost over the lifetime of the asset.

Policy Application

9.5.9 The Renewals Expenditure Summary [SBPT223] indicates the following proposed CP5 deliverables:

- Shallow mineworkings desk studies - 2600 no.
- Shallow mineworkings ground investigations - 75 no.
- Shallow mineworkings treatment - 19 no.

9.5.10 No renewal volume items are provided for Mining activities in the Tier 0 Database [SBPT3038] or the Data Book [SBPT3338].

9.5.11 Renewal cost items are provided for 'Other (Earthwork)' in CP5 [F53] totalling some £52m and £45m per Control Period in CP6-CP11 [G53-L53]. We understand that mining activities are included as 'Other (Earthwork)' for CP5 – [F53], however details of the costs associated with the above elements or how exactly they have been included in the SBP Data Book are unclear. No details of the proposed activities for CP6-CP11 costs [G53-L53] have been provided.

9.5.12 The Mining Policy [SBPT 3015b] notes that the cost of ground investigations and the treatment of mineworking risk sites tends to be very site specific, with costs varying significantly depending on local factors. NR states that for CP5 a workbank of ground investigation and treatment sites has been developed based on individual site estimates, rather than by applying a generic unit rate to an assessed volume. NR refer to a review of recent costs in the NR report "CP5 mining unit costs". At the time of writing this document has not been provided to us for review.

9.5.13 NR have identified four operational deep mines that may impact on the railway during CP5 and beyond. The Mining Policy indicates a total financial risk in CP5 of £26.3m. The Civils Uncertainty Analysis – Stage 1 [SBPT3283] indicates that this figure is £31.3m. This risk has not been costed into the SBP.

9.5.14 Discussions with the Routes indicate that the proposed CP5 mining activities are being planned and we have not seen any evidence that this work would not be deliverable in CP5.

9.6 Summary

Earthworks

9.6.1 In developing their CP5 asset policy NR have adopted a 'risk based approach' to the identification of sites for remedial work. This is a significant step forward from the CP4 polices and the earthworks policy at IIP stage.

9.6.2 The policy implicitly assumes that interventions should be primarily driven by 'safety' issues rather than say 'track performance'. This is very positive.

9.6.3 For earthworks, the combination of the adopting a risk based approach and the Risk Index as an output measure provides a pragmatic 'line of sight' between the asset performance (earthwork condition, number of failures etc.) and network performance (derailments, delay minutes. Schedule 8 costs etc.).

9.6.4 On the basis that the CP5 Policy has a clear linkage to asset outputs (e.g. Risk Index), is based on good inventory and condition information and has an explicit risk based intervention approach we consider it reasonably likely that the Asset Policy will be robust and will be capable of delivering a reduction in asset risk in the short-term.

9.6.5 NR have adopted a sophisticated modelling approach to derive their short-term and long-term intervention policy for earthworks. This modelling is logically derived and well documented and suggests that NR should adopt a significant change in the type of work undertaken to the earthworks asset in CP5 onwards. It is proposed that the volume of pro-active 'maintenance' and 'lighter' 'refurbishment' interventions would be significantly increased and the volume of more 'traditional' 'heavier' 'renew' interventions would be reduced.

9.6.6 Whilst we are supportive of the principle of targeting more 'lighter' pro-active intervention activities (such as drainage) to reduce safety risk, in terms of long-term sustainability, we have concerns in relation to the principle of reducing the volume of 'heavy' renewals. We consider that the 'lighter' pro-active activities need to be in conjunction with a continued programme of 'renewal' activities.

9.6.7 Whilst recognising that NR's detailed modelling would indicate that the proposed combination represents best whole life value, we have a number of concerns and therefore consider that there is some uncertainty as to whether the Policy will be sustainable in the long-term. Accordingly we consider it uncertain whether the proposed Policy will deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets.

9.6.8 We understand that NR have not assumed any Civils maintenance efficiencies ('embedded' or otherwise). For the Civils asset no renewals 'embedded efficiency' has been assumed.

9.6.9 In terms of Policy implementation we have concerns related to the constraint of reducing risk and condition at a Route Level but maintaining overall 'average' risk and condition, in that this seems to suggest that the earthworks condition at some Routes will deteriorate and the risk at some Routes (such as Scotland) will increase.

9.6.10 Our concerns in relation to the proposed change in the type of work undertaken to the earthworks asset in CP5 onwards means that we consider that there is moderately high uncertainty associated with the calculated volumes and costs for CP5 and CP6-CP11.

9.6.11 In general it is unclear how NR have equated safety risk between the 'principal' asset types such as Buildings vs. Earthworks vs. Structures. This gives rise to a significant uncertainty that Asset Outputs cannot be equated between asset types and that it may be being proposed that assets are funded to achieve different levels of risk.

9.6.12 As noted in Section 5 above, we have prepared a ‘System Diagram’ for each ‘Sub-Asset’ (‘Level 3’) and ‘allocated’ an uncertainty ‘colour’ to each element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. The summary for Earthworks (excluding Mining) is presented in Figure 9-8 below. A larger copy is included in Appendix D.

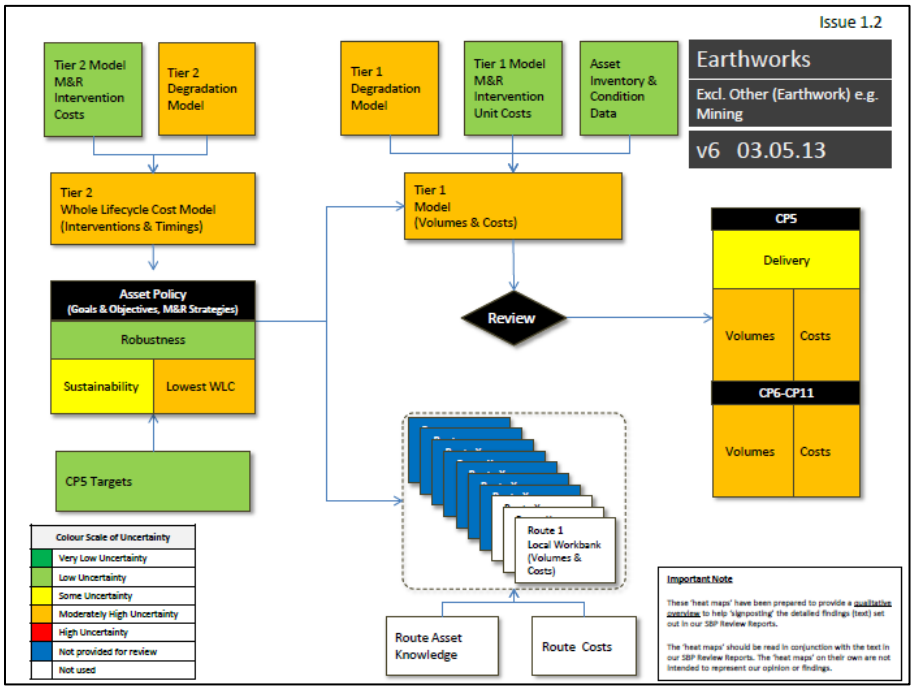


Figure 9-8 'System Diagram' for Earthworks (Excl. other (Earthworks) e.g. Mining)

Mining

9.6.13 The NR mining policy stage gate process does not seem an unreasonable way of managing the risk to the network of potential collapse of historic shallow mineworkings. However, we do not consider that there is sufficient information to assess whether the Mining Policy is robust, sustainable or represents lowest possible whole system cost over the lifetime of the asset.

9.6.14 The SBP submission indicates that a number of Shallow mineworkings desk studies, ground investigations and treatments are proposed in CP5. No details of the proposed activities for CP6-CP11 have been provided. Details of the costs associated with these elements or how exactly they have been included in the SBP Data Book are unclear.

9.6.15 NR have identified four operational deep mines that may impact on the railway during CP5 and beyond. The Mining Policy and documents indicates a total financial risk in CP5 between £26.3m - £31.3m. This risk has not been costed into SBP.

10 Buildings

10.1 General

10.1.1 The NR SBP submission contains a Building Asset Policy [SBPT3016]. This document is split into two volumes covering building fabric and mechanical and electrical assets.

10.1.2 Within the policy the NR building portfolio is split into six groupings based on the type of site. These types are:

- **Franchised stations** (2,525 locations) - passenger stations which are operated by a Train Operating Company (TOC) under a lease agreement and governed by Station Access Conditions;
- **Managed stations** (17 locations) - passenger stations which are directly managed by NR;
- **Light maintenance depots (LMD)** (71 locations) - depot facilities which are leased to a TOC for the purposes of maintaining or servicing rolling stock;
- **Maintenance delivery units (MDU)** (489 locations) - buildings used by the NR in-house maintenance teams;
- **National delivery service depots (NDS)** (32 locations) - locations which are used by NR for the strategic storage of materials; and
- **Lineside buildings** (approximately 14,000 locations) - buildings used for a variety of purposes located adjacent to the track, typically signal boxes (classified as critical lineside buildings), relay rooms, buildings associated with GSM-R, and staff welfare accommodation.

10.1.3 Within the plan the relative levels of spend against these respective building types is as shown in Figure 10-1. Because of the relatively small expenditure on LMD plant and NDS depots and lack of evidence, our review of these cost elements has been less detailed.

10.1.4 The current level of asset knowledge associated with each of these building groupings is variable. This ranges from solid inventory and condition data associated with the station portfolios to a more limited level of detail for the significant number of lineside buildings. It is significant to note that the building types where good asset data is present account for roundly 80% of the spend levels.

10.1.5 NR's building asset information database is OPAS. NR have stated that it is their aim to have OPAS populated with detailed asset information for all of their buildings by the end of CP4. This is not an insignificant task given the numbers involved and the on-going need to continue to programme and deliver the inspection programme for their stations.

Buildings					
Asset Type	**CP4**	**CP5 Pre-Efficient SBP**	**CP5 Post-Efficient SBP**	**Variation CP4-CP5 Post-Eff**	**% var**
Managed stations	£303m	£214m	£189m	-£114m	-38%
Franchised stations	£723m	£753m	£675m	-£48m	-7%
Light maintenance depots	£77m	£89m	£79m	£2m	+3%
Depot plant	£20m	£56m	£51m	£31m	+154%
Lineside buildings	£91m	£128m	£115m	£24m	+27%
MDU buildings	£53m	£72m	£64m	£11m	+20%
NDS depots	£12m	£16m	£15m	£3m	+22%
Total*	**£1,279m**	**£1,328m**	**£1,187m**	**-£92m**	-7%
	** Figure for total CP4 renewals costs provided by NR = £1,284m*				

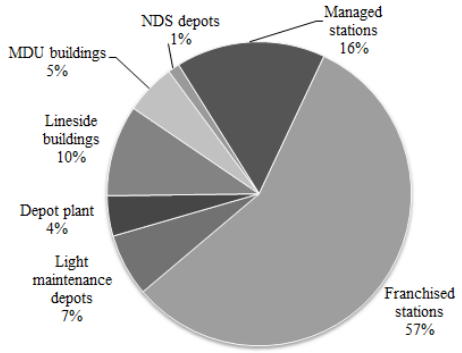


Figure 10-1: Buildings Expenditure CP4-CP5 and Percentage Split for CP5

10.2 Asset Performance and Targets

Historic Performance

10.2.1 The levels of historical performance for the building portfolio are highly dependent on the quality of the asset data which is available for each of the individual building types. The most comprehensive asset data is for franchised stations.

10.2.2 The buildings portfolio is subject to two Regulatory measures – Station Stewardship Measure (SSM) M17[24], and Light Maintenance Depot Stewardship Measure (LMDSM) M19[25]. Both are reported in the NR Annual Return.

10.2.3 It is a requirement that NR report on the SSM by station category and a total figure for England and Wales, and separately for Scotland.

10.2.4 In essence the historical trend for station and depot asset condition, for those assets being measured, has shown steady improvement – see Figure 10-2.

10.2.5 There is no data available to measure the historical performance of the other building types in the portfolio.

[24] This is the average condition rating of each station (including managed stations) where NR are the operator or the landlord – a total of 2,375 stations are measured (NR Annual Return 2012). Not all stations have SSM scores.

[25] This measure assesses the overall average condition of Light Maintenance Depots (LMDs) where Network Rail has responsibility for the repair of assets by providing, at each year-end, the number of depots in individual average condition ratings of 1–5. Those leased to a Depot Facility Owner on a "full repairing basis" are excluded from the calculation. (NR Annual Return 2012).

Category		Control Period 4 End CP4 Target	2009/10 Actual	2010/11 Actual	2011/12 Actual	Forecast 12/13	Forecast 13/14
A		2.48	2.38	2.30	2.26	2.25	2.24
B		2.60	2.46	2.40	2.37	2.35	2.34
C		2.65	2.52	2.47	2.43	2.41	2.41
D		2.69	2.54	2.47	2.41	2.41	2.40
E		2.74	2.58	2.50	2.43	2.41	2.41
F		2.71	2.56	2.50	2.47	2.49	2.48
Scotland		2.39	2.39	2.33	2.28	2.34	2.33
LMDSM	E&W	2.52	2.47	2.46	2.40	2.41	2.41
	SCOT	2.56	2.65	2.67	2.67	2.50	2.50
	ALL	2.52	2.50	2.50	2.48	2.42	2.42

Figure 10-2: CP4 SSM and LMDSM Values (note, a lower score denoted better condition)

Targets

10.2.6 For building assets NR have identify two asset output measures. These attempt to demonstrate delivery of the outputs both in the short-term (robustness) and longer-term (sustainability). The measures for buildings are as follows:

- Robustness: measured through compliance with an annual reactive faulting level;
- Sustainability: defined as the maintenance of asset condition, as measured by percentage asset remaining life (PARL), at the exit levels from CP4.

10.2.7 There has also been an attempt to link the building outputs to certain key measures in the HLOS associated with:

- Safety;
- Reliability;
- Capacity;
- Financial sustainability;
- Customer Satisfaction; and
- Environmental performance.

10.2.8 We acknowledge that NR have tried to provide a linkage to each of the foregoing through their current measures – for example the level of asset condition as scored by PARL could be linked to customer satisfaction. It is accepted by NR that these are not a perfect fit and the development of better linkages is continuing.

10.3 Policy

10.3.1 The Buildings Asset Policy covering the building fabric (Volume 1) has been in development for some time and the version submitted with the SBP is the latest refinement of that process.

10.3.2 Volume 2 (M&E) is a far more recent document which has not benefitted from the lengthy developmental period and modelling work of Volume 1. Nevertheless, it has adopted a pragmatic approach to the management of mechanical and electrical assets linked to programmed interventions which may be defined by suppliers. It is acknowledged by NR that the implementation of Volume 2 is less mature than for Volume 1.

10.3.3 Within the building fabric policy the approach to each of these building types is different with varying degrees of sophistication applied to each. The approach ranges from the use of specifically commissioned research into asset degradation where current condition information is available, to the far less detailed rolling forward of current levels of expenditure in the absence of, for example, NDS depot building condition data. Current asset knowledge is a factor in the level of sophistication employed in the policy.

10.3.4 We accept that there has had to be a pragmatic approach taken to the development of the policy taking account of the varying levels of asset information and the levels of criticality the particular asset grouping has in relation to the overall portfolio.

10.3.5 The dominant building type is the franchised stations which account for over half of the planned levels of spend. The Policy in this case is based on the outputs from the Tier 2 model translated into volumes in Tier 1. The same is true of the critical blocks at the LMDs. The degradation / intervention regimes produced by the Tier 2 model are designed to maintain asset condition. Forecasts produced by NR demonstrate that over CP5 the critical assets covered by the modelling will largely maintain their PARL.

10.3.6 In the case of managed stations the NR view is that their presence at the limited number of such facilities means that they are able to directly monitor the rates of degradation and intervene as necessary to maintain condition. Thus, there is a reliance on a bottom-up approach to the generation of activity volumes.

10.3.7 To develop the policy applicable to lineside buildings the findings of a NR surveyed sample of the portfolio have been evaluated to determine activity. These have then been extrapolated across the national portfolio. This approach would appear to be reasonable given the lack of asset data however, the impact on the condition of this regime cannot be determined from available information. There is some uncertainty with CP5 volumes and moderately high uncertainty associated with the CP5 costs and CP6-CP11 volumes and costs.

10.3.8 The remaining building types rely on historic spend levels. With this group there is a lack of credible evidence to support the outcomes of the steady-state funding during CP4. This has resulted in some uncertainty regarding how this level of activity will impact on condition in CP5 in order to maintain the CP4 exit asset condition.

Robustness

10.3.9 The CP5 Building Asset Policy as it applies to franchised stations and LMDs has been based on good asset knowledge and a combination of WLCC modelling and an assessment of the impact of the policy application in the Tier 1 model on the asset portfolio. We have concerns that the way in which the volumes of work are derived in the modelling leads to higher volumes than would be necessary to maintain asset condition. As a result we consider that the Policy is robust and highly likely to provide the required performance for the asset.

10.3.10 In the case of Managed Stations, a bottom-up approach has been used to generate activity volumes. None of the bottom-up Asset Management Plans have been provided and this ‘bottom-up’ view does not appear to have been constrained by top down direction, which we believe may lead to more work

being undertaken than otherwise would have been planned, delivering a higher service level than is required. Our view therefore is that the Policy will deliver the required building performance in CP5.

10.3.11 For other buildings assets, including LMDs, we are less certain that the policy is robust. The policy approach for their management has been developed from a sample of these buildings and/or the historic spend on the asset types. With the exception of LMDs, no or very limited WLCC modelling has been used to understand these assets. There is a lack of evidence to support the outcomes of the expenditure in CP4 resulting in some to moderately high uncertainty as to impact on asset condition of the proposed maintenance and renewal regime.

Sustainability

10.3.12 We are of the opinion that the management approach proposed for station buildings (franchised and managed) is likely to be sustainable. Again the policy approach we believe provides for significant maintenance intervention and the long term performance of the assets should be ensured. For managed stations NR claim that the sustainability is proved by a back-check of the bottom-up workbank they have carried out using the Tier 1 model. Evidence to support this was received following the review meeting on 12 April 2013 but we have not had the opportunity to consider this as part of the review.

10.3.13 For NR's other building assets (lineside buildings, MDUs) the lack of information on condition and impact of maintenance make the long term performance of the Policy less clear. The level of information on the performance and value of maintenance expenditure needs to be improved in the next Control Period to fully understand the effect of the management approach to these assets.

Whole System Cost

10.3.14 NR have carried out WLCC modelling of their critical fabric assets. This has informed the bottom-up planning of managed station workbanks as well as top-down forecasts of franchised station and LMD assets. This has included modelling of discrete interventions on specific components of the assets. It has been mentioned previously that we have some concerns regarding the way in which the Tier 2 WLCC model considers benefits. This is in regard to the fact that it operates as an NPC rather than an NPV model. The impact of this is that renewals are deferred leading to the potential overall decline in asset condition over time and greater reliance on management intervention.

10.3.15 We do not consider the use of NPC to be appropriate in the consideration of whole system cost since the benefits of renewal are not fully taken into account. It is acknowledged however that the Tier 1 model has a role in this.

10.3.16 The use of a greater number of minor interventions to push renewals further into the future means that it is likely that the whole system costs of these critical assets will not be optimised. We have not been able to validate this whilst cost breakdown data is not available.

Embedded Efficiency

10.3.17 NR have indicated [SBPT220, Table 2] that it expects to save £66m as a result of embedded efficiencies. This is forecast to come from *"significantly improved asset data and modelling"*. No further detail has been provided as part of the SBP submission on how this has been calculated.

10.3.18 As part of our IIP review NR however shared a brief paper '*Embedded Efficiencies Report Buildings'* [NR December 2011] which provided an account of the means by which the embedded efficiencies of £66m were calculated.

10.3.19 We have uncertainties regarding the process by which these embedded efficiencies have been calculated based on the information provided in the paper. Principle amongst these concerns is a lack of objective evidence that the process which was adopted was credible. There is a lack of clarity on the baseline adopted, the datasets used in the exercise, and the challenge and review process adopted. We are unclear about which new practices are being introduced to generate the efficiencies. Finally, the paper describing the process is over a year old and has clearly not taken account of the recent versions of the Building Asset Policy volumes.

10.4 Policy Application

10.4.1 The delivery of the Buildings Asset Policy is being driven both from the Routes, in terms of their workbanks, and centrally where limited local asset information has led to a reliance on centralised modelling.

10.4.2 The application of the policy has been reliant on the buy-in by the Routes to the aims and objectives of the policy and the understanding of what is required to ensure compliance. In this regard it was clear that a number of the RAMs had been actively involved in the development of the policy and this brought with it a high level of understanding and buy-in.

10.4.3 The Route teams were provided with the output from the Tier 0 model which split the modelled plans down to individual project level where this was supported by asset data, for example at a franchised station. Routes then matched their local workbanks to the planned funding levels to generate their submissions.

10.4.4 From our sampling it would appear that where Route local asset knowledge was good this process worked well and there was then a dialogue between the centre and the Route challenging the submission.

10.4.5 Where there was less certainty regarding the asset knowledge, or no existing workbanks were available, there was a requirement to undertake a more intensive exercise to confirm or identify the plan activities. In one case it was stated that the Route had to visit all of their assets to validate the planned activities.

10.4.6 Where there was a perceived requirement for the Route to undertake projects which were outside the norm of the modelling then this had to be justified to the central team. It was notable that all of the Routes sampled had projects which fell into this category.

10.4.7 In developing their submissions all of the Routes we visited were able to demonstrate that, in a sample of the workbank items, there was evidence of

compliance with the requirements of the policy in terms of the planned levels of intervention against levels of PARL.

Activities and Volumes

10.4.8 As described above the means of generating volumes in the modelling for each of the building types was different.

10.4.9 The volumes associated with the franchised stations were largely determined for the critical elements from the degradation curves developed in the Tier 2 model. We understand that the Routes were provided with the modelled volumes ahead of their submissions, giving them an indication of the potential level of spend. We have, during IIP, expressed some reservations regarding the operation of the degradation model which we consider generates higher levels of activity than is necessary to maintain asset condition. We believe that this is because of the modelling assumptions associated with the generation of a 'typical' asset and the profile of the degradation curves. As a result we are uncertain whether the volumes of activity included in the plan are truly reflective of those required to deliver a 'flat' level of asset condition in both the short and long term. Following a review meeting on 12 April 2013 NR provided additional information to support the modelling approach which we have not had the opportunity to fully consider as part of this review.

10.4.10 For the managed stations there is a reliance on the local asset knowledge, as opposed to the degradation modelling, to first generate work volumes. The NR position on this is that there are a limited number of these facilities which have a near constant presence of NR staff who will be able to identify work required. We are uncertain that the planned levels of activity can demonstrate that asset condition will be sustained at the CP4 exit levels.

10.4.11 The LMD volumes have been developed in a similar fashion to those associated with the Franchised Stations utilising the Tier 2 modelling. As such the concerns expressed in 10.4.9 apply and we are uncertain whether the planned activity levels will deliver the 'flat line' asset condition required.

10.4.12 In the case of lineside buildings NR have undertaken a level of sampling to determine the works required to be undertaken to these assets and then allocated this to the Routes on the basis of their asset inventory. We recognise that this is a reasonable means of determining the activity volumes in the absence of complete asset condition data. Nevertheless we have some uncertainty regarding whether this sampling has generated volumes which accord with the delivery of the required outputs due to the lack of evidence.

10.4.13 There is limited asset data on which to determine the volumes associated with the planning of the activities of the MDU and NDS facilities. As such NR have rolled forward current spend levels. We consider this a reasonable approach for these facilities in the absence of asset data. Whilst the methodology is practical, it does lead to some uncertainty in the CP5 renewal volumes as to how this level of activity will impact on condition, and there is moderately high uncertainty in CP6-CP11 volumes.

Costs

Overall Spend

10.4.14 Figure 10-5 provides a summary of the historic and forecast costs associated with the buildings portfolio.

10.4.15 In the early part of CP5 there is a clear emphasis on franchised stations which see a significant level of increased expenditure in year one dropping off over the course of the control period.

10.4.16 Significant percentage increases are also noted in depots and depot plant. From discussions with the Routes these peaks appear to be the result of the renewals of significant items of plant (carriage washers etc.) and maintenance shed renewals.

10.4.17 For the buildings asset, maintenance cost items are provided for each of the sub-asset lines (e.g. managed stations, NDS Depots) but costs for these are not listed. The cost of CEFA examinations for buildings is understood to be included in the overall 'civils' figure of £419m (post efficient) in CP5 and CP6. No maintenance volumes are provided.

Unitised Costs

10.4.18 NR have undertaken an exercise to develop costs for key activities associated with the buildings portfolio. This build-up from 'first principles' has broken each of the activities down to its key elements and then built up a suite of appropriate rates. This has created a set of national average rates which can be used in the modelling.

10.4.19 Reconciliation of the rates within the Tier 1 model and the Unit Cost Workbook identified a discrepancy between the two. Network Rail provided clarification that the rates in the Tier 1 model were approximately 10% too low due to an oversight in the production of the SBP submission, which is in-line with the discrepancy identified by Arup. Significant inconsistencies in item descriptors and in individual unit rates meant Arup was unable to complete the reconciliation as a number of items included in the Tier 1 model were not identified within the Cost Workbook.

10.4.20 In discussions with the Routes it was clear to us that these unitised rates had been adopted to varying degrees. In the majority of cases the rates were 're-structured' to take account of local factors. At the other extreme the rates were ignored and the workbank priced by the Route Investment Projects (IP) team.

10.4.21 During the course of the review it has not been possible to gather sufficient information to enable us to come to a judgement on the Route cost figures.

10.4.22 Based on the foregoing we believe that there is uncertainty regarding the costs which have been used in the development of the plan. This is principally because we have been unable to secure sufficient evidence to allow us to judge the quality of the figures in key areas.

		Actual	Actual	Actual	Forecast	SBP							pre-efficient
£m (2012/13 Prices)		2009/10	2010/11	2011/12	2012/13	2013/14	CP4		2014/15	2015/16	2016/17	2017/18	2018/19	CP5
Buildings		257	289	280	242	216	1,284		321	298	272	237	200	1,328
Managed Stations		58	66	60	61	59	303		36	67	43	35	33	214
Franchised Stations		143	172	161	132	114	722		191	154	159	132	116	753
Depots		32	31	36	30	18	146		51	37	33	31	24	176
Lineside Buildings		21	18	17	13	22	91		29	25	27	24	23	128
Depot Plant		4	2	5	5	4	20		13	14	10	15	5	56

Figure 10-5: Historic and Forecast Levels of Spend on Building Asset Renewals

Delivery

10.4.23 The Buildings Asset Policy and the associated modelling has resulted in the balance of the activities planned for CP5 moving away from renewals to more of a programme based in lower scale interventions like refurbishment.

10.4.24 The last section demonstrated that there is forecast to be a reduction in expenditure associated with managed stations and an increase in spend for the majority of the other building types. The most significant increase in actual spend levels comes from the franchised stations. We note that there is no evidence of asset management principles being applied to managed stations to develop a long-term plan, resulting in a reactive strategy, not a long-term plan. We do not consider the increased level of spend at these locations to be undeliverable.

10.4.25 At the review sessions held with the Routes it was notable that in some instances representatives from the IP organisation were present. In these cases there was a general acceptance that in formulating the workbanks cognisance had been taken over its deliverability. The synchronisation of building works with planned activities associated with other asset disciplines was also noted.

10.4.26 We consider that whilst this may place a greater reliance on the management of delivery contracts there is little unique about the work associated with the building portfolio which will require the use of scarce resources, as in the case of signalling work. We therefore have little uncertainty regarding the building plan's deliverability.

10.5 Summary

10.5.1 The Buildings Asset Policy sets out the NR policy for the management of a diverse portfolio of building types. Each of the six groups of building type has been treated separately with the individual policy applications largely driven by the level of asset information currently held.

10.5.2 In general, the approach which has been taken by NR where asset information is limited has been pragmatic and we agree with the methodology employed. Whilst accepting of the principle we remain concerned regarding the Tier 2 modelling work particularly that associated with the derivation of the asset degradation / intervention curves. These we believe to produce greater volumes than are required to deliver the required outputs.

10.5.3 Clear targets have been stated by NR to demonstrate both robustness and sustainability across the portfolio. We have some level of uncertainty regarding the application of the targets where there is a current lack of a baseline from which to measure delivery. This applies where asset data is currently poor.

10.5.4 The development of the unit costs is welcomed. However in the development of the plan the customising of the rates by the Routes has meant that we are uncertain regarding the appropriateness of these.

10.5.5 In terms of delivery, we have not seen evidence that the Buildings work would not be deliverable by NR in CP5.

10.5.6 As noted in Section 5 above, we have prepared a 'System Diagram' for each 'Sub-Asset' ('Level 3') and 'allocated' an uncertainty 'colour' to each element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. The summary for Buildings is presented in Figures 10-6 to 10-10 below. Larger copies are included in Appendix D.

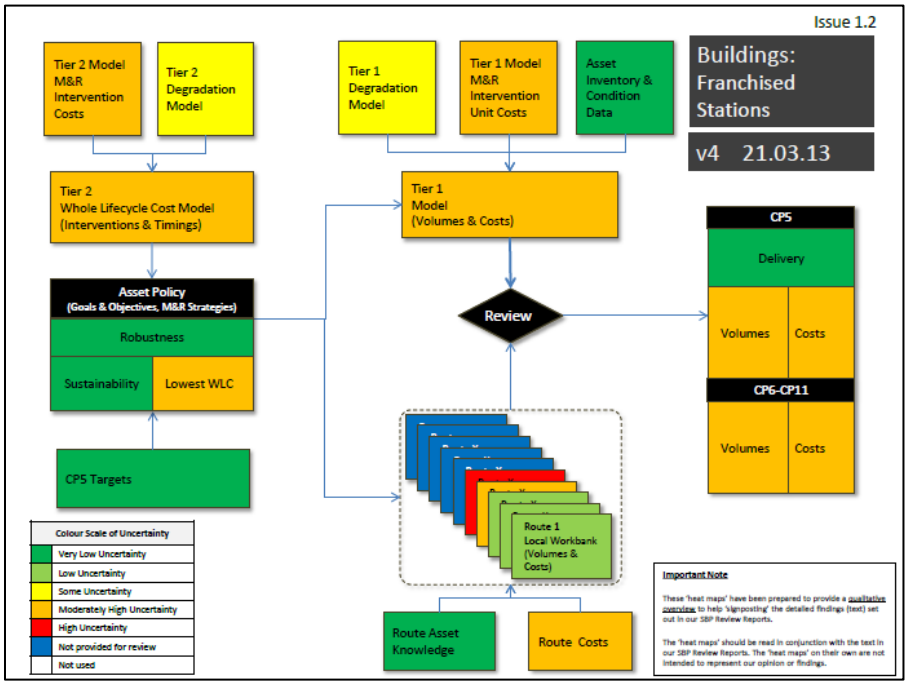


Figure 10-6 'System Diagram' for Buildings – Franchised Stations

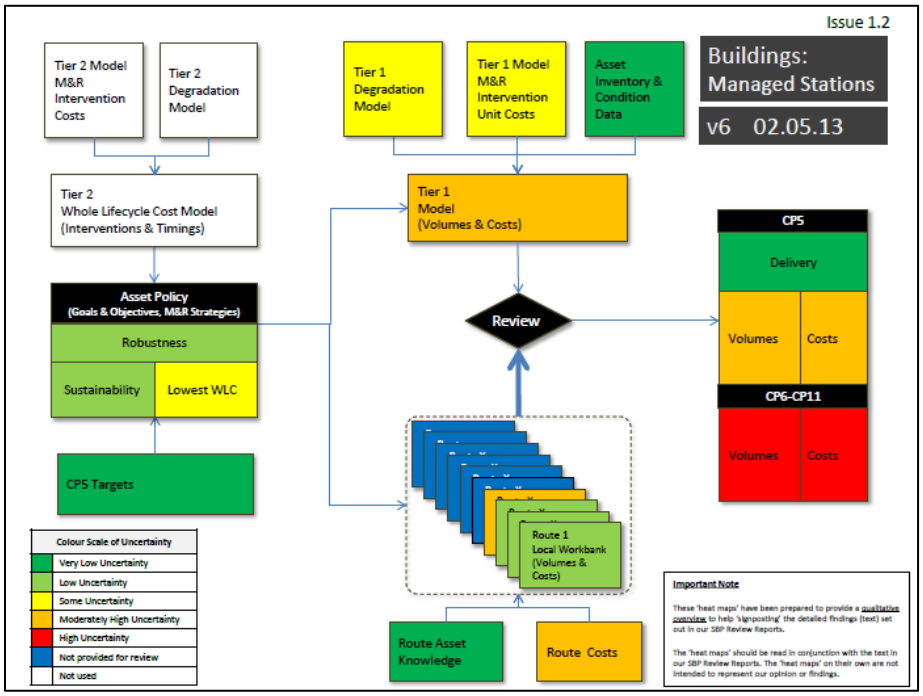


Figure 10-7 'System Diagram' for Buildings – Managed Stations

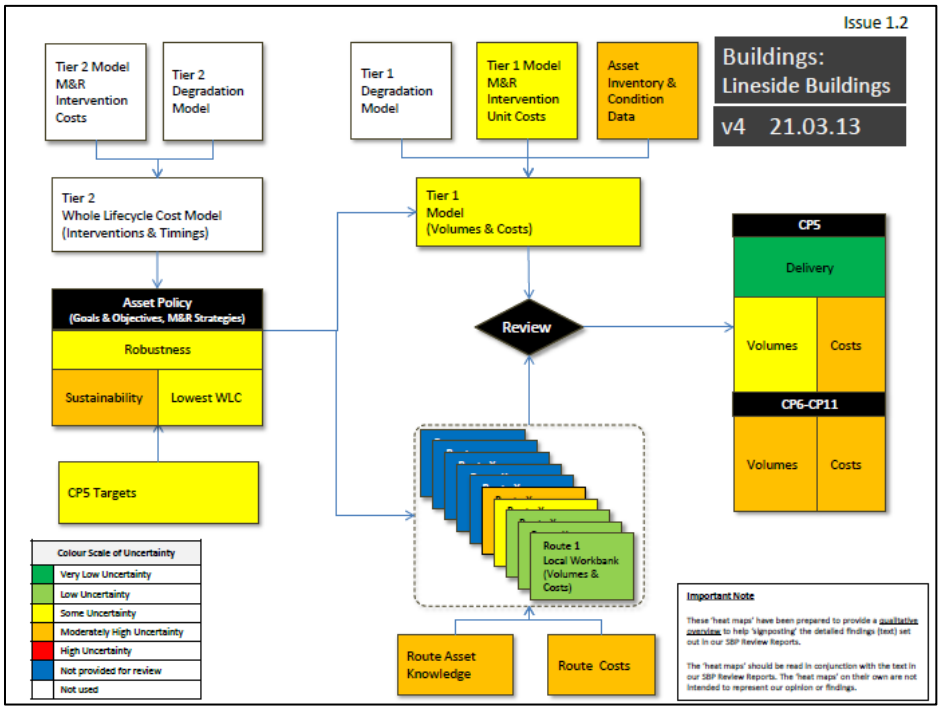


Figure 10-8 'System Diagram' for Buildings – Lineside Buildings

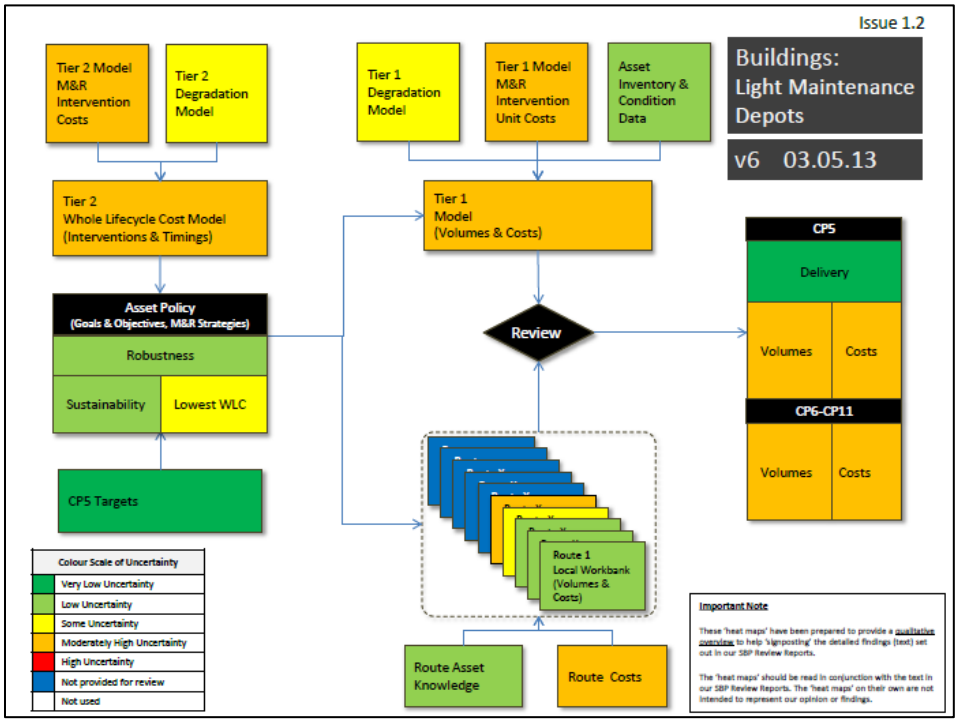


Figure 10-9 'System Diagram' for Buildings – Light Maintenance Depots

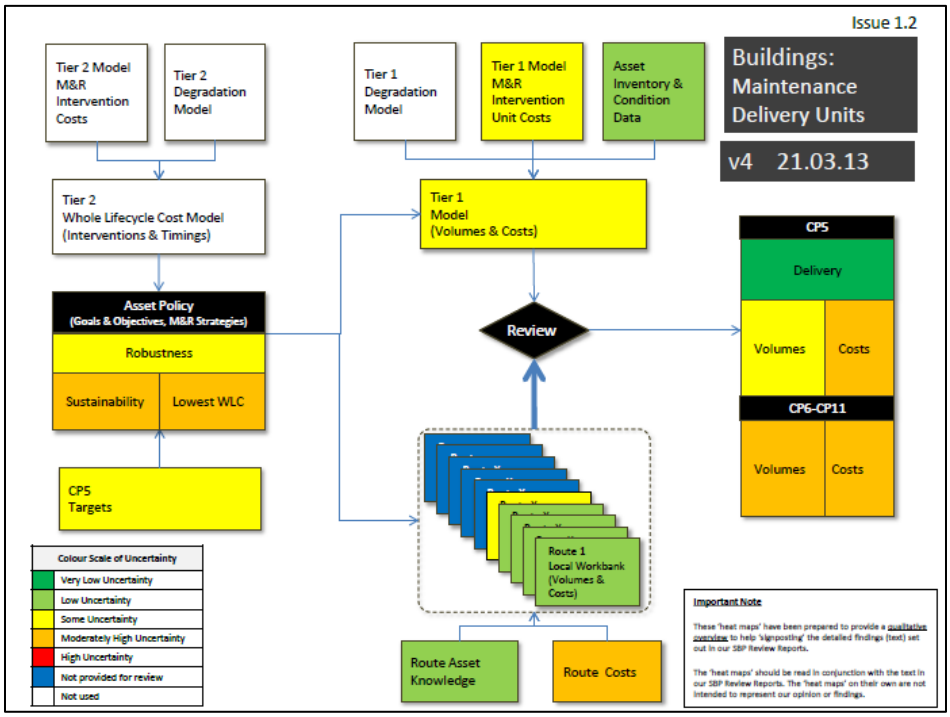


Figure 10-10 'System Diagram' for Buildings – Maintenance Delivery Units

11 Drainage

11.1 General

11.1.1 The Drainage Asset Policy document concentrates on the track and earthworks drainage, as this forms the majority of the drainage asset and is where the majority of drainage maintenance and renewals monies are currently spent. Further details of these assets are given in the Track Asset Policy [SBPT3010] and CP5 Earthworks Asset Policy [SBPT3015a].

11.1.2 Tunnel drainage is part of the earthworks asset portfolio, although the tunnels themselves are within the structures asset portfolio. Culverts are considered within the Structures Asset Policy [SBPT3013]. NR note that all other drainage assets are considered within the relevant parent asset Policy - for example station drainage is part of the Buildings Asset.

11.2 Asset Performance and Targets

Historic Performance

11.2.1 In terms of 'performance' the Drainage Asset is considered by NR as a 'servant' asset such that it supports the reliable delivery of other asset types, primarily Track and Earthworks.

11.2.2 The NR Earthworks Asset Policy [SBPT3015a] summarises earthworks reliability trends and NR have analysed earthworks failure data between 2004 and 2012, a summary plot is presented in Figure 11-1 below.

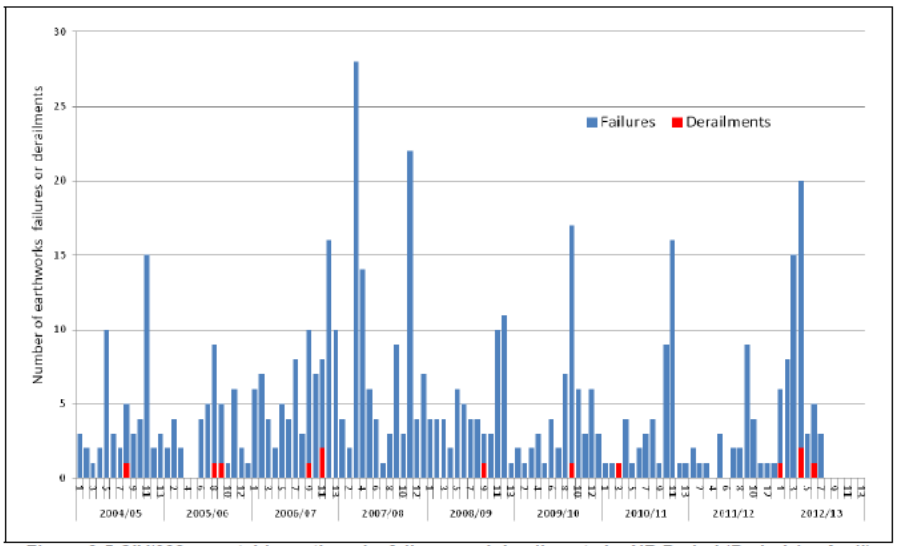


Figure 11-1: Reportable Earthworks Failures and Derailments 2004-2012

11.2.3 NR note that 80% of failures are related to high rainfall. They also note that for derailments between 2007 and 2012, it is estimated that 50% were directly attributable to inadequate earthworks drainage.

11.2.4 No national data on track formation failures due to poor or inadequate drainage is presented in the Policy. However, one Route – Western - does set out historic drainage performance associated costs in their Route Plan

[SBPT219]; see Figure 11-2. This is very useful as it provides evidence as to the potential benefit from drainage works.

Drainage performance – flooding incidents

Year	No. of Flooding Incidents	Delay Minutes	Schedule 8 Costs
2009/10	24	5,084	£239,318
2010/11	16	11,361	£762,140
2011/12	8	2,549	£189,399
2012/13 (as at 12/09/2012)	32	8,724	£642,808

Drainage performance – wet beds

Year	No. of Recorded Wet Beds (Closed Out)	Cost (Manual Removal)	Cost (Mechanical Removal)
2009/10	1,536		
2010/11	1,627		
2011/12	1,534	£1,239,785	£469,518
2012/13 (as at 11/09/2012)	909		

Figure 11-2: Drainage Performance – Western Route 2009-2012 [SBPT219]

11.2.5 NR note that historically the drainage asset has been renewed and maintained as an integral part of the renewal and maintenance of the track, earthworks, structures and buildings assets. Furthermore they note that with current NR accounting practices it has not been possible to reliably disaggregate the costs or volumes of drainage works to obtain historic total drainage expenditure.

Targets

11.2.6 It is noted that there are currently no regulatory targets set for the volume of renewal activity and that any CP5 targets (regulated or otherwise) have yet to be defined.

11.2.7 In the SBP documentation that we have reviewed, we have not identified a clear summary of outputs / activities that are to be undertaken in CP5 based on the Drainage Policy. A number of Routes (e.g. Sussex) have identified specific large drainage projects to be undertaken in CP5 (e.g. drainage renewal of 1km of track drainage to alleviate formation and track geometry problems).

11.2.8 There are no specific high level asset measures for Drainage as it is seen as supporting the Earthworks and Track assets. The specific high level earthworks and track measures for 'robustness' and 'sustainability' are set in the Strategic Business Plans [SBPT101, 102].

11.2.9 There is no quantitative data in the Drainage Policy that gives any indication of the exact improvement that will be accrued in CP5 from the drainage expenditure. Accordingly our opinion is that it is highly uncertain what exactly the Targets are for the Drainage Asset in CP5. However, we consider it very likely that the implementation of the proposed Drainage Policy will help reduce the number of track failures and reduce earthworks risk in the medium to long-term.

11.3 Policy

11.3.1 Since our IIP Review in December 2011 [Arup 2011a], NR have continued to improve their asset knowledge. Specifically they have undertaken a national walkover survey of the remaining 65% of the network which has no data. This has allowed NR to have a much more reliable inventory including minor assets (inlets and outlets, ponds, pumping stations and soakaways) that were unknown at IIP; however, there is still some uncertainty associated with the quality of the drainage asset inventory.

11.3.2 Although NR appear to have made good progress with drainage surveys, we note that much of the condition of the drainage asset (over 70% of pipework for example) has yet to be determined. Our opinion is that there is high uncertainty associated with NR's knowledge of their drainage asset condition.

11.3.3 For the drainage asset the only item classed as 'maintenance' relates to drainage inspections and surveys. It is highly uncertain what the impact of the proposed maintenance optimisation during CP5 [SBPT3004] will entail and its potential impact on the effectiveness of the drainage inspections and surveys.

11.3.4 NR have not yet undertaken a quantitative whole life cost analysis to identify lowest WLC interventions. We note that this is part of NR's planned development work.

11.3.5 The principle of managing the route drainage as a single system with improved liaison with the Track and Earthworks teams is very positive. However, at the time of writing we have not seen details of the proposed Drainage Management Plans. It is unclear whether each Route will be producing these in CP5, when in CP5 and what exactly each will comprise. We also note that the Routes seem to be at very different maturity stages with their drainage asset management.

11.3.6 As noted above it is very positive that, earthworks, track and drainage are being considered as a system and that the division of responsibilities has been explicitly set out in the Drainage Policy.

Robustness

11.3.7 Due to uncertainty associated with asset inventory and condition, together with specific outputs for the asset, we consider there is still uncertain whether the Drainage Asset Policy is robust.

Sustainability

11.3.8 Due to uncertainty associated with whole life costing, together with specific outputs, we consider that it is still highly uncertain whether the Drainage Asset Policy is sustainable.

Whole System Cost

11.3.9 Due to uncertainty associated with various aspects of the Policy, in particular the linkage between cost / outputs and whole life costing, we consider that it is still highly uncertain whether the current Policy represents lowest whole life, whole system cost.

Embedded Efficiency

11.3.10 For the drainage asset no renewals 'embedded efficiency' has been assumed by NR. This is consistent with NR's view that although the Civils policies have been revised, *'the elevated level of uncertainty related to this asset makes it impossible at this time for us to assess any level of embedded efficiency that may result from the new asset policies.*' [SBPT220].

11.4 Policy Application

11.4.1 The drainage asset is considered by NR as a 'servant' asset with all CP5 and CP6-CP11 volumes and costs being accounted for under either Earthworks or Track.

Activities and Volumes

11.4.2 We have not been able to understand what in terms of physical drainage related activities are to be delivered in CP5 associated with the proposed Plan 5.

11.4.3 Maintenance volume items are provided for Off-track drainage [F211-L211] but volumes for these are not populated. No maintenance volume items are provided for Earthworks drainage inspections and surveys.

11.4.4 There are no renewal volume items for drainage activities for earthworks drainage or track drainage in the Tier 0 Database [SBPT3038] or the Data Book [SBPT3338].

11.4.5 We understand that earthworks drainage renewals volumes have been derived 'top-down' from the two SCAnNeR models. Whilst have been able to understand the general derivation of these in the SCAnNeR models we have had difficulty in 'tracing' these forward to the costs in the SBP submission. It is unclear how specific large drainage projects identified by Routes for CP5 (e.g. Sussex Route - drainage renewal of 1km of track drainage to alleviate formation and track geometry problems) have been taken into account.

Costs

11.4.6 Maintenance cost items are provided for Earthworks drainage inspections and surveys [E11 - L12] and Off-track drainage [F65-L65] but these are not populated.

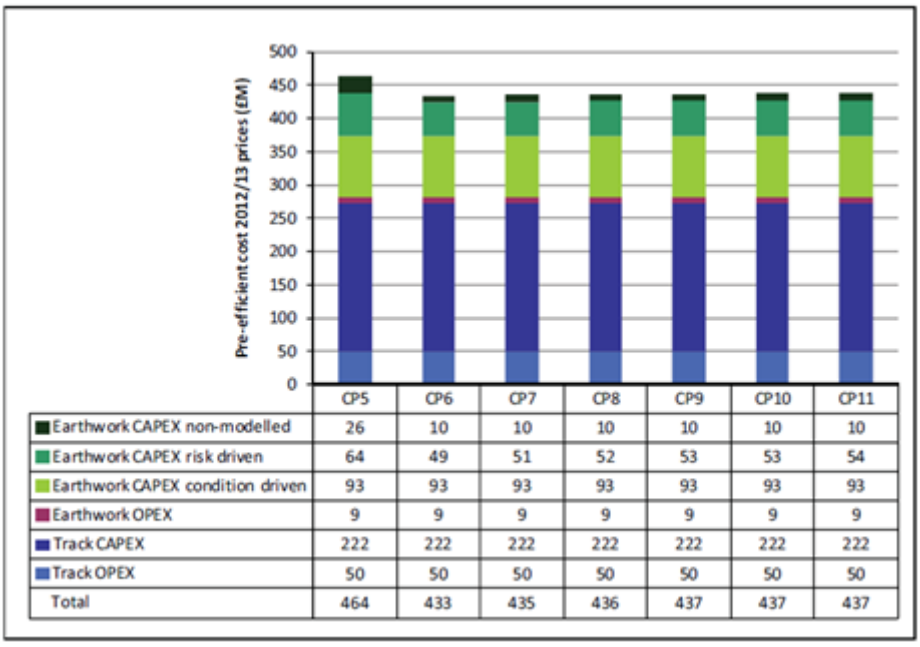
11.4.7 It is noted that there is a high dependency on a small number of unit rates (e.g. for Track Drainage 96% of CAPEX value is based on just 3 out of the 59 different rates) and there is a large dependency on the accuracy of these items. The ranges given for these items between the ‘Best’, ‘Minimum’ and ‘Maximum’ values highlights that the actual costs for this works can vary considerably. For example the rate for renewing a pipe varies from £72.80/m to £1329/m with a quoted 'best' figure of £414/m (note that 61% of the CAPEX spend for track drainage is associated with this item). Accordingly we consider that there is moderately high uncertainty associated with the unit rates.

11.4.8 A CP5 cost for Earthworks Drainage renewals of £183m [F49] and a further £162m in CP6 rising to £167m in CP11 is proposed [G49-L49]. The CP5 cost estimate for Earthworks Drainage renewals provided by the Tier 1

Earthworks SCAnNeR model is £159m. We understand the additional £24m in the SBP submission relates to tunnel drainage works but we are unclear on the detail of these costs. The Earthworks Drainage renewals for CP6-CP11 appear to be based on the Tier 1 Earthworks SCAnNeR model. An additional £10m in each period is added we presume to cover the additional tunnel drainage activities. Again we have not been provided with any details of these extra costs or their derivation. As noted above it is unclear where Drainage inspections and surveys are costed and also any allowance for preparation of Drainage Management Plans or similar.

11.4.9 A CP5 cost for Track Drainage renewals of £209m [F122] reducing to £129m per Control Period (CP6-CP11) is proposed [G122-L122]. We are unclear how these Track Drainage renewal costs have been derived. We understand that the Drainage SCAnNeR model has been used to develop these costs, however, the model presented for review provides a figure for CP5 of £221m and it is not clear how this figure has been taken forward into the final submission. We note in the consolidation of costs in the Tier 1 Track model, however, that an earlier version of the SCAnNeR model is referred to [AO/030/3A]. We also note that the Drainage SCAnNeR model also provides volumes of maintenance and renewals works; however, these are not included in the Tier 0 Database [SBPT3038] or the Data Book [SBPT3338].

11.4.10 We have not been able to reconcile the figures presented in Figure 11-3 (£464m) with the above figures or the overall CAPEX figures presented in the Drainage Renewals Expenditure Summary [SBPT223].



	CP5	CP6	CP7	CP8	CP9	CP10	CP11
Earthwork CAPEX non-modelled	26	10	10	10	10	10	10
Earthwork CAPEX risk driven	64	49	51	52	53	53	54
Earthwork CAPEX condition driven	93	93	93	93	93	93	93
Earthwork OPEX	9	9	9	9	9	9	9
Track CAPEX	222	222	222	222	222	222	222
Track OPEX	50	50	50	50	50	50	50
Total	464	433	435	436	437	437	437

Figure 11-3: Selected Investment Option - Plan 5 [SBPT3017]

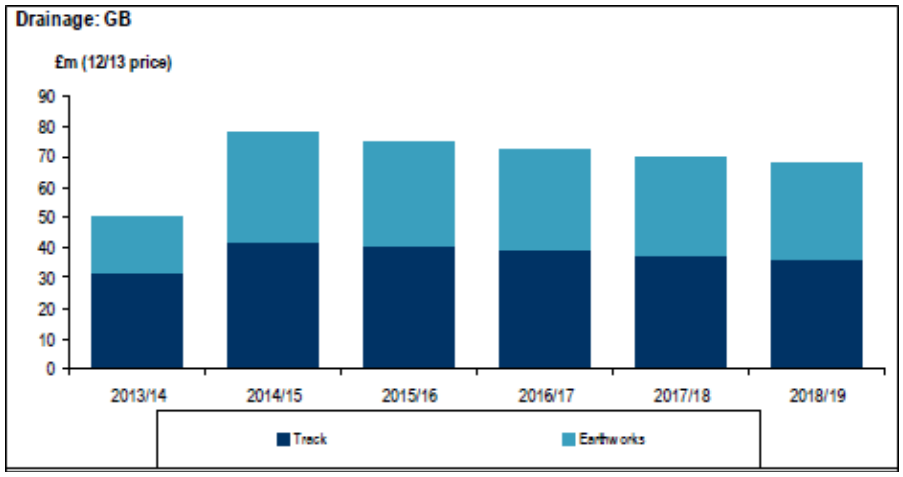


Figure 11-4: Track and Earthworks Drainage [SBPT223 p43]

11.4.11 All these factors mean that we consider it is highly uncertain as to what is being proposed in the way of drainage works in CP5 and CP6-CP11 and the expenditure that is being proposed.

Delivery

11.4.12 The Route Plans and our meetings with the Routes indicate that the Routes are 'gearing-up' to undertake the drainage improvements implied by the Asset Policy. The Routes appear to be approaching this in different ways with some (such as Western Route producing a bottom up plan for renewal, refurbishment and maintenance of Track Drainage - [SBPT219]). We have not seen these plans but have not seen evidence that drainage improvement work would not be deliverable in CP5.

11.5 Summary

11.5.1 The NR SBP submission includes a CP5 Drainage Asset Policy document [SBPT3017] which explains NR's proposed management approach for drainage including earthworks, track and tunnel drainage assets. The Asset Policy has progressed significantly since IIP based on improved inventory information which has allowed a more risk based approach to be developed.

11.5.2 It is very positive that earthworks, track and drainage are being considered as a single system and that the division of responsibilities have been explicitly set out in the Drainage Policy.

11.5.3 It is unclear what exactly the targets are for the Drainage Asset in CP5. However, we consider it very likely that the implementation of the proposed Drainage Policy will help reduce the number of track failures and reduce earthworks risk in the medium to long-term.

11.5.4 Whilst we support the principle of investment in drainage improvement, we consider that it is still uncertain whether the Drainage Asset Policy is robust and highly uncertain whether the Drainage Asset Policy is sustainable or represents lowest whole life, whole system cost.

11.5.5 An expenditure of £183m for earthworks drainage and £209m for track drainage in CP5 appears to be being requested. It is unclear as to what activity is associated with these figures and into CP6-CP11. For example we have not seen details of the proposed Drainage Management Plans. It is

unclear whether each Route will be producing these in CP5, when in CP5 and what exactly each will comprise. We also note that the Routes seem to be at very different maturity stages with their drainage asset management.

11.5.6 For the drainage asset, no renewals 'embedded efficiency' has been assumed by NR.

11.5.7 In terms of delivery, we have not seen evidence that drainage improvement work would not be deliverable by NR in CP5.

11.5.8 As noted in Section 5 above, we have prepared a 'System Diagram' for each 'Sub-Asset' ('Level 3') and 'allocated' an uncertainty 'colour' to each element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. The summary for Drainage is presented in Figure 11-5 below. A larger copy is included in Appendix D.

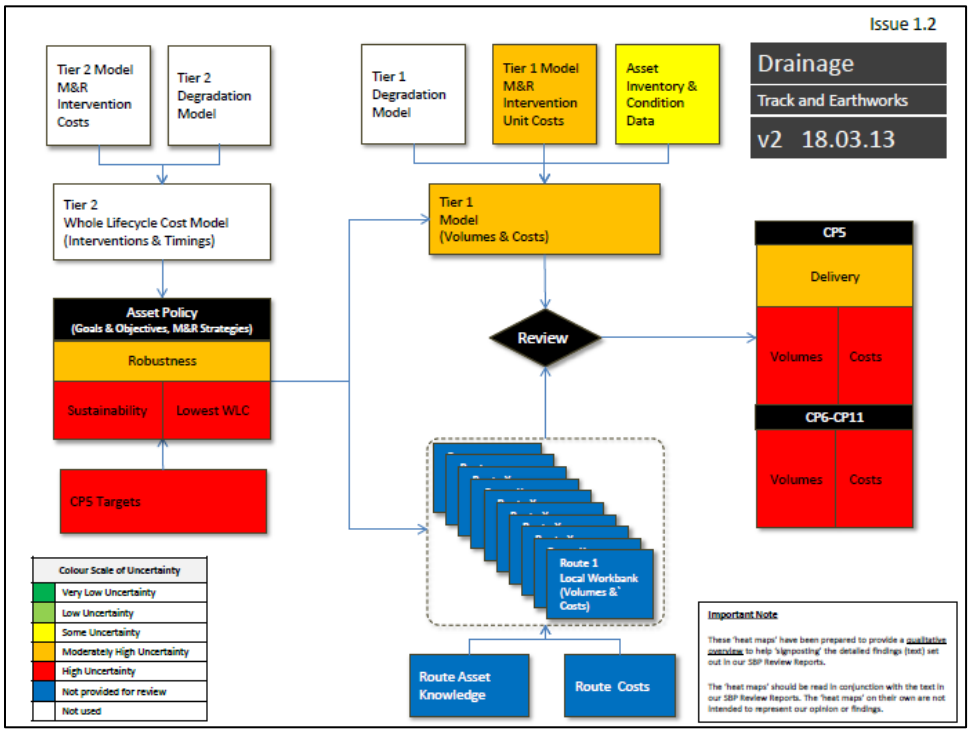


Figure 11-5 'System Diagram' for Drainage (Track and Earthworks)

12 Off Track

12.1 General

12.1.1 We have reviewed the off track Asset Group at Level 3 of the NR Cost Breakdown Structure in the Tier 0 Data Book [SBPT3038] namely:

- Level 2: Track
  - Level 3: Off Track

12.1.2 Our review is aligned to the NR Off Track Policy [SBPT3020] and thus includes both the boundary measures (fencing) and vegetation clearance asset management aspects. Vegetation clearance is an OPEX item, whereas fencing renewal is CAPEX. The Level 3 off track asset reported in the Tier 0 model and data book includes drainage which is discussed elsewhere in our report.

12.1.3 The off track assets described in the relevant NR policy [SBPT3020] are the vegetation that lie either side of the tracks up to the railway boundary and the physically fenced railway boundary itself.

12.1.4 The off track asset group has been discussed in challenge meetings with NR as part of meetings on the track asset. In general the level of discussion has been limited as the focus of meetings was on the track asset. Our notes from these meetings are in the accompanying document [Ref AO/030/4].

12.1.5 It was noted in meetings with route engineers that the definition of the off track asset can include other work items which reflect organisational arrangements for work delivery.

12.1.6 Boundary measure assets are categorised by the level of security for the adjacent track. Class I assets bound busy or electrified lines, whereas Class III assets typically bound agricultural land. Class I assets represent approximately 18% of the fencing asset and includes all fencing adjacent to 3rd rail electrification.

12.1.7 NR's knowledge of their fencing condition is shown in the Policy by the following summary chart – Figure 12-1. Currently 25-40% of the boundary measures are in poor to very poor condition depending on track category classification.

12.1.8 We noted a slight discrepancy (3% by length) between the fencing asset volumes in the Policy and that used in the Tier 1 model to develop renewal costs. NR have advised the Tier 1 model uses more up-to-date volume data than what is stated in the Policy.

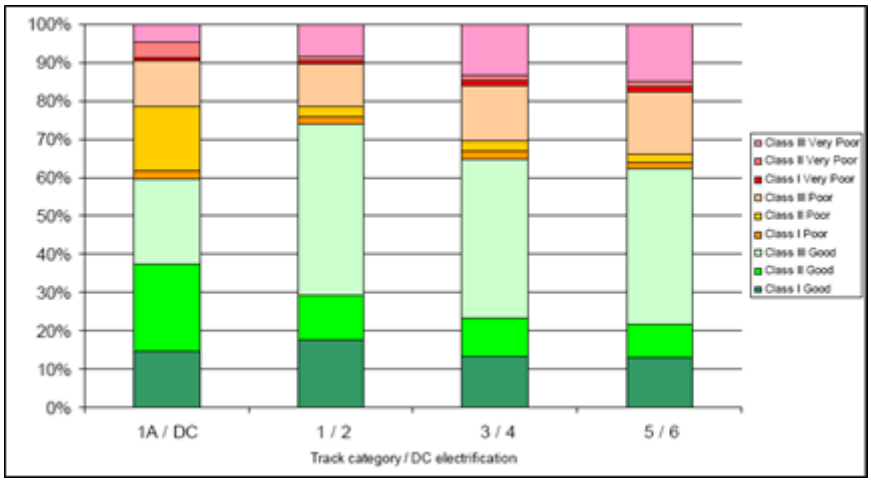


Figure 12-1 Fencing Asset Condition from Off-Track Asset Policy [SBPT3020, Figure 2.8]

12.1.9 The criticality of vegetation to the performance of the network is judged by its proximity to the running lines and, using data from the survey in 2009-11 is shown by the following summary chart:

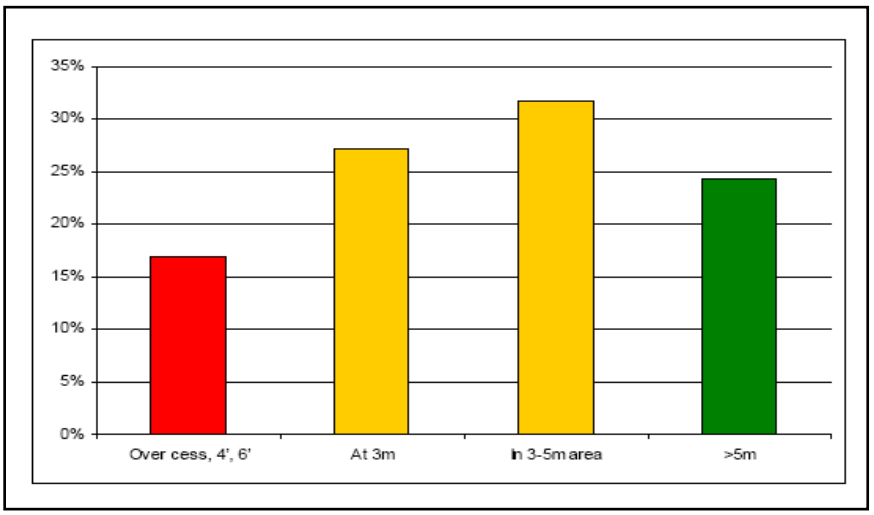


Figure 12-2: Vegetation Asset Performance from Off-Track Asset Policy [SBPT3020, Figure 2.9]

The information indicates that around 17% of the network has a significant amount of encroachment over the track.

12.2 Asset Performance and Targets

12.2.1 The impact of the off track asset on safety and efficiency is generally understood. The Policy sets out the linkage between management of vegetation and boundary measures on train performance. The potential effects of the off track asset are to directly impact running trains or to affect the performance of other assets such as signalling. The management of boundary measures is also driven by statutory requirements on NR.

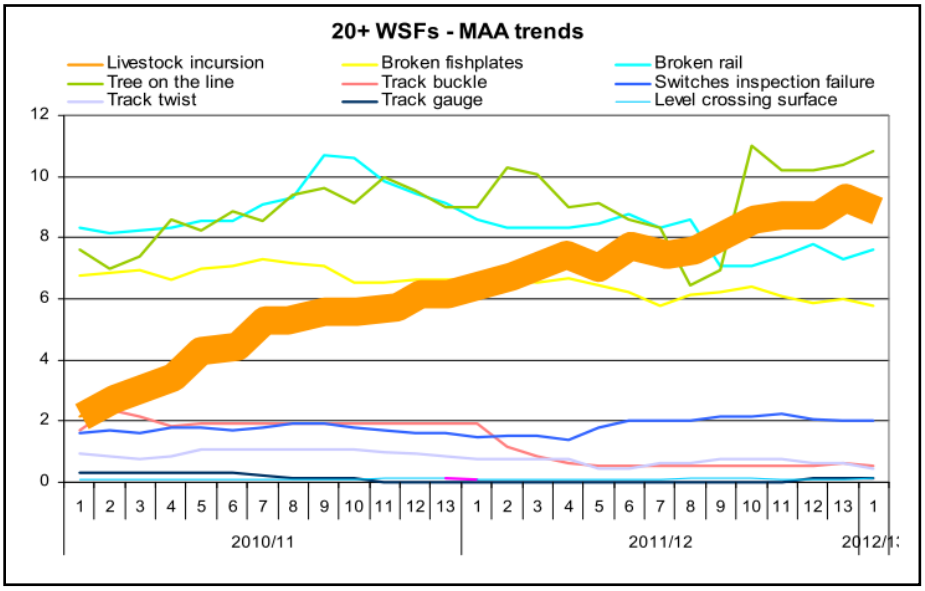


Figure 12-3: Wrongside failures due to livestock incursion highlighted in comparison with other track and off track wrongside failures from Off-Track Asset Policy [SBPT3020, Figure 2.3]

12.2.2 No performance targets are set for off track asset performance and management in the policy. Asset condition and associated risk to performance is used to influence policy and management planning. Objectives are set to remove poor condition assets or maintenance backlog over time but we are not clear how these are linked to overall asset management objectives.

12.3 Asset Policy

12.3.1 The policy prioritises intervention on assets based on condition and assessed risk together with, in some situations, legal obligations. Different interventions are set out for the varying conditions.

12.3.2 Class I and II fencing assets must be renewed when their condition falls to poor. Refurbishment is proposed for fencing interventions on Class III assets as a suitable approach to dealing with the backlog of poor and very poor condition fencing.

12.3.3 A Tier 1 model has been used to review the volumes and costs of fencing renewal and inform policy selection.

12.3.4 We consider the use of refurbishment for lower risk assets to be acceptable; however, the impact of this type of asset improvement on the future quantities and timing of renewal has to be considered and accounted for in forward planning.

12.3.5 Vegetation management policy is to be a planned preventative approach.

Robustness

12.3.6 In our opinion there is some uncertainty that the proposed policy will be robust for both boundary measures and vegetation management since no performance targets have been set. The policy, however, will result in increased activity and costs in CP5 and the benefit of this is not clear over the approach taken in CP4.

Sustainability

12.3.7 A move from a reactive to a pro-active approach to the management of the off track assets is proposed but we are not clear what outputs are proposed hence there is some uncertainty associated with the long term sustainability of the proposed NR approach.

Whole System Cost

12.3.8 Whole life/system costs have not been determined for vegetation management.

12.3.9 The Tier 1 model for fencing considers whole lifecycle costs. However, the assumption in the Tier 1 model for refurbishment of Class III fencing assets possibly overestimates the improvement in asset condition / life span.

12.3.10 We believe that the overall costs which are included in the plan may be above the levels necessary to deliver the policy requirements but it is difficult to make a judgement in the absence of information.

Embedded Efficiency

12.3.11 No embedded efficiencies are claimed for the off track asset policy.

12.4 Policy Application

12.4.1 NR are proposing to address the backlog of poor and very poor condition fencing by the end of CP5 in England & Wales, and the end of CP6 in Scotland. The Tier 1 model has been used to inform this decision.

12.4.2 The need to remove the backlog of poor and very poor condition boundary measure assets has led to an increased level of expenditure in CP5.

Activities and Volumes

12.4.3 The fencing renewal volumes are calculated by the Track Tier 1 model. That said, the SBP cost is higher than that calculated in the Tier 1 model (£171m vs. £159m) and the SBP volumes are not specified in the Tier 0 model. We therefore have moderately high uncertainty on the precise volumes to be delivered.

12.4.4 No work volumes have been provided for vegetation clearance.

Costs

12.4.5 Pre-efficient costs for CP5 for boundary measure asset renewal are predicted to be £171m and fall to £108m in CP6-CP11.

12.4.6 The modelling of refurbishment of Class III fences may be under-stating the need for renewals in CP6-CP11 arising from refurbishing the backlog of poor condition fences.

12.4.7 No maintenance costs have been provided for vegetation inspection or management in the Tier 0 database.

Delivery

12.4.8 We consider that the Policy is likely to be deliverable given the work is typically carried out by competent third-party contractors.

12.4.9 Within vegetation, the Policy highlights the risk that the spread of ash dieback may require an increased volume of tree felling as there may be over 200,000 ash trees within the railway boundary.

12.5 Summary

12.5.1 The off track asset includes vegetation and boundary measures.

12.5.2 We believe that the asset information held by NR for the off track asset to be good. The asset data presented shows a backlog of maintenance and renewals in both vegetation clearance (OPEX) and fencing replacement (CAPEX).

Vegetation

12.5.3 The proposed policy approach to vegetation management is robust; however, high volumes of vegetation management are anticipated as defined in the Off Track Policy driven by a target of clearing the backlog of work within the period. We are not certain whether this target provides additional value as compared to the work carried out in CP4.

12.5.4 NR highlight the risk that the spread of ash dieback may require an increased volume of tree felling as there may be over 200,000 ash trees within the railway boundary. There is no contingency in the CP5 Policy for tree felling from ash dieback. NR have advised that such work will be determined by Government policy at the time.

Boundary Measures

12.5.5 The NR approach to boundary measures asset management is driven by both security and safety. A target has been set to refurbish or renew the asset in CP5 in England and Wales with the consequence of an increased level of expenditure in CP5 over CP4.

12.5.6 There is a change in approach from being reactive to pro-active for these assets. However, in the absence of clear performance targets, there is some uncertainty on what this approach will deliver in the long term and hence the sustainability of the policy. The modelling used as the basis for the renewal costs may underestimate the costs for fencing renewal in CP6-11.

12.5.7 We believe that the overall costs which are included in the plan may be above the levels necessary to deliver the policy requirements.

Overall

12.5.8 We consider that the policy for both asset groups is likely to be deliverable given the reliance on competent third-party contractors to undertake the work.

12.5.9 There is some uncertainty whether the overall costs included in the SBP may be above the levels which are necessary to deliver the policy requirements. It is uncertain what volumes are actually being proposed and how they compare to CP4 historic volumes of work. There is moderately high uncertainty that the fencing renewal costs and volumes are underestimated in CP6-11.

12.5.10 As noted in Section 5 above, we have prepared a ‘System Diagram’ for each ‘Sub-Asset’ (‘Level 3’) and ‘allocated’ an uncertainty ‘colour’ to each

element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. The summary for off track is presented in Figure 12-4 below. A larger copy is included in Appendix D.

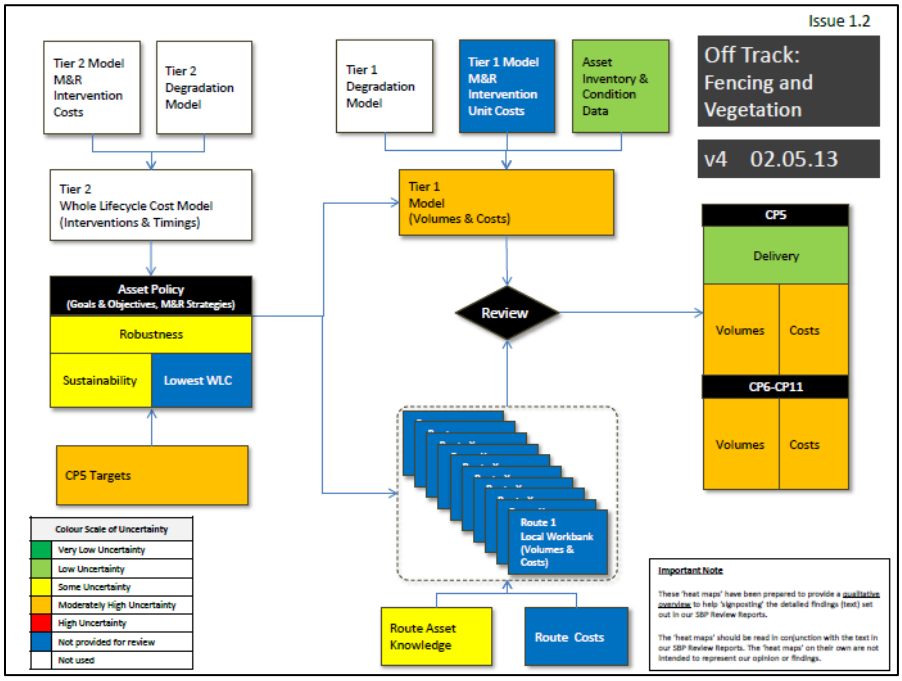


Figure 12-4 'System Diagram' for Off-track (Fencing and Vegetation)

13 Fleet

13.1 General

13.1.1 We have reviewed the Fleet Asset Group at Level 3 of the NR Cost Breakdown Structure in the Tier 0 Data Book [SBPT3038] namely:

- Level 2:
  - Wheeled Plant and Machinery
  - Level 3:
    - High Output
    - Incident Response
    - Infrastructure Modelling
    - Intervention
    - Materials Delivery
    - On track Plant
    - Seasonal
    - Stoneblower
    - Locomotives
    - Fleet Support Plant
    - Road Vehicles
    - S&C delivery

13.1.2 The relative split of CP5 'pre-efficient' expenditure is shown in Figure 13-1 below.

Wheeled Plant					
Asset Type	**CP4**	**CP5 Pre-Efficient SBP**	**CP5 Post-Efficient SBP**	**Variation CP4-CP5 Post-Eff**	**% var**
High output	-	£125m	£114m	-	-
Incident response	-	£7m	£7m	-	-
Infrastructure monitoring	-	£24m	£23m	-	-
Intervention	-	£128m	£119m	-	-
Materials delivery	-	£12m	£11m	-	-
On track plant	-	£150m	£141m	-	-
Seasonal	-	£44m	£41m	-	-
Locomotives	-	£2m	£2m	-	-
Fleet support plant	-	£28m	£26m	-	-
Road vehicles	-	£114m	£111m	-	-
S&C delivery	-	£2m	£2m	-	-
Total	**£345m**	**£637m**	**£598m**	**£253m**	**+73%**

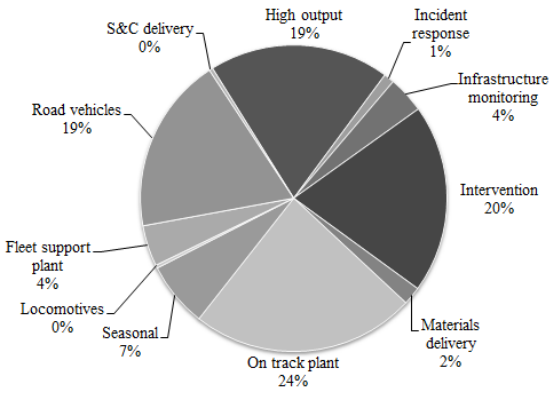


Figure 13-1 Fleet Expenditure CP4 –CP5

13.1.3 The NR fleet (wheeled plant) asset is divided into six principal fleets made up of a variety of vehicles from track maintenance machines (including intervention and materials delivery units), incident vehicles (including snowploughs) and road transport (both vans and cars) as shown in Figure 13-2. The fleet asset is managed by the National Delivery Service (NDS).

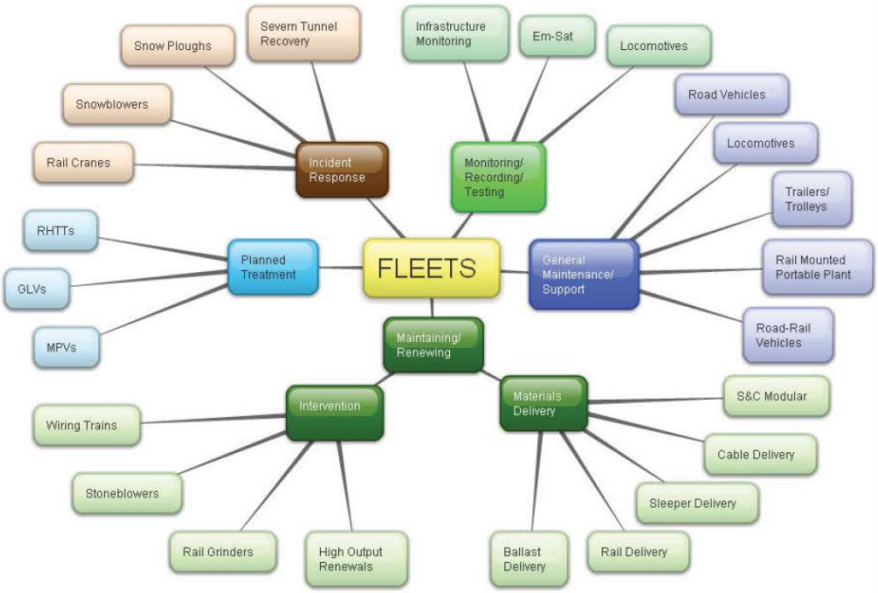


Figure 13-2 Fleet asset

13.1.4 The NR fleet policy [SPBT3018] focusses on NR owned plant, excluding plant owned by external organisations, and identifies how the asset management of the NR owned fleet will be undertaken.

13.1.5 NR present information on the fleet asset inventory and condition in the Fleet Policy including asset age, condition and service affecting failure rates for plant types.

13.1.6 The fleet asset represents a diverse range of plant that in part supports the delivery of track maintenance and renewal activities. Our review of the fleet asset has focussed on the intervention and materials delivery fleet as these are the more critical in terms of delivery of the maintenance and renewals works on the wider NR assets including track.

13.2 Asset Performance and Targets

13.2.1 A critical aspect for the management of the NR fleet asset is in our view the understanding of the demand for the asset in CP5. We are unclear if the requirement and availability levels have been determined or evaluated especially for the plant to support the maintenance and renewals works.

13.2.2 The overall fleet assets required to deliver the defined CP5 outputs will be made up of NR owned and supply chain owned assets. It is recognised that there will be competing demands at peak times for limited resources to deliver the full programme of infrastructure maintenance, renewals and enhancements as set out in the SBP. In addition, it is considered likely that several suppliers will have other railway infrastructure fleet demands from contracted work with other rail infrastructure owners such as HS1 and TfL.

Nevertheless NR have attempted to define their overall requirements in the appendices to the Fleet Asset Policy [SBPT3018] from which they draw conclusions on the ability of their supply chain to provide the balance of Fleet resources to deliver their CP5 Business Plan.

13.2.3 The alignment of the Fleet Asset Policy [SBPT3018] to the NR business plan is shown in Table 13-1.

Table 13-1: Fleet Business Plan Summary

Type of Plant	Aligned to Business Plan
Seasonal and Incident Response	Yes
Intervention Fleets (these vehicles are described in the main policy document and also referred to in Appendix 3, pages 8 and 9)	Broadly, but not to sufficient detail to demonstrate delivery of the SBP
Materials Delivery Fleets	Not to sufficient detail to demonstrate delivery of the SBP
Infrastructure monitoring fleet	Yes
On Track Plant	Yes
Locomotives	Yes
Seasonal Treatment Train	Yes
Road Vehicles	Yes

13.2.4 There are three important subsets to the intervention fleets that are not defined to a level of detail to give confidence that the quantum of resource will be available to deliver the Business Plan. These are fleets to deliver the plain line heavy refurbishment programme, the S&C heavy refurbishment programme and the S&C tamping programme for maintenance, renewals and enhancements.

13.2.5 NR Infrastructure Projects state in Appendix 3 to the Policy that there is a potential shortfall in:

- S&C tilting wagons and the associated turnaround facility throughput;
- Medium Output Ballast Cleaners (MOBCs) and other Ballasting plant and a significant portion of the current fleet will become life expired within CP5;
- Stoneblowers;
- Grinders; and
- MPVs.

13.2.6 It is not clear that this potential shortfall has taken account of the large programme of work included in the full enhancement programme, for example, Crossrail (on NR infrastructure); Thameslink; Northern Hub; etc. Whilst any shortfall identified in the future can be resolved by a procurement programme and leasing, it can take up to three years from identifying the need to actually have new large bespoke equipment delivered. We therefore conclude that even taking into account the planned overhauls and procurement there is a risk to CP5 delivery caused by a current shortage of NR owned and supplier owned fleet resources.

Targets

13.2.7 It is not clear what sub fleet by sub fleet reliability and availability targets have been set. This is a key driver of fleet size and on-going preventative maintenance costs.

13.2.8 We question whether NR are confident that they can obtain the specification of new machines that will deliver the sustainability targets of the Track Policy, through the retendering of tamping contracts during CP5.

Robustness

13.2.9 For the NR owned fleet, the policy appears robust, and is an improvement on that produced in 2011 for the IIP.

13.2.10 We have concerns that NR may not have done enough work to date, such that they can be confident that the overall bespoke fleet (plant) resources that are required to deliver the SBP outputs for asset management, including enhancements, are available at the cost levels required to deliver the SBP.

Sustainability

13.2.11 We have concerns that NR may not have done enough work to date, such that they can be confident that the overall bespoke wheeled plant resources that are required to deliver the SBP outputs for asset management, including enhancements, will be available at the cost levels required to deliver the SBP. We therefore have moderately high uncertainty on the sustainability of the Policy.

Whole Life, Whole System Cost

13.2.12 Delivering a minimum whole life cost for the many and varied types of the mechanised wheeled plant may not be optimal in terms of delivering the high levels of availability and reliability required to deliver the SBP.

13.2.13 Where a minimum whole life cost is not sought, it may well be the correct policy for fleet in its role in supporting the delivery of infrastructure asset renewal and maintenance where the working requirements for fleet are set by outside the fleet function.

Embedded Efficiency

13.2.14 No embedded efficiencies are claimed by NR associated with the Fleet Policy or approach.

13.3 Policy Application

Activities and Volumes

13.3.1 The role of fleet in the delivery of the SBP M&R volumes for track and electrification is highly critical. We believe that this is so highly critical that NR may find that to deliver exceptionally high levels of Intervention Fleet availability and reliability may be worth incurring increased levels of expenditure to improve the delivery performance of these asset groups.

13.3.2 Whilst there are plans in the Fleet Policy to procure new support machinery for the increase in plain line reballasting, there are none to develop and

procure similar support machinery for S&C to compliment the three ballast vacuum machines listed in the Policy [SBPT3018, Page 66].

13.3.3 NR have been challenged to demonstrate that this policy to procure (rather than lease) road vehicles is an optimal choice, particularly a four year renewal cycle.

13.3.4 The Policy would appear to have considered renewal interventions. The maintenance interventions are not clearly linked to availability and reliability targets.

13.3.5 We consider that this over-arching policy may be applicable to certain fleet vehicles. However we do not consider it to be appropriate to certain key items associated with the delivery of track maintenance and renewal volumes where the financial cost implications of the failure of a machine during operations far outweigh the cost of appropriate maintenance.

13.3.6 We note that the CP5 Track Asset Policy [SBPT3010] with its mid-life ballast replacement for plain line and S&C increase the demand for tampers and haulage. NR's capacity study suggests that there is adequate capacity in the network as long as a healthy balance between weekend and midweek delivery of the programme is achieved.

13.3.7 We consider that a predominantly weekend operation will require further investment on tampers, wagons and locos and will result in midweek under-utilisation. We have been advised by NR that producing an optimised spread of work across weeknights and weekends is key to the delivery of SBP volumes and efficiency. We agree with this approach.

13.3.8 No volumes of maintenance or renewal have been provided in the Tier 0 model or Data Book. However, Renewal volumes have been calculated for CP5 and CP6-CP11 in the Wheeled Plant Tier 1 model, but are not reported in the Tier 0 Model

Costs

13.3.9 The costs for the fleet (wheeled plant) asset presented in the data book (Tier 0 model) are those provided from the Tier 1 model.

13.3.10 The costs are shown as renewals and sum to £637m in CP5 (pre-efficient).

13.3.11 No maintenance costs have been provided for CP5 or CP6-CP11.

Delivery

13.3.12 It is not clear where the accountabilities for plant delivery sit between NDS and Infrastructure Plant. Ultimately, together, they provide plant to support the infrastructure renewal and maintenance plans defined by Routes and enhancements. If NDS simply provides the plant, then the accountability falls to IP to ensure that fit for purpose contracts with fully trained and competent operators will be in place to meet the expectations of Routes and Projects. This is particularly the case for the electrification programme, the Route's track renewal programme and their track geometry maintenance programme.

13.3.13 For Stoneblowers the model appears to show that availability is slightly below the modelled fleet size and for grinders it appears to show a fit.

However, the policy states clearly that the assumptions and coarseness of the calculations make the results acceptable.

13.4 Summary

13.4.1 The fleet asset represents a diverse range of plant that in part support the delivery of maintenance and renewal activities. Our review of the fleet asset has focussed on the intervention and materials delivery fleets as these are the more critical in terms of delivery of the maintenance and renewals works on the wider NR assets including track.

13.4.2 The expenditure on fleet in CP5 is increased over CP4 (£637m c.f. £345m) due to the procurement of additional high output fleet and the transfer of the road vehicle fleet to owned vehicles rather than leased.

13.4.3 No maintenance costs or volumes have been provided for CP5 or CP6-CP11. Although Renewal volumes have been calculated for CP5 and CP6-CP11 in the Wheeled Plant Tier 1 model, but are not reported in the Tier 0 Model

13.4.4 There is some uncertainty that the quantum of resource will be available to deliver the Business Plan. In particular, the resource to deliver the plain line heavy refurbishment programme, the S&C heavy refurbishment programme and the S&C tamping programme for maintenance, renewals and enhancements. In addition there is a large programme of work included in the Enhancement programme, including for example, Crossrail (on NR infrastructure); Thameslink; Northern Hub; etc. Whilst any shortfall identified in the future can be resolved by a procurement programme and leasing, it can take up to three years from identifying the need to actually have new large bespoke equipment delivered.

13.4.5 NR have based their fleet resource plan on an expectation of an optimum spread of work between weekends and week nights. We consider that a predominantly weekend operation may require further investment on tampers, wagons and locos and will result in midweek under-utilisation.

13.4.6 It is not clear what sub fleet by sub fleet reliability and availability targets have been set. This is a key driver of fleet size and on-going preventative maintenance costs. This leads us to believe that there is not yet a full understanding of fleet asset degradation.

13.4.7 NR are proposing to spend £114m on road vehicles in CP5 and between £114m and £118m in each Control Period CP6-CP11. These costs have been derived from applying the Policy to the national fleet inventory in the Tier 1 model.

13.4.8 NR have been challenged to demonstrate that their policy to purchase road vehicles rather than lease is optimal, particularly the four year renewal cycle.

13.4.9 We question NR's confidence that their specification of the bespoke fleet (plant) resources required to deliver the SBP outputs for track assets, including enhancements in CP5, will deliver the Track Policy targets and that they will be available at the planned renewal cost levels. Accordingly, we consider that there is some uncertainty associated with the fleet renewals costs for intervention and materials delivery fleets in CP5.

13.4.10 For the NR owned fleet, the policy appears robust, and is an improvement on that produced in 2011 for the IIP.

13.4.11 We have concerns that NR may not have done enough work to date, such that they can be confident that the overall bespoke wheeled plant resources that are required to deliver the SBP outputs for asset management, including enhancements, will be available at the cost levels required to deliver the SBP. We therefore have moderately high uncertainty on the sustainability of the policy.

13.4.12 As noted in Section 5 above, we have prepared a 'System Diagram' for each 'Sub-Asset' ('Level 3') and 'allocated' an uncertainty 'colour' to each element to provide a qualitative overview. These diagrams have been included as a summary to complement our specific text. The summary for fleet is presented in Figure 13-3 below. A larger copy is included in Appendix D.

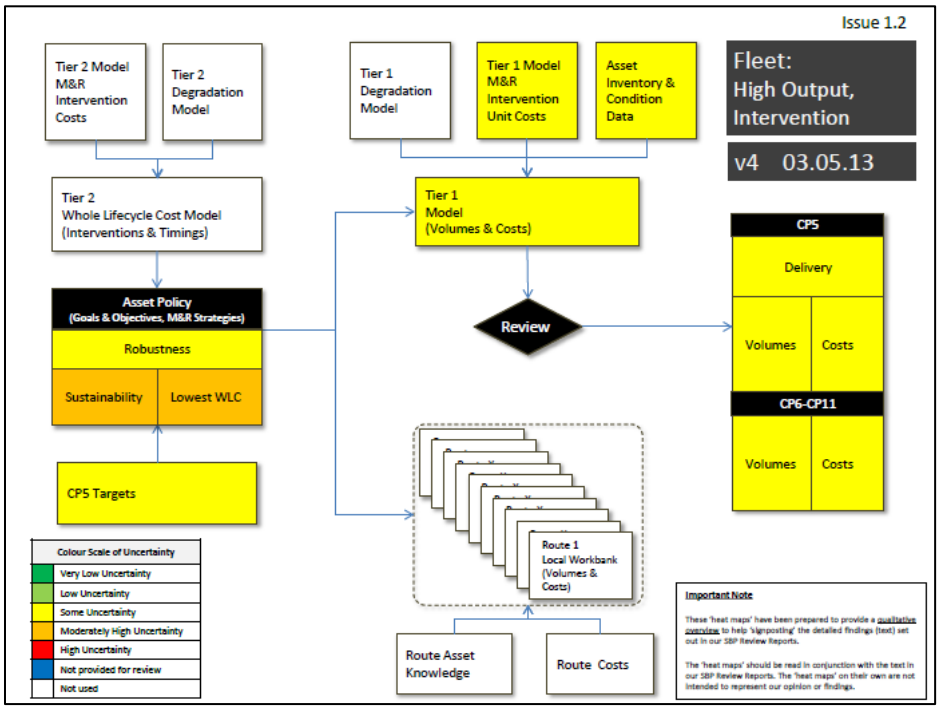


Figure 13-3 'System Diagram' for Fleet (High Output)

14 References

Ref	Document Title	Version / Date
Arup 2011a	Office of Rail Regulation and Network Rail Part A Reporter Mandate AO/017: Initial Industry Plan (IIP) 2011Review – Summary Report – Observations and Conclusions	Issue 1 16 December 2011
Arup 2012a	Office of Rail Regulation and Network Rail Part A Reporter Mandate AO/017: Initial Industry Plan (IIP) 2011Review – Review of Tier 2 Whole Life Cycle Cost Models	Issue 1 23 April 2012
Department for Transport 2013a	Railways Act 2005 Statement for Control Period 5 (HLOS and SoFA)	July 2013
Department for Transport 2013b	Secretary of State for Transport Guidance to the Office Of Rail Regulation	July 2013
Transport Scotland 2013a	'The Scottish Ministers' High Level Output Specification'	July 2013
SBPT 3297	Uncertainty Analysis Overall Summary – Tier 3 Linking Expenditure to Performance	Version 0.4
Arup 2013c	Arup, Part A Reporter Mandate AO/030: PR13 Maintenance & Renewals Review, Addendum Report - Meetings & Questions, Document Ref: AO/030/04	March 2013

Appendix A

Mandate

A1 Mandate AO/030 – 'Main Mandate'

Mandate for Independent Reporter Part A

Audit Title:	PR13 M&R review of asset policies and their application in planning: progressive assurance and SBP submission.
Mandate Ref:	[to be added by Network Rail]
Document version:	Draft A
Date:	08/05/2012
Draft prepared by:	Richard Coates
Remit prepared by:	
Network Rail reviewer:	Dan Boyde

Authorisation to proceed

ORR		
Network Rail		

Background

Network Rail submitted proposed updates to its asset policies in September 2011. These gave Network Rail's best view of efficient policy at the time, and were the policies used in developing its contribution to the IIP submission. The asset policy documents and supporting evidence were reviewed by the ORR, supported by the independent reporters, AMCL and Arup. Their reports are published on the ORR website.[26]

Network Rail will carry out further work on its policies in the lead up to submission of its Strategic Business Plan (SBP). Network Rail must submit evidence to ORR to demonstrate that it is making sufficient progress in developing a robust SBP submission. This is termed progressive assurance. Network Rail and ORR have agreed high level milestones at which Network Rail must submit this evidence.

Network Rail will submit its SBP and all supporting information in January 2013.

Scope

Under this mandate the reporter will assess:

- The evidence supplied by Network Rail under progressive assurance relating to its proposed CP5 asset policies and their application;
- The final CP5 asset policies submitted by Network Rail in support of its SBP; and
- The application of its asset policies in developing SBP cost, volume, output and efficiency projections.

[26] http://www.rail-reg.gov.uk/pr13/PDF/amcl-iip-2011-review.pdf
http://www.rail-reg.gov.uk/pr13/PDF/arup-asset-policies-2011-review.pdf

In doing so it will consider:

- Compliance with the Network Licence, particularly section 1 relating to Network Management; and
- Our tests of robustness, sustainability and minimum whole lifecycle, whole system cost and further criteria for assessing asset policy as shared with Network Rail.

The Independent Reporter Part A will carry out the review for:

- Track;
- Off-track;
- Buildings;
- Drainage;
- Civils; and
- Fleet.

This includes review of:

- Asset policy documents;
- Strategic planning tools;
- Whole lifecycle cost analysis tools;
- RAMPs documentation; and
- SBP documentation including costs, volumes and outputs tables.

The reporter will also review whole lifecycle cost analysis tools for signalling and telecoms.

The reporter will review the progress that Network Rail has made in development of its asset policies, strategic planning tools, whole lifecycle cost analysis tools and key network and asset sustainability and performance measures through a rolling programme of evidence submission and review meetings. Network Rail will submit its progressive assurance evidence for these areas by 31 July 2012 at the latest. The reporter will provide an interim progressive assurance report and feedback to ORR and Network Rail by 07 September 2012.

The reporter will review the progress that Network Rail has made in development of its plans by operating route through challenge meetings and review of submitted evidence. This is likely to include review of Network Rail's strategic framework / process mapping, RAMP template, RAMP guidance documentation and other communications with routes. Network Rail will submit its progressive assurance evidence by 30 April 2012 at the latest. The reporter will provide an interim progressive assurance report and feedback to ORR and Network Rail by 30 May 2012.

The reporter will review Network Rail's submitted SBP policies, models and data tables, and all supporting evidence. Network Rail will submit finalised supporting evidence in advance of SBP as it becomes available.

Asset policy documents

The review will build on the findings of the reporter mandate AO/017: Initial Industry Plan (IIP) 2011 Review. It will include an assessment of the extent to which recommendations in AO/017 have been addressed.

Policy will be assessed against the criteria of robustness, sustainability and lowest whole life, whole system cost and the further indicators of good asset stewardship as detailed in Appendix 1. The review will include understanding how Network Rail has used the outputs of tier 2, minimum whole lifecycle cost modelling, in its development of policy.

The reporter will assess the quality of Network Rail's projections of efficiencies embedded within the proposed asset policies. It will assess Network Rail's projections of further scope efficiencies to be delivered in CP5.

Minimum whole lifecycle cost analysis tools

The reporter will review the efficiency / minimum whole life and whole system cost of the proposed policy against the criteria in Appendix 1. In doing so it will assess the application of the tier 2 models in justifying this policy, bearing in mind the existing evaluation of these models against the criteria in Appendix 2. It will assess the extent to which recommendations made under mandate AO/017 have been addressed.

Strategic planning tools

The reporter will consider whether the proposed policies have been accurately modelled in the tier 1 strategic planning models. This will include:

- Modelling principles: Do the models accurately model asset policy as set out in the asset policy documents?
- Degradation: Are the degradation assumptions used consistent with those used in tier 2 modelling?
- Input data: Are asset input data (including number, criticality, condition, age, used life etc.) consistent with Network Rail's asset registers? Are these correctly disaggregated by operating route?
- Unit costs: are unit costs used consistent with tier 2 modelling? N.B. A separate mandate will address CP4 exit unit costs
- Recommendations: have recommendations from mandate AO/017 been addressed?

The review of computational accuracy of the models is not included within this mandate.

RAMPs

The reporter is to review the format, process for populating, and the content of the final Route Asset Management Plans (RAMPs) submitted as part of the SBP against the criteria in Appendix 3.

SBP costs, volumes and outputs tables

The reporter is to review the process through which the SBP [pre-efficient] costs, volumes and output tables have been compiled from tier 1 model outputs and route based plans (workbanks and RAMPs).

- Is the process robust?
- Are these data tables consistent with delivering required outputs at minimum industry whole lifecycle cost?
- Are these data tables robust by operating route?
- Are the tables fully populated, from CP4 to CP11?
- Does the profile of historical and projected costs appear reasonable, in line with policy and have apparent anomalies been explained by Network Rail?
- Has a QRA been carried out and what is the quality of it?
- Are projected scope efficiencies reasonable? Can further scope efficiencies be delivered through further refinement of policy? N.B. A separate mandate will cover efficiencies in greater detail.

Methodology

As part of this workstream the reporter will undertake the following activities:

1. Attend all relevant progressive assurance, policy presentation and policy challenge meetings;
2. Attend monthly quadripartite coordination meetings (Network Rail / ORR / AMCL / Arup);
3. Undertake a review of draft and final asset policy and policy justification documents;
4. Undertake a review of any other relevant supporting and information including bases and assumptions, documentation, models, presentations etc.;
5. Prepare and submit draft and final reports following each of the progressive assurance high level milestones to both ORR and Network Rail, setting out the main observations and conclusions arising from the review process;
6. Prepare and submit draft and final reports following the submission of SBP and supporting documentation.

The reporter will produce a detailed methodology in presenting its proposals.

As far as possible, it is intended that the reporters shall co-ordinate their activities with the analysis being carried out by the ORR in order to avoid duplication of work.

The Reporters shall also avoid duplicating activity already undertaken – or in progress - under various mandates reviewing asset policy development to the IIP, tier 1 and tier 2 modelling tools and asset data inputs.

Deliverables

1. Minutes of meetings and a summary of the reporters' views of the challenge workshops.

2. Progressive assurance review of RAMP process - presentation of findings to ORR and Network Rail by 30 May 2012.

3. Progressive assurance review of asset policy and its justification – presentation of findings to ORR and Network Rail by 7 September 2012.

4. SBP Draft Report - 1 March 2013.

5. SBP Final Report – 29 March 2013.

Timescales

The key milestones for the work are as follows:

- Kick-off meeting with ORR and Network Rail in May 2012.
- Network Rail to provide evidence relating to the production of robust plans by operating route, including RAMPs, by 30 April 2012.
- Reporter to produce progressive assurance review of production of robust plans by operating route report by 30 May 2012.
- Network Rail to provide evidence relating to the ongoing development of asset policy, planning models (tiers 0, 1 and 2), output and performance measures by 31 July 2012.

- Reporter to produce progressive assurance review of the development of asset policy, planning models (tiers 0, 1 and 2), output and performance measures by 7 September 2012.
- Network Rail to submit SBP and all supporting documentation by 7 January 2013.
- SBP draft report by 1 March 2013.
- Final reports by 29 March 2013.

Independent Reporter proposal

The Reporter shall prepare a remit for review and approval by the ORR and Network Rail on the basis of this mandate. The approved remit will form part of the mandate and shall be attached to this document.

The remit will detail methodology, tasks, programme, deliverables, resources and costs.

Given the importance of this review, the Reporter shall provide qualified personnel with direct experience in the respective disciplines to be approved by the ORR. The contractor is asked to submit details of the previous experience and qualifications of such personnel as part of their proposal.

Appendix 1 – Policy review
The review will consider asset policies against three high level criteria:

1. **Robustness: Is it reasonable to believe that the policy can deliver the required outputs, for England & Wales and Scotland?** In testing the robustness of the policy the reporter should consider whether the policy and plans have been demonstrated to be capable of delivering the outputs required for CP5 (2014-2019). This includes consideration of outputs, KPIs and condition measures as disaggregated by operating route.
2. **Sustainability: If demand on the network were to remain steady, would application of the asset policy continue to deliver the outputs specified indefinitely?** A sustainable asset policy is one which delivers (at least) the agreed outputs for the final year of the control period in the long term (to at least end of CP11) if demand on the system remains within the capacity limits of the current network and any enhancement schemes already committed to by industry. The demonstration of compliance with this test is likely to involve forecasting and modelling as part of the submission. This test is to ensure that, in managing within CP4 funding, Network Rail is making genuine efficiencies and is not deferring essential work at the cost of inefficiently higher expenditure in later control periods.
3. **Lowest whole life, whole system cost: Has asset policy been demonstrated to deliver the required outputs both in the short and long-term at lowest possible whole system cost over the lifetime of the assets?** In demonstrating minimum whole life cost Network Rail must demonstrate that both scope and unit cost efficiencies have been fully considered.

In assessing against these high level criteria the reporter will also consider the 'Indicators of Good Asset Stewardship' as set out below. They will assess whether comprehensive and convincing rationales have been provided demonstrating good asset stewardship in compliance with Network Rail's licence obligations.

The reporter will assess against the following key tests (i.e. not an exhaustive list) as a sub-set of the overall asset management capability, that are generally associated with good asset stewardship and that are likely to give rise to compliance with the Licence obligations relating to asset management policies and plans.

1. **Performance Requirements / Outputs** – have these been defined at system and individual asset group level taking into account strategic objectives? How are these influenced by demand? What level of risk can be tolerated for each performance requirement? What level of system resilience etc.?
2. **Line of sight** – is there a clear relationship from business objectives (performance, demand, capacity etc.), policy/strategy down to specific outputs defined in the route asset management plans and route delivery plans.
3. **Asset Knowledge** – is there adequate accuracy and completeness of asset inventory data, capability, capability, including structure and critical component / element details, age, condition, maintenance history, failure modes, service life etc.
4. **Asset Behaviour and Criticality** – is there an adequate understanding of asset behaviour, criticality, critical components, and failure modes
5. **Asset Degradation** – is there an adequate understanding of deterioration rates of critical components and materials?
6. **Renewal and Maintenance interventions** - Has a suitable range of intervention options been considered taking into account any enhancement requirements due to interoperability, asset system interfaces etc.? Do these interventions simply reflect current / historic practice or have materials and techniques used by others (e.g. identified from benchmarking activity) and other future developments / techniques been considered?
7. **Asset Cost Data** – is there adequate maintenance and renewal cost data for the identified maintenance and renewal interventions to enable suitably accurate lifecycle cost estimation? Are suitable unit rates available for calculating the works and other costs (e.g. access, possession costs, mobilisation etc.)?
8. **Lifecycle Option Preparation** – have a suitable range of alternative lifecycle management options been considered for the critical asset types and components, based on adequate asset knowledge an understanding of asset behaviour, maintenance and renewal options? How has resilience been considered? Have any Scotland specific issues been identified and considered? How have sub- options been rationalised and optimised?
9. **Lifecycle Option Selection and Strategies** – have clear alternative lifecycle strategies been considered? Typical strategies may be:
    - "Do Minimum" Strategy – the minimum required to sustain safety across the analysis period, e.g. infrequent/irregular but major interventions to satisfy/meet the minimum safety and performance targets.
    - Preventative Strategy – regular and frequent minor interventions to maintain the condition of the asset by slowing down the rate of deterioration.
    - Targeted Strategies – with interventions aimed towards:
        - Minimising Whole Life Costs while satisfying safety/performance targets;
        - Minimising network disruption; satisfying the disruption targets;
        - Delivering a required condition score;
        - Etc.

    Where asset policies deviate from lowest whole lifecycle, whole system cost, has the inefficiency caused by funding constraints been quantified to understand the long-term cost and risk implications?
10. **Preferred Lifecycle Option** - How are the preferred lifecycle options for different asset types reflected in the asset policies and plans?
11. **Sensitivity testing** – Has sensitivity testing been carried out to understand levels of uncertainty within confidence limits, both for underlying asset information and in the decision support tools used in the development of asset policy?
12. **Overall Planning Process** – is it clear how 'top-down' decisions will be used in practice to influence local asset maintenance and renewal choices? How are 'bottom-up' unconstrained asset needs evaluated against 'top-down' asset policies and a planned workbank produced (e.g. how a workbank at an SRS level is derived)?
13. **Systems Approach** – has the policy adopted a systems engineering approach which considers cross-asset groups and cross-industry requirements? Has interaction between

asset types/ overall system been considered? (e.g. if head hardened rails are specified has the impact on wheels been considered).

14. **Risk and Review** – is it clear how asset risks will be managed and reviewed? Is there definition of tolerable risks and is this applied in practice? What level of resilience is required, has a RAMS (reliability, availability, maintainability and safety) approach been adopted?
15. **Deliverability** – is it clear how the proposed asset management approach will be delivered? – is it feasible that the policy can be delivered given known constraints e.g. technology, supply chain, training, experience etc. (e.g. Maintenance – does the policy adequately consider the maintenance implications in terms of numbers of staff, skills, training, and equipment?) Are roles and responsibilities defined?
16. **Continuous Improvement** – research and development, feedback and efficiency improvements.

Appendix 2 – Minimum whole lifecycle cost analysis tools review

i. Input data – what is the robustness of input data?:

- understanding of degradation - elicitation vs evidence of actual degradation. Quality of information and elicitation techniques
- unit costs - are unit costs derived from actuals in an auditable way? Are unit costs considered accurate? (Ref. Arup's unit cost audits - 2010/11 reg accounts)
- modelling of appropriate intervention options
- understanding of effect of intervention
- sensitivity analysis - comment on the sensitivity of outputs to uncertainty in model inputs

ii. Robustness of cost modelling:

- Comment on extent of costs considered - e.g. is the cost of safety and performance risk fully considered?
- Verification - are the outputs plausible based on expert engineering knowledge? Have the model outputs been checked considering their application to on-the-ground assets?
- Assurance - has the integrity of the coding been tested?
- How has modelling been tested to ensure that it is delivering required outputs?

iii. Assessment of extent to which WLCC model outputs are used in both policy and tier 1 planning models:

- Do they support policy?
- Do they support proposed volume, expenditure and output forecasts?

iv. Coverage of WLCC models:

- what assets are included in the WLCC models?
- are these appropriate? i.e. Have they been prioritised correctly (by associated spend / criticality etc.)?

v. Scenarios:

- Has a suitable number of scenarios been tested?
- Are they a sensible representation of intervention options?
- To what extent do they help to understand minimum whole life cost?
- Is current policy included for comparison?

vi. Best practice:

- Has WLCC modelling best practice been fully considered and adopted? Has NR considered models and degradation information available externally?

Appendix 3 – Route Asset Management Plans

1. Format
    a. What do RAMPs cover? (e.g. Costs, volumes, outputs, KPIs, efficiencies)
    b. Is there information which should be included but is not?
    c. Is the format consistent with strategic planning models?
    d. To what extent is format controlled and is this appropriate?

- Process
    a. What level of control / autonomy is there? Is the level of control appropriate? How does the route interact with the centre?
    b. How are the RAMPs populated? By whom? At what level of detail? On what intelligence?
    c. To what extent can routes deviate from policy? How is this controlled?
    d. To what extent do routes challenge policy? How is this managed?
    e. To what extent do routes challenge CP4 exit unit costs on a route basis? How is this managed?
    f. To what extent do routes challenge central efficiency assumptions? How is this managed?
    g. How do RAMPs interact with tier 1 modelling? Over what timeframes are plans based on bottom-up workbanks? Is this appropriate?
- RAMP documents / tables
    a. Are the RAMP documents / tables complete?
    b. Are the RAMP documents / tables accurate?
    c. Are the RAMP documents / tables accurately reflected in the SBP submission?

A2 Mandate AO/030 – Additional Scope – Audit of Model Integrity

Additional scope to mandate for Independent Report (Part A)

Audit Title:	Additional scope to AO/030: Audit of integrity of Network Rail's Tier 0, 1 and 2 models used in support of SBP
Mandate Ref:	AO/030 (additional scope)
Document version:	Draft B
Date:	October 2012
Draft prepared by:	Richard Coates
Remit prepared by:	
Network Rail reviewer:	

Authorisation to proceed

ORR		
Network Rail		
Independent Reporter		

Purpose

This mandate sets out the scope of work for the Part A Independent Reporter (Arup) to review Network Rail's (NR) Tier 0, 1 and 2 models.

There is a need for ORR, Network Rail and its key stakeholders to be satisfied that the overall modelling process is robust, that any specific errors are identified and that any other key weaknesses are recognised. There are a number of mandates for the Reporter to review different aspects of the modelling process. This mandate focuses on those aspects of the Tier 0, 1 and 2 models that are not covered in the other mandates. The outcome of this work will feed into the Reporter's view of overall uncertainty of the SBP outputs.

Background

Network Rail has developed a suite of models to help build up its M&R plans for PR13. Tier 2 models are detailed asset models that are designed to test and inform asset policies. Tier 1 models are strategic planning models which forecast work volumes, outputs and expenditure for a portfolio of network assets. The Tier 0 model draws on the outputs of the Tier 1 models and the Route Plans to present a "dashboard" overview of NR's plans.

Network Rail has used the outputs of its Tier 1 models to develop a central 'top down' forecast of maintenance and renewal requirements in CP5 and beyond, to inform and challenge route developed plans, and to contribute to Network Rail's justification of policy by evidencing the sustainability of plans.

The quality of the outputs of these models depends on:

- The modelling principles, i.e. how policy has been modelled;
- The input data; and

- The computational accuracy of the models.

The Independent Reporter previously audited the model input data and computational accuracy of the Tier 0 and Tier 1 models at the time of IIP (AO/016 and AO/021) and produced a set of recommendations.

This mandate covers the assessment of progress made by Network Rail against these previous recommendations. It also covers the further audit of the computational accuracy and (where not covered by other mandates) the modelling principles and data inputs of Tier 0, 1 and 2 models. This work is both for progressive assurance and to assess the models submitted as part of Network Rail's SBP.

This work interfaces with several other mandates. Co-ordination is required to avoid overlaps and to ensure that the overall review of IIP does not inadvertently omit vital areas of assessment. This mandate should draw on previous audits where possible to avoid duplication of work.

Key interfaces are with:

- AO/015 – Audit of bottom-up benchmarking
- AO/016 and AO/021 – IIP Tier 0 & 1 Model Audits
- AO/017 - Initial Industry Plan 2011 Review
- AO/028 – Audit of asset data quality
- AO/030 - PR13 M&R review of asset policies and their application in planning: progressive assurance and SBP submission (Arup)
- BA/025 - PR13 M&R review of asset policies and their application in planning: progressive assurance and SBP submission (AMCL)
- AO/034 – PR13 review of Network Rail's maintenance and renewal unit costs used in planning
- AO/035 – Audit of efficiency evidence

Scope

The aspects of the Tier 0, Tier 1 and Tier 2 models to be audited are:

- Tier 0 – scope of the tier 0 review is to be agreed when there is clarity around its function and use. To the extent that it includes computation and modelling, the audit will cover computational accuracy and modelling principles. The Audit will cover data inputs of all high level reporting tools including the main dashboard.
- Tier 1 – computational accuracy of the following asset-specific modules: fleet, track, civils (structures, tunnels and earthworks), operational property and level crossings.
- Tier 2 – review Network Rail's Quality Assurance (QA) on computational accuracy of all models except for Electrical & Power (which is to be reviewed by AMCL).

The scope is shown diagrammatically in the Appendix A, with the scope of this mandate shown by the blue boxes. [Note that AMCL will be auditing the computational accuracy, modelling principles and data inputs for some aspects of the Electrical & Power, Signalling, Telecoms, Level Crossings Tier 1 and Tier 2 models – as per diagram in Appendix A].

In addition, all recommendations made by Arup in its previous audit of Tier 0 and 1 models under mandates AO/016 and AO/021 should be reviewed. This will include liaising with AMCL in respect of those made for the electrical & power, signalling and telecoms Tier 1 models.

Computational accuracy

The reporter will audit the Tier 0 (depending on scope agreed) and Tier 1 models listed above for computational accuracy, auditing the accuracy of the macro coding and formulae that model application of policy. This will build on the audit carried out under mandates AO/016 and AO/021 and the associated recommendations. The focus of the review will be on new or altered functionality since the previous audit and review of progress against recommendations and will not repeat the previous work.

The key objective of this review is to perform a detailed "forensic" audit of the formulae and macros that constitute Tier 0 and Tier 1 modelling in order to be able to confirm that they correctly carry out the calculations described in their functional specifications and to identify any computational errors. The reporter should also comment on the robustness of the functional specifications.

The audit will include:

- Audit of macro coding
- Audit of spreadsheet based data manipulation
- Audit of data from input to output to confirm that correct data are being accessed, correct calculations are being applied and model outputs are correctly collated and presented (including link between Tier 1 and Tier 0 models)
- Audit of output calculation of asset condition indicators and their consistency with relevant policies, as well as any interface with other output models (e.g. Operational Performance Model)
- Audit of robustness of modelling by Tier 1 model, Tier 0 model, regional disaggregation if appropriate.
- Assessment of effectiveness (production of accurate outputs) in assessing model output uncertainty.

The reporter will review and comment on Network Rail's own QA of the Tier 2 models, to come to a view of their computational accuracy.

Tier 0 model

The scope of audit is to be agreed as discussed above. It is likely to include the following:

In addition to computational accuracy checks, the Reporter will review the modelling principles of the Tier 0 model. This will include the treatment of efficiencies, interfaces with Tier 1 models and the route plans and a review of the functional specification. All data inputs are to be audited by addressing the following areas:

1. Efficiencies: The reporter will check efficiencies are consistent with those audited under mandates AO/015 and AO/035 and are consistent with assumptions made in Tier 1 models and route plans (i.e. no double counting or gaps).
2. Interventions: The reporter will audit the interventions modelled and check consistency with those identified in the asset policies, interfacing with AO/030 and AMCL mandate BA/025.
3. Interfaces: The reporter will check that the Tier 0 model draws on the correct outputs of the Tier 1 models and/or route plans; draws on historical data and forecast plans for CP4 correctly; and correctly interfaces with output models. For the avoidance of doubt, interfaces with the route plans and "Hyperion" model will be excluded from this review (but is expected to be reviewed under mandate AO/030).

Overview

The reporter should present its view on the uncertainty of the models' outputs as follows:

- Tier 0 – range of uncertainty arising from the audit of computational accuracy, modelling principles and data inputs
- Tier 1 (machinery, track, civils and operational property) – review of traffic light classification provided in the Reporter's report for AO/016 and AO/021[27] for computational accuracy
- Tier 2 – 'traffic light' classification based on a review of Network Rail's QA of computational accuracy

Methodology

The reporter will deliver the scope of work described above through:

- Audit of Tier 0, 1 and 2 models
- Review of all supporting documentation, including functional specifications
- Coordination with other reporter studies as listed above
- Close working with the model development team on the structure and workings of the model, workshops and meetings as required

The reporter's proposal will separately consider the need for detailed audit where work has not previously been undertaken. For example, it is expected that the Tier 1 model for Civil Structures will require a more comprehensive audit than those Tier 1 models that are substantially the same as at IIP.

Provision of Models and Documentation

At the outset Network Rail will provide the following data to the Reporter:

- All relevant Tier 0 and 1 models (working 'shell' models) with documentation including the functional specifications
- All relevant Tier 2 models with documentation including the functional specifications
- All relevant policy statements (at least in Final Draft)
- Framework document mapping out the inputs and outputs of Tier 0, 1 and 2 models and showing how they fit together, along with interactions with any other models and Route Plan outputs.
- QA documentation on Tier 2 models.

These data/documents are required to be provided by 30 October 2012 at the latest.

Any other data that is reasonably requested by the Reporter will be provided by Network Rail.

Deliverables

The main deliverable of this project is an audit report covering all findings from checks that have been undertaken.

Governance process for issuing Independent Reporter reports is included in Appendix B.

Timescales

[27] AO/016 & AO/021: IIP Tier 0 & 1 Model Audits, 1 June 2012

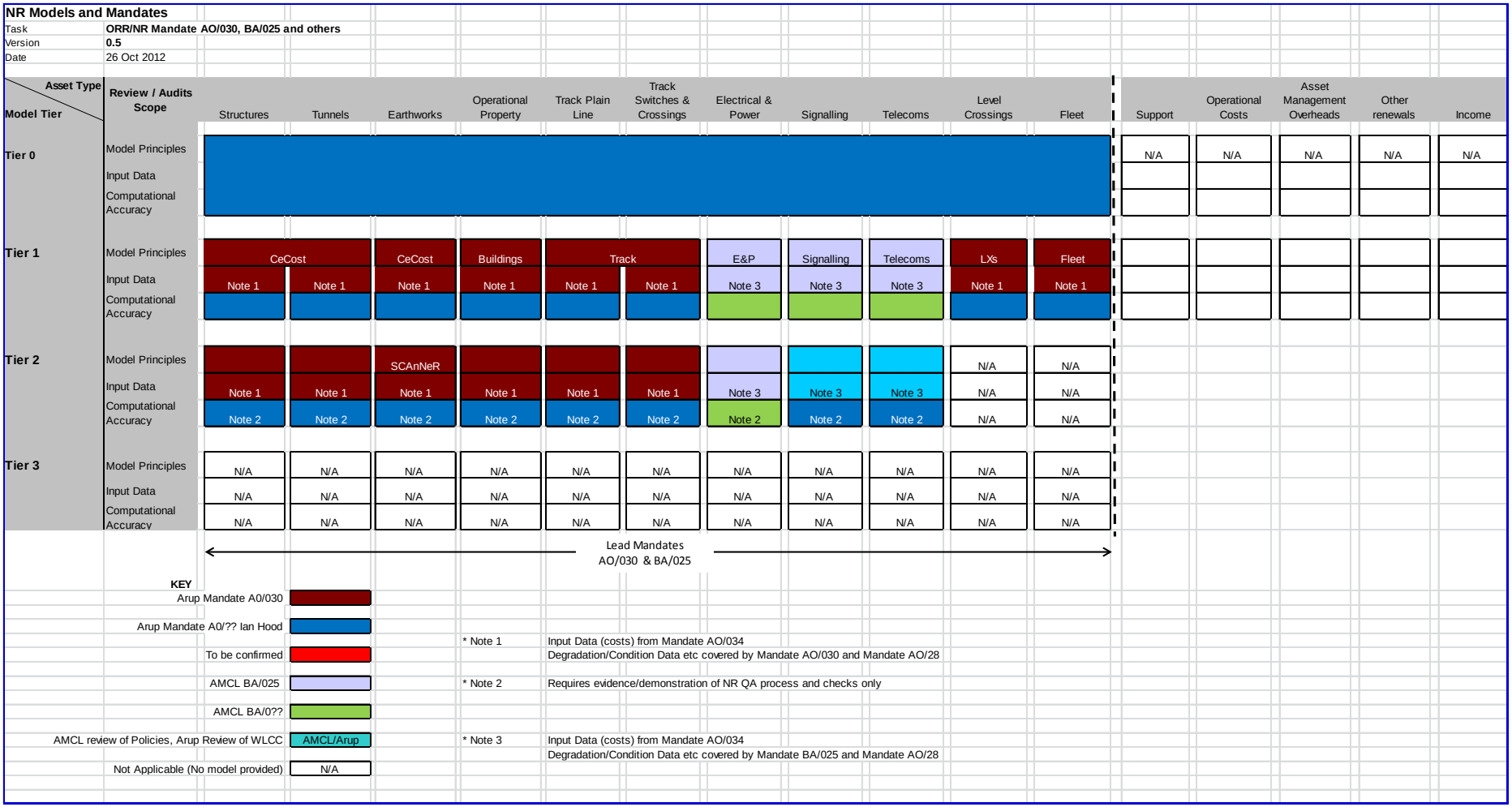
- Kick-off meeting October 2012, to include hand over of models and documentation for audit
- Fortnightly progress reports
- Draft report 31 January 2013
- Final report 28 February 2013

Independent Reporter remit proposal

Arup shall prepare a proposal for review and approval by the ORR and Network Rail on the basis of this mandate. The approved proposal will form part of the mandate and shall be attached to this document.

The proposal will detail tasks, programme, deliverables, resources and costs.

Appendix A: Scope of audit of Tier 0, 1 and 2 models



Appendix B
Governance process for issuing Independent Reporter reports

Revision	Purpose	Outcome
Draft	Review for factual correctness and comments	First drafts of the report should be issued to ORR and Network Rail, who have fourteen days to review the contents before a tri-partite session is arranged at which feedback is provided to the reporter. Network Rail may choose to provide Director level input at this stage.
Final draft	Review	The Reporter will issue a final draft report to both ORR and NR within five working days of the tri-partite meeting All three parties agree contents and recommendations as far as possible via correspondence or meetings as appropriate. Further comments shall be provided within five working days.
Final report		The Reporter will issue its final report to both the ORR and NR. If agreement over its contents has not been reached the report will contain the Reporter's independent assessment together with opinions from ORR and NR to document their positions ORR will publish the report on their website It is anticipated that the issue of the final report (i.e. version 1) would take no longer than 1 working week after receiving the final report.

Appendix B

Review Approach

B1 General

B1.1.1 PR13 Mandates AO/030 and BA/025 required Arup and AMCL respectively to undertake progressive assurance review activity as well as reviewing NR's SBP submission post 7th January 2013.

B1.1.2 This section provides additional detail on the approach that we adopted in undertaking our Progressive Assurance review and developing our approach to reviewing the SBP Submission.

B1.1.3 It also provides a brief background on our review of NR's Initial Industry Plan which was submitted in September 2011 towards the start of the PR13 review process.

B2 Initial Industry Plan Review

B2.1.1 On 30th September 2011 NR issued the Initial Industry Plan (IIP). The purpose of the Initial Industry Plan (IIP)[28] is set out below:

"This Initial Industry Plan (IIP) sets out the industry's view of how the railway could develop during Control Period 5 (CP5, 2014-19) and beyond to deliver a better value for money and affordable railway that can support and stimulate sustainable economic growth. The IIP has been produced to inform the development of the Governments' High Level Output Specifications (HLOSs) and Statements of Funds Available (SoFAs) to be published in summer 2012, the periodic review process more generally and to inform broader government decision making in relation to industry reform and franchise re-letting."

B2.1.2 An IIP was issued for England & Wales, and a separate IIP document for Scotland.

B2.1.3 Arup were appointed as Part A Independent Reporter under Mandate AO/017 to review the following asset groups:

- Track
- Structures (including Bridges, Tunnels and Earthworks)
- Buildings / Operational Property

Subsequently, separate Asset Policies for Earthworks, Drainage and Fleet were provided by NR for review by Arup.

Arup were also asked to consider the Whole Life Cycle Cost (WLCC) models for the above five asset groups plus Signalling and Telecoms assets.

B2.1.4 In parallel, AMCL as the Part B Independent Reporter were appointed to review the following asset groups:

- Level Crossings
- Signalling

[28] Initial Industry Plan England and Wales Proposals for Control Period 5 and beyond September 2011

- Electrical Power and Fixed Plant
- Telecoms

B2.1.5 The Mandate was drafted to complement our work under other Independent Reporter Mandates, specifically:

- AO/15: 'NR Bottom-Up Benchmarking Programme Audit'
- AO/16: 'Prioritised audit of inputs to Network Rail's Tier 1 strategic planning models used in support of IIP'
- AO/21: 'Audit of integrity of Network Rail's tier 0 and tier 1 strategic planning

B2.1.6 The review was commenced in June 2011 and a summary report was delivered on 16 December 2011 to assist ORR with their advice to Ministers. A report on the Whole Life Cycle Cost Models was delivered in April 2012 and a report on the Tier 0 and Tier 1 Models was delivered in February 2012.

B2.1.7 Full report references are given below, andall these reports are available from the ORR website

Arup

- AO/17: Initial Industry Plan 2011 Review
  - Arup Summary Report - Observations and Conclusions - Issue 1 16 Dec 2011
  - Arup Review of Tier 2 Whole Life Cycle Cost Models – Issue 1 23 April 2012
- AO/016 & AO/21:
  - Arup 'IIP Tier 0 & 1 Model Audits'. – Draft 2 6 February 2012

AMCL

- BA/020: Initial Industry Plan 2011 Review (E&P, Signalling & Telecoms)
  - AMCL Report Initial Industry Plan 2011 Review, Final Report Draft A 29th November 2011

B3 Progressive Assurance

B3.1.1 As part of Mandate AO/030 we undertook Progressive Assurance of NR's proposed Asset Policies and their application. The aim of the Progressive Assurance activity was to give ORR confidence that NR was making sufficient progress in developing a robust SBP submission ahead of the formal SBP submission in January 2013.

B3.1.2 The requirements and timescales for NR's submission of progressive assurance material and our review were set out by ORR in their document *'Requirements for Network Rail's January 2013 Strategic Business Plan'* issued on 15 March 2012.

B3.1.3 Specifically under Mandate AO/030 we were required to report against two milestones set out in the SBP requirements document, namely:

- Milestone #2 'Operating Route Analysis' by 30th May 2012
- Milestone #3 'Asset Management' by 7th September 2012

The findings that we reported at these milestone dates are summarised below.

Milestone #2 'Operating Route Analysis'

B3.1.4 The scope of Milestone #2 'Operating Route Analysis' was to review NR's evidence in relation to:

> *"What is the process being used to ensure production of robust business plans by operating route? (To include process map and clarification of the role and interaction of asset policy, strategic planning models, route based asset management plans, efficiency benchmarking.)*
>
> *How will route based asset management plans be presented in the SBP? (Include draft templates and descriptions.)"*

B3.1.5 We reported on Milestone #2 in our presentation to ORR and NR on 29th May 2012. This was a joint presentation with AMCL and a copy is included in the accompanying Addendum Report (AO/030/04). Our key comments made at that time were:

- *Still work in progress - viewed [RAMP] Iteration #1 - end March 2012*
- *We have had very limited visibility of developing plans so far*
- *NR have made significant progress with overall process – adopted and being implemented by the Routes - considerable way still to go*
- *SBP Route Plan submission will not be as detailed as RAMP / SRS level*
- *Level of detail behind Route submissions still unclear*
- *Potentially most challenging part to come – reconciling 'top down' strategic view with local 'bottom-up' Route view*
- *NR will have an 'answer' for SBP - Issue is degree of confidence*
- *Relative 'power' of Central vs Route at HAM / RAM level will be key – degree to which 'policy' is adopted in practice.*
- *Estimate that NR may be circa 6 months behind where we would ideally like ourselves to be if we were doing this to be 'self-assuring' for January 2013.*

B3.1.6 We subsequently provided an update on Milestone #2 in our presentation to ORR and NR on 11th September 2012. This was a joint presentation with AMCL and a copy is included in the accompanying Addendum Report (AO/030/04). Our key comments made at that time were:

Current Position

- *Still work in progress - viewed [RAMP] Iteration #2 - end May2012*

- *NR have made significant progress with overall process – adopted and being implemented by the Routes - considerable way still to go*
- *'Top-down' direction wrt [RAMP] templates, budgets and efficiencies seen, but adopting a 'step-by-step'approach – no overall development plan / Gantt Chart seen*
- *HLOS: - Not yet incorporated into Plans (published July 2012)*
- *We have had not yet met with Routes to understand how they have populated so the level of detail behind Route submissions still unclear*

General Comments

- *Policy application ongoing, with parallel ongoing policy development being noted as a risk in a number of Route Plans*
- *Asset Management 'outputs' not 'explicit' - e.g. 'what we get for our money in CP5 …' - hard to see line of sight.*
- *Unclear where base assumption 'As per CP4 exit' (and definition) came from and whether appropriate / whether other options could be better value.*
- *'Status' of IIP numbers seems to be unclear – some see as a constraint ('what can we do to achieve IIP numbers …') – significant potential concern if 'local business' over-rides 'technical need' … no formal process identified for reconciling differences.*
- *Potentially most challenging part to come – reconciling 'top down' strategic view with local 'bottom up' Route view – no documented process seen.*
- *Relative 'power' of Central vs Route at HAM / RAM level will be key – degree to which 'policy' is adopted in practice.*
- *Unclear how cross-route / asset wide prioritisation will be considered (i.e. moving IIP numbers)*
- *Extensive focus on efficiencies (Mandate AO/035 will review)*
- *Unit cost / volumes – being considered – work in progress (Mandate AO/34 will review costs)*
- *Unclear why Civils & Buildings volumes not included.*
- *Route Efficiency Benefit Sharing (REBS) and Alliancing – impact not seen, unclear if / how these will influence Route Plans*
- *Reconciliation with HLOS - no documented process seen.*

Conclusion

- *NR will have an 'answer' for SBP - Issue is degree of confidence*
- *IIP 'top down' and Route 'bottom-up' challenge is happening*
- *Evidence of robust dialogue*
- *Unclear process for reconciliation*
- *Need to make sure 'right conclusions' are reached - significant risk that business may 'outweigh' policy / technical need.*
- *Not yet met Routes – so unclear how working in practice*

Opinion

- *Estimate that NR may be circa 6 months behind where we would ideally like ourselves to be if we were doing this to be 'self-assuring' for January 2013 - ideally a 'baseline' SBP submission would have been available by HLOS …*

Milestone #3 'Asset Management'

B3.1.7 The scope of Milestone #3 'Asset Management' was to review NR's evidence in relation to:

"What further progress has been made on development of:
a) asset policy;
b) strategic planning models (tier 1 and 0 models);
c) whole lifecycle cost modelling (tier 2 models);
d) key network and asset sustainability / performance measures?;

(Include update on risk based maintenance, level crossings policy)
How has Network Rail addressed, or plans to address relevant reporter recommendations from IIP review of policy and modelling?"

B3.1.8 We also reported on Milestone #3 in our presentation to ORR and NR on 11th September 2012. This was a joint presentation with AMCL and a copy is included in the accompanying Addendum Report (AO/030/04). Our key asset group findings made at that time were:

- *Track – Tier 2 model updated (to be reviewed). Policy update in progress.*
- *Off-Track – No progress seen*
- *Buildings – IIP recommendations being addressed. Updated Policy yet tobe seen. Effectiveness of approach for buildings assets still not proven.*
- *Drainage – No update to Policy seen. Significant activity on asset inventory.*
- *Civils – New risk-based Policy being developed – work in progress, needs to be integrated with WLCC findings and POAP. Tier 1 model still being developed.*
- *Earthworks – Revised Tier 1 and Tier 2 model adopted, risk-based approach linked to short term and long term condition.*
- *Fleet – NR planning to purchase plant to deliver Track Policies, timescale for delivery is limited*
- *EP – Issues remain around NR policy for EAW compliance that are not reflected in the current approach*
- *Signalling–WLCC modelling enhanced but used to verify rather than drive policy*
- *LX – Now have stand-alone policy which should provide consistent approach to asset interventions but development behind other asset groups*
- *Telecoms – Extent of demonstration of WLCC modelling is limited to one asset type*

B3.1.9 As part of our report on 10th September 2012 we included a progress assessment against our recommendations made in our IIP Review Reports (Arup 2011a and Arup 2012a).

Update Presentation

B3.1.10 Towards the end of the Progressive Assurance review period we provided an update to ORR and NR on 23rd November 2012. This was a joint presentation with AMCL and a copy is included in the accompanying Addendum Report (AO/030/04). Our key findings made at that time were:

Route Meetings

- *Meetings held with DRAMs for Scotland, Wessex and LNE in September 2012 to discuss the process for developing Route Plans*
- *New structure and people in Routes*
- *Most DRAMs started around January 2011*
- *Significant effort and has stretched resources in some cases – on top of 'day-job'!*
- *Variation in maturity of policies across asset groups*
- *Late production/changes to policies an issue for Route Plan production*
- *No formal process for reconciliation with policies, but:*
    - *Good and regular HAM/RAM discussions*
    - *Overall Programme Plan and milestones understood*
    - *Guidance from Centre reasonable but some Routes have taken initiative*
    - *Significant differences in Routes' interpretation of Civils Policy noted*
- *A 'strong push' to align with IIP numbers noted by one Route; difficult to comply with this in Structures and Drainage*
- *Explanation of deltas between Route Plans and IIP numbers noted as a key factor by all*
- *Scotland Route has different drivers and funding; Scotland Route Plan will form basis of Scottish SBP*
- *Evidence of impact of local factors in all 3 Routes - e.g. Track access requirements affect WLCC approach for ECML and WCML, Waterloo capacity (TOC driven), co-located Property team in Scotland*
- *Alliance in Wessex considered to be a strong point with aligned objectives – formal sign off process for Route Plan to be confirmed, delivers certainty rather than efficiency*
- *Asset information a combination of central data and local knowledge*
- *ADIP considered to have been effective*
- *Unit costs nominally taken from Centre with local variations applied – some cases of Central Unit Costs not being considered applicable in Route*
- *Tier 2 model use variable across Routes – Signalling model used significantly to assess NOS/ERTMS impacts/opportunities; ERTMS implementation is treated as renewal (modern equivalent)*
- *Risk to efficiencies identified by NOS and Plain Line Pattern Recognition noted with respect to the Unions*
- *Efficiencies generally the least developed element of the Route Plans at the time of meetings*
- *CP5 efficiencies considered for achievability at Route level – i.e. not all ORBIS efficiencies accepted, challenge of multi-skilling*
- *RAM is now funded by DRAM, not HAM – has implications on staffing requirements at Route level and post-September negotiations*

CP5 Route Output Specifications

- *Purpose of Route Output Specification is to inform the Route of the outputs that need to be delivered in CP5 in order to be compliant with the HLOS.*
- *Help inform the completion of the Route Business Plan which feeds into NR's SBP. Describes*
    - *Enhancement Projects from HLOS.*
    - *Passenger / Freight Traffic Growth Projections*
    - *Some accompanied by 'CP5 Project Definition Sheets' e.g. Scotland and East Midlands*
- *Targets*
    - *No safety targets at Route Level*
    - *No sustainable development targets at Route Level*
    - *No 'asset stewardship' / 'asset management' objectives*
    - *Performance Outputs – 'top down'*
        - *PPM*
        - *CaSL*
        - *Delay Target*
    - *Capacity Metric*
        - *Capacity metric in CP5 focuses on number of passengers to be accommodated into major cities – London plus Birmingham, Manchester, Leeds plus Bristol, Leicester, Liverpool, Newcastle, Nottingham and Sheffield.*
        - *Specifies Enhancement Schemes*
    - *Committed Infrastructure Investment in CP5*

Route Specifications - Comments

- *No clarity of progress since receipt of Route Specs in August*
- *No Specific Asset Management aspects in HLOS - Some mention in sos-guidance-to-orr dated 21 July 2012 – unclear how this has formally been cascaded*
- *Asset Management:*
    - No explicit mention of Asset Stewardship in Route Specifications
    - Context and demand analysis identified at high-level
    - Capability and capacity change plans (projects) identified
    - PPM and CaSL identified per TOC
    - Route wide delay minutes identified – do not include service growth
    - No further apportionment of delays
- *Enhancements:*
    - *Process for assessing impact on Maintenance & Renewal unclear e.g. Capability changes requiring Asset replacement, or additional maintenance due to increase in traffic*
    - *Limited quantified benefit and alignment of enhancements to current issues/drivers of delay*
- *At this stage it is not clear how:*
    - *HLOS PPM/CaSL has been apportioned to Routes*
    - *Delay minutes have been derived by Route*
    - *Routes will apportion delay minutes:*

        - *Across asset groups?*
        - *Across geographical sectors/Routes/SRSs/Criticalities?*
        - *To a common process/guidance?*
    - *How Opex options are considered:*
        - *How do current maintenance regimes contribute to delay minutes?*
        - *What are the gaps, if any?*
        - *How is maintenance being optimised to achieve future targets?*

Policies and Modelling

- *Policies 'awaited'*
    - *Track*
    - *Buildings*
    - *Fleet*
    - *EP*
    - *Signalling*
    - *LX's*
    - *Telecoms*
- *Policies 'about there' that we have had sight of*
    - *Earthworks*
    - *Structures*
- *Policies not seen and significantly changed from IIP (we understand)*
    - *Drainage*
- *Policies still 'not provided yet'*
    - *'Off Track'*
- *Suite of Tier 2 models created for most critical asset groups*
- *Models have developed and matured over 3 development phases*
- *Developed concurrently with CP5 Asset Policies*
- *Case studies undertaken with Routes/RAMs*
- *Some driving of policy – but generally for validation*
- *Evidence of use by Routes to select options (e.g. Signalling)*

B4 SBP Assessment Plan

B4.1.1 As outlined above, Progressive Assurance was significantly less successful than envisaged by ORR and Arup, primarily because NR were not in a position to provide substantially completed material to the timeline set out in the ORR document *'Requirements for Network Rail's January 2013 Strategic Business Plan'* issued on 15 March 2012.

B4.1.2 The key implication of this was that prior to 7th January 2013 we did not have clarity as to the level of detail in the Route Plans and an understanding as to how volumes and costs (plus efficiencies) would be presented. We also had not received a significant number of complete Asset Policies and associated Tier 1/2 Models - a number were not received till November / December 2012.

B4.1.3 Ahead of receipt of the SBP Submission on 7th and 8th January 2013 we prepared an internal plan (Assessment Plan) setting out our overall methodology for our review of the SBP submission. This Assessment

Plan was based on our understanding of the SBP submission at that time and the 'gaps' that we had identified.

B4.1.4 Based on our understanding from progressive assurance we identified the key elements which we believed to have contributed towards and been used by NR in deriving the SBP submission. The four main elements were identified as:

- Asset Policies
- Whole Life Cycle Cost Models (Tier 2)
- Strategic Models (Tier 1) calculating volumes and costs
- Route Plans

These are interrelated as shown in the following 'Flow Chart' (Figure B3-1) to derive Maintenance & Renewal Volumes & Costs.

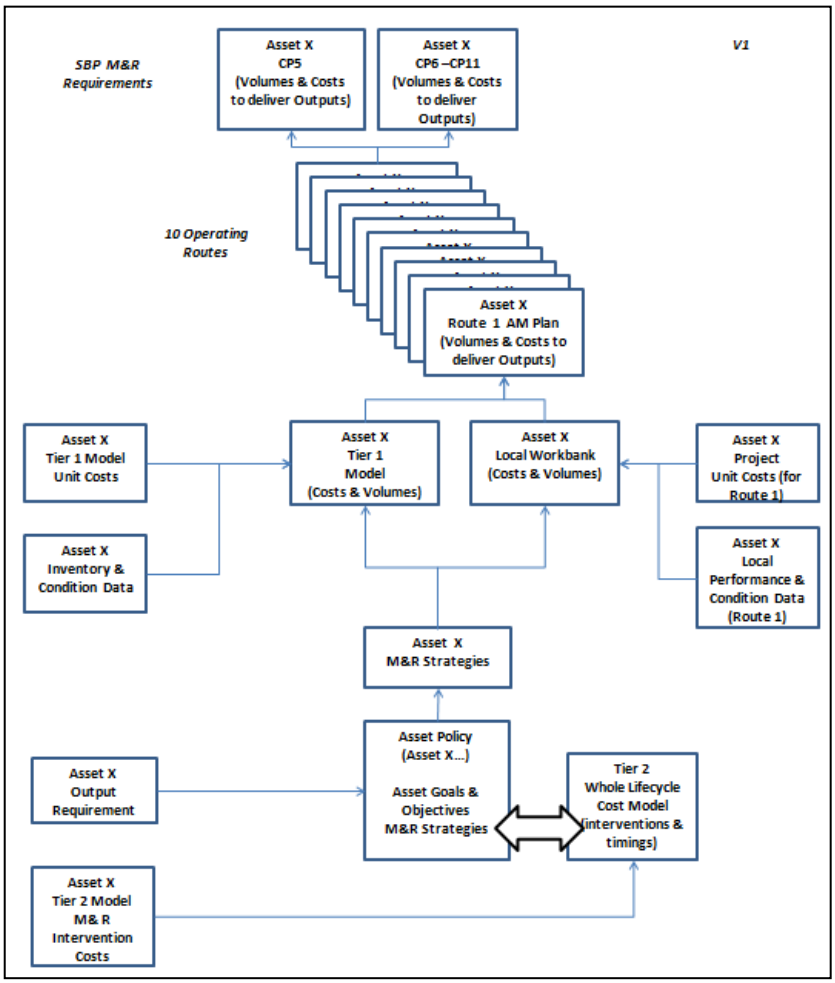


Figure B4-1 System Diagram showing derivation of M&R volumes

Overall Approach to M&R Assessment

B4.1.5 As explained in the main text, Arup had been appointed to consider maintenance & renewal aspects of the SBP submission under three inter-related mandates, AO/030, AO/034 and AO/035. With this in mind we adopted a 'three stage' overall approach, namely:

- Stage 1 – Review Volumes of work proposed and basis (Mandate A0/030)
- Stage 2 – Review costs used to derive SBP figures (Mandate AO/034)
- Stage 3 – Review proposed efficiencies (Mandate AO/035)

Stage 1 – Volumes (Mandate AO/030)

B4.1.6 Our approach has been to assess the derivation of the 'volumes' of Maintenance & Renewal work being proposed in NR's SBP and their relationship to the overall performance required under the HLOS. This has included a review of the individual asset policies.

B4.1.7 Our Progressive Assurance work indicated that volumes of work had been derived from some combination of 'top down' or central modelling (Tier 1) combined with local Route based 'bottom-up' knowledge and / or specific workbanks.

Stage 2 – Costs (Mandate AO/034)

B4.1.8 We reviewed the origin of the costs (unitised rates or otherwise) that have been used in deriving the SBP figures for CP5 and CP6-CP11. These are reflected in the Pre-Efficient figures in the SBP Data Book.

Stage 3 – Efficiencies (Mandate AO/035)

B4.1.9 We reviewed the origin of the efficiencies (central or local) that have been used in deriving the SBP figures for CP5 and CP6-CP11. These are reflected in the Post-Efficient figures in the SBP Data Book.

Specific Approach

B4.1.10 For Mandate AO/030 (Stage 1 above) we adopted the following approach.

- Desk Based Review of SBP M&R Documentation as provided by NR on 7th January 2013.
- Challenge Meetings:- Meetings were arranged with NR during January / February 2013. These were led by ORR and comprised both Central meetings and Route meetings. The Reporters attended as observers.
- Specific Meetings:- Following the central Challenge Meetings A number of specific meetings were held with NR
- Questionnaire:- As part of the preparation for the Route Interviews we prepared questionnaires to be completed by key NR staff. Three questionnaires were drafted:
  - Head of Asset Management (HAM) for each asset type
  - Director of Route Asset Management (DRAM) for each Route
  - Route Asset Manager (RAM) for each asset type and each Route.
- Route Interviews:- Interviews were arranged with a sample of NR Operating Routes during January and February 2013. These meetings were led by the Reporter with the aim being to help us understand the detailed 'background' working undertaken by the Routes in developing the final Route costs, volumes and outputs in the SBP. Specifically we focussed on individual asset types and the practical application of central guidance.

B4.1.11 Based on a qualitative review of uncertainties and their potential impact on our opinions the following sampling of Routes and Assets was jointly adopted by Arup and AMCL.

B4.1.12 In total some 34 Route Interviews / Meetings were held out of a possible 60 combinations of Routes and Assets.

v6a

	Asset					Central			Central	
Route	Track	Signalling LX's	Structures	E&P	Op Property	Telecoms	Earthworks Drainage		Fleet	Total
	Arup	*AMCL*	*Arup*	*AMCL*	*Arup*	*AMCL*	*Arup*		*Arup*	
Anglia	1	1	1	1	1					5
East Midlands	1	1								2
Kent	1		1	1						3
LNE	1	1					1			3
LNW	1		1	1	1					4
Scotland	1	1	1	1	1		1			6
Sussex		1					1			2
Wales	1	1	1		1					4
Wessex		1			1					2
Western	1		1	1						3
Total										
No. RAM Audits	8	7	6	5	5	0	3		0	34

Figure B4-2 Route Interview Sampling

B4.1.13 Copies of the questionnaire returns and notes from the Route Interviews / Meetings undertaken by Arup are presented in our accompanying report Ref AO/030/04.

Appendix C

Review of Uncertainty Analysis

C1 Overall Uncertainty Analysis

C1.1.1 The NR SBP submission includes an 'Uncertainty Analysis' [SBPT3297], which describes the 3-stage analysis undertaken by NR – see extract in Figure C-1 below

By the end of CP5 we expect to deliver performance in the range 91-93% PPM, and options concerning the target are discussed in the *Performance Plan*.

Whilst Figure 1 and its associated analysis addresses the question of how our PPM is likely to evolve over the course of CP5, by necessity it assumes that all the activities and asset interventions in our plan will be achieved. The next questions therefore are:

(A) How likely are we to achieve all the planned activities & interventions?

(B) What is the impact on PPM of over/underachieving the activities & interventions?

We have developed a 3-stage uncertainty analysis to answer (A) and (B), where each stage informs the next:

(A)	Stage 1	Renewals expenditure
	Stage 2	Total company expenditure
(B)	Stage 3	Linking performance to expenditure

The rest of this document describes how each stage has been undertaken, the results obtained from that stage of the analysis so far, and the conclusions that can be drawn.

This analysis is based on a top down view of the uncertainty for each part of our expenditure plan. While we will recognise that the analysis will continue to improve as we continue to develop the approach for overall QRA of our plan, we consider that the results of this analysis provide a broad indication of the overall cost uncertainty within the plan.

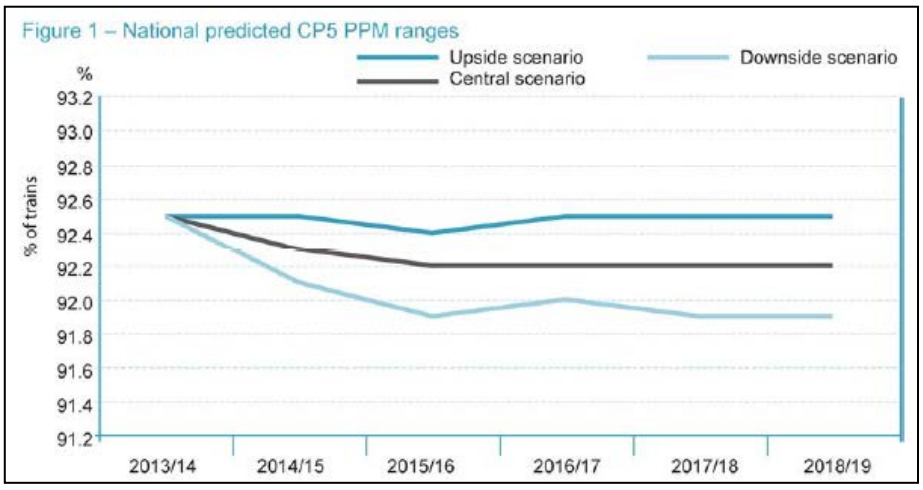


Figure C-1 NR's Uncertainty Analysis and Predicted PPM ranges [SBPT3297]

C1.1.2 In preparing this report we have briefly considered the uncertainty analysis associated with the renewals expenditure – i.e. NR's Stage 1 analysis. Comment on other aspects of the uncertainty analysis is included in our accompanying reports [A0/034 and AO/035].

Stage 1 - Renewals Expenditure

C1.1.3 The stated purpose of the Stage 1 analysis was:

" To assess the level of confidence we have in our projection of the renewals expenditure required to deliver a set of specified outputs over CP5."

NR have assessed uncertainty as it applies to each of the component parts of the 'modelled' equation:

Total cost = Unit Cost x Volume x Efficiency

C1.1.4 NR note that the analysis

- Includes 'common cause' uncertainty but excludes 'special cause' (i.e. unusual, unexpected events);
- Is limited to Renewals expenditure for the duration of CP5 for all assets with the exception of Wheeled Plant & Machinery;
- All the stages of their methodology are *'under development and the results obtained should be regarded as indicative only'*.

Method

C1.1.5 The method for deriving the uncertainty was to ask national asset teams to identify a range of common cause uncertainties inherent in their projections for unit costs, volumes and efficiencies. This was achieved by reference to historical data or, in the absence of this, engineering judgement. Uncertainty ranges were estimated for each cause and these were then combined for each asset in a Monte Carlo simulation tool, @RISK. The final stage was to combine all the asset uncertainties into a single uncertainty range for all asset renewals.

C1.1.6 The use of @RISK to carry out this type of analysis is not unreasonable and provides a useful mechanism for understanding the overall uncertainty range. We would point out that it crucially depends on the correct identification of underlying uncertainties and correlations between parameters.

C1.1.7 We also note that correlation within and between asset spends has been incorporated to 'recognise intra-asset correlation (how movements in unit cost/volume in one asset spend category affect the unit costs/volumes in another) as well as inter-asset correlation (how movements in expenditure in one asset affect the expenditure in another)'. A default 'unit cost' coefficient of 0.6 has been assumed for all correlations except where strong evidence suggests otherwise.

C1.1.8 We are unclear as to how this correlation has been derived, and how sensitive the resultant uncertainty is to the selected value. We would expect NR to provide this information.

C1.1.9 The high level output from the Stage 1 uncertainty analysis has been presented in the form of a probability distribution of the total CP5 renewals expenditure - see Figure C-2.

C1.1.10 An example 'spot value' is shown that NR suggest can be interpreted that they are '43% confident of being able to deliver the outputs for a renewals expenditure of £12.64 billion.'

Figure 2 – Stage 1 Indicative result – cumulative probability distribution plot for total national renewal spend

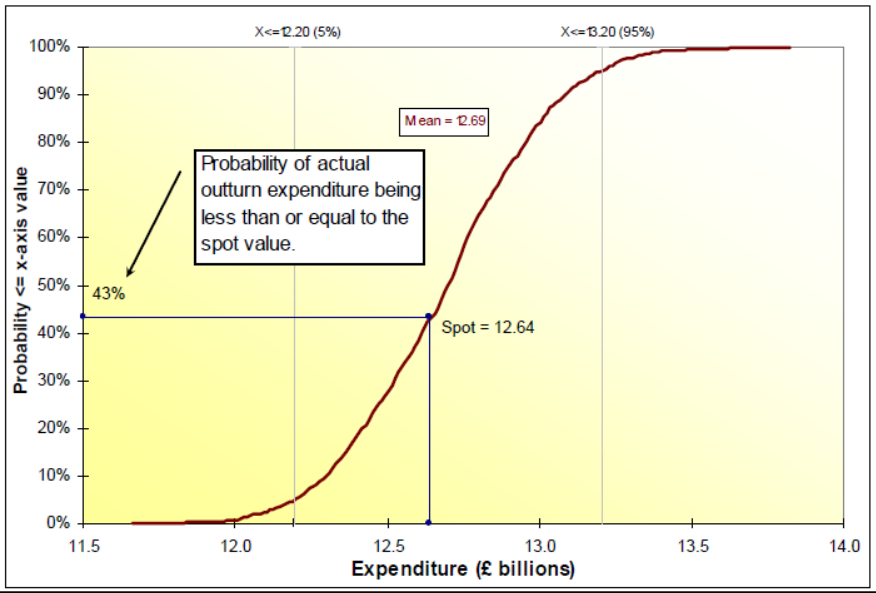


Figure C-2 Stage 1 – Indicative Result – National Renewal Spend [SBPT3297]

C1.1.11 Figure C-3 shows the same data underlying Figure C-2 tabulated as a summary of the outputs of the simulation model runs. The "Spot" value is described as *'the projected expenditure that the asset teams have determined would be required to renew and maintain the assets in a sustainable manner to deliver the specified outputs; it does not include the impact of uncertainty.'*

Table 1 Summary of CP5 expenditure						
	Spot	Spot %	Range (95thP-5thP)	Range as % of spot	P50	P80
National Renewals	12,639	43.1%	1,005	7.9%	12,698	12,950
Track	3,293	67.5%	247	7.5%	3,259	3,323
Signaling	3,001	40.0%	182	6.1%	3,015	3,064
Level Crossings	542	39.5%	33	6.0%	545	553
Civils	2,578	44.5%	396	15.4%	2,597	2,698
Buildings	1,106	39.9%	192	17.3%	1,122	1,172
Electrical power	1,140	28.2%	130	11.4%	1,162	1,199
Telecoms	381	33.2%	36	9.5%	385	395

Figure C-3 Stage 1 – Indicative Result – National Renewal Spend of £12.639Bn [SBPT3283]

C1.1.12 NR also present a regression sensitivity chart showing which assets contribute the most to the variability of the total renewals expenditure – see Figure C-4 below. This seems to suggest that the overall CP5 maintenance and renewal expenditure is most sensitive to variation in Civils costs, despite these having a lower total projected spend than Track or Signalling.

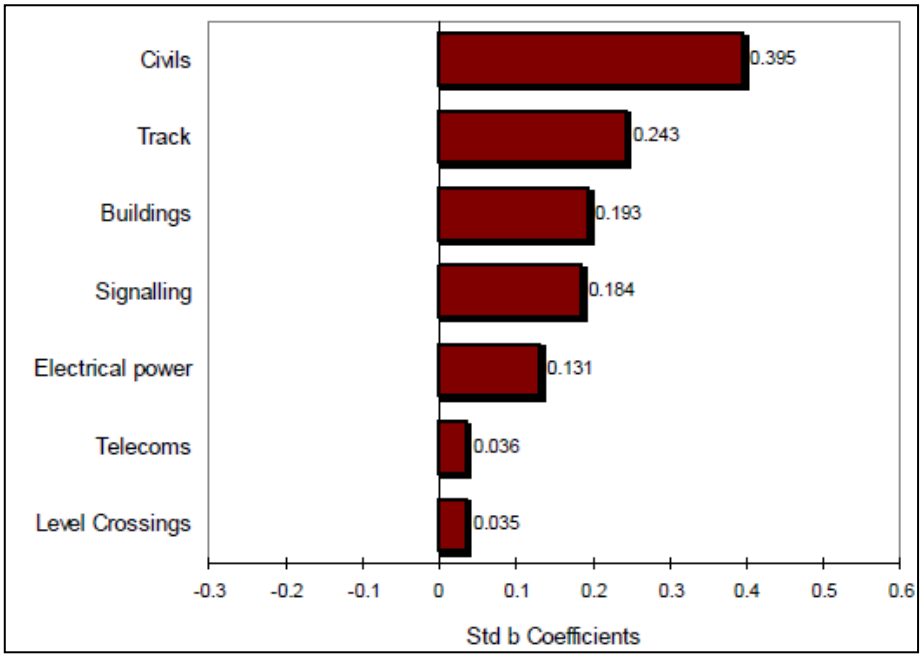


Figure C-4 Stage 1 – Indicative Result – Sensitivity Analysis [SBPT3283]

C1.1.13 Our understanding is that the costs in Figure C-3 are 'top down' and therefore reflect the 'Tier 1 modelled scenario' within the Tier 0 Database. We also assume they are post-efficient, given that the uncertainty analysis includes assessment of the efficiencies. This appears to be confirmed below where we compare the spot bids in Figure C-3 above with the corresponding figures in the Tier 0 Database in the Table C-1 below.

C1.1.14 This comparison shows there is a difference for the Signalling, Level Crossings and Electrical Power cost estimates, the reasons for which are unclear. We are also uncertain on the reason why the individual spot bids do not add up to the total spot bid shown (£12,041m v £12,639m).

Table C-1: CP5 Renewal Costs

Asset	Spot Value (taken from Table 1, Uncertainty Analysis – Stage 1)	Tier 1 Modelled Scenario, post efficient
Track	£3,293m	£3,293m
Signalling	£3,001m	£2,946m
Civils	£2,578m	£2,578m
Buildings	£1,106m	£1,107m
Electrical Power	£1,140m	£921m
Telecoms	£381m	£380m
Level Crossings	£542m	£448m
Total Total shown in NR Table 1	£12,041m £12,639m	£11,673m

Interpretation of results – National

C1.1.15 In reviewing the national renewals expenditure, and as noted above, we do not understand the derivation of the £12.64 billion renewals spot bid. We are therefore unable to judge the interpretation provided by NR, in particular whether their plans *'already stretch significantly our ability to deliver renewal activity in CP5.'*

C1.1.16 We note that this uncertainty analysis has been undertaken using the 'top down' modelled figures. The SBP submission has in general been based on a 'mixture' of 'top down' and 'bottom up' route derived figures - an example is Track renewals cost which has increased from £3,293m to £3,431m. We are unclear what effect the use of the 'top down' figures may have on the uncertainty of the SBP costs.

C2 Asset Specific Uncertainty Analysis

Interpretation of results – by asset

C2.1.1 The results of the uncertainty analysis are presented by asset in the 'Uncertainty Analysis – Stage 1' document [SBPT3283], with supporting details provided in appendices. A summary of our views of these analyses is set out below.

Track

C2.1.2 NR have produced a detailed uncertainty analysis of the Tier 1 volumes in Appendix B of the Uncertainty Analysis document [SBPT3283].

C2.1.3 The appendix sets out NR's views as to major causes of uncertainty and their likely impacts on renewal and maintenance costs. They are then combined using @RISK software to estimate the overall level of uncertainty. The net impact is that NR would expect total costs to be up to £140m higher than the modelled costs (at the 90% confidence level). NR note that this excludes any uncertainties related to unit costs.

C2.1.4 NR's 'Uncertainty Analysis – Stage 1 document' shows that they predict a 67.5% probability that the Track renewal costs will be equal to or lower than the spot bid of £3,293m.

C2.1.5 However, this is at odds with the results provided in section 3 of the appendix. Here the conclusion is that the overall average impact of uncertainties increases the renewal costs by £47m to £3,340m (the P50 point, i.e. there is a 50% probability that the renewal costs will be equal to or lower than this value). We are unclear why the appendix results are different to Table 1 for track renewal costs.

Structures

C2.1.6 A short overview of the uncertainty analysis is provided in 'Civils Uncertainty Analysis' Rev 04. This is based on a review of data from the Cost Analysis Framework (CAF) forms.

C2.1.7 Unit costs are considered to vary by up to +/- 10% with most +/-5%. Volumes are considered to vary by up to +/-15%. Efficiencies are considered to vary between 13% and 16% (most likely 13.5%).

C2.1.8 There is insufficient information to comment on these uncertainties or the method by which they were derived. It appears to be in an early stage of development as section 1.2.2 in the document suggests for volumes '*There are several items which will need to be considered in further iterations beyond this stage.*'

C2.1.9 Given the size of the structures renewals costs, we would have expected a detailed review of sources of uncertainty to have been undertaken along the lines of that carried out for Track.

C2.1.10 NR have identified Civils renewals as the asset with most uncertainty. Structures is the largest contribution to these costs. However, we are unable to say whether the large uncertainty range that has been estimated is due to

the early development of the analysis or the underlying uncertainties themselves. In our view, more work is required before such a conclusion can be reasonably made.

C2.1.11 The overall uncertainty analysis for renewals expenditure [SBPT3297] states that:

'Civils contributes the most [to CP5 renewals expenditure uncertainty], primarily due to uncertainties about earthworks and civils-other expenditure.'

With the civils assets, there are a number of reasons for this increased level of uncertainty:

- *The policies are brand new and untested. The models supporting the policies will take time to validate against future observations, as there are no known comparable models within other rail organisations to perform validation against.*
- *The forecasting models are very sensitive to degradation information, the availability of which over the whole life cycle of the assets is limited, due to a typical asset life of 150 years.*

The first two issues above are exacerbated by the inherent complexity of the models, which is required by the varied nature of the asset base."

C2.1.12 Whilst we would agree that there are uncertainties associated with the 'earthworks' and 'civils-other' expenditures (which we assume refers to 'Other assets', e.g. footbridges culverts etc. plus 'Structures other') we are very surprised that these items are the 'primary' uncertainties. This requires further review. In the meanwhile we have very low confidence in the overall uncertainty analysis.

Earthworks

C2.1.13 A number of areas of uncertainty or assumptions for Earthworks renewals are provided in document 'Civils Uncertainty Analysis' Rev 04 [SBPT3283]. Overall, NR estimate that these give rise to an uncertainty of +/-15% to unit costs, +/- 24% to volumes and efficiencies to be in the range of 13.0% to 16.0% (most likely 13.5%) in CP5.

C2.1.14 The range of volumes has been informed from sensitivity tests undertaken in SCAnNeR and reported in 'CP5 earthworks modelling – SCAnNeR outputs to 22nd July 2012.' The conclusions of the sensitivity tests were reported as:

- *'The outputs are directly related to the input degradation rate*
- *The cost outputs are directly related to the input intervention unit costs*
- *There should be a differential between the unit costs for renew, refurbish and maintain in excess of 5 for acceptable model behaviour. This is achieved in the unit costs adopted*

- *The 100yr whole life cost is significantly influenced by the input discount rates*
- *The model is relatively insensitive to variations in all other input parameters'*

C2.1.15 We welcome the fact that the assessment of volumes is based on sensitivity tests of SCAnNeR. This is a reasonable approach but we are unable to comment further because of the lack of supporting information.

Buildings

C2.1.16 The uncertainty analysis for Buildings renewals is described in the document 'Buildings Uncertainty Analysis' Rev 03 [SPBT3283]. We review here the analysis of volumes.

C2.1.17 **Managed Stations** renewal volumes have been derived from a top-down workbank that was 'further refined following a survey of the managed stations, review of historic work volumes, and input from route engineering teams to account for inaccurate information and local stakeholder requirements.' NR then conclude that the resulting volumes represent a highly accurate central estimate, with uncertainty demonstrating a normal distribution with standard deviation of 4.7%. In other words, the volumes are within +/- 9.2% (with 95% confidence).

C2.1.18 Volumes for **Franchised Stations** are taken from the Tier 1 model for some assets (buildings, platforms, footbridges, canopies and train shed roofs) and an analysis of historic costs for others (including minor work, planned preventative maintenance, inspections etc.). The uncertainty analysis was undertaken using a Monte Carlo simulation (presumably in @RISK) by varying:

- Average Risk Scores (ARS) by +/- 0.5 points in a uniform distribution,
- Asset remaining life (ARL) by +/-15% in a uniform distribution, and
- Historic estimates by a normal distribution of standard deviation 5.65%.

We note that no evidence or reason is provided for the above uncertainties.

C2.1.19 This results in CP5 renewal costs with a PERT distribution of with a mode of £687m, a minimum of £668m and maximum of £821m.

C2.1.20 We recognise that the relationship between ARS, ARL and predicted cost of renewals is complicated. We are unsure how NR have taken this complex relationship into account.

C2.1.21 Given this is the largest category of buildings renewal costs, we therefore question the resultant PERT distribution and would want to see more supporting evidence and analysis. NR have also recognised in their text that they need to undertake further work.

C2.1.22 Volumes for **Other Buildings** (which we assume to be 'LMDs, MDU's, Dept Plant, Lineside Buildings and NDS Depots) have been derived from a number of sources. NR have undertaken a high level review of uncertainties and assessed their combined impact using Monte Carlo simulation. The resultant range is a normal distribution with standard deviation of 11.9%, so approximately +/- 24% (at 95% confidence). There is no supporting material against which to judge this.

Drainage

C2.1.23 We understand that the impact of uncertainties caused by drainage on track renewals has been included in the uncertainty analysis for Track. We have not found any specific assessment of uncertainty in drainage renewal costs.

Off-Track

C2.1.24 The uncertainty analysis for fencing is described in 'Off Track (Fencing) Uncertainty Analysis', Rev 02 [SBPT3283].

C2.1.25 Volumes for renewing Class I (e.g. palisade-type) and Class II (chain link, welded mesh) fences are considered. We are unclear how the analysis has been undertaken.

Fleet

C2.1.26 NR have not undertaken an uncertainty analysis of fleet renewal costs.

Conclusions

C2.1.27 Overall, we observe that the analyses of asset renewal volumes are at different stages of development and have adopted different methods. Our opinion is that more work is required before any conclusions can be drawn from the findings of the analysis.

References

Ref	Document Title	Version / Date
SBPT 3297	Uncertainty Analysis Overall Summary – Tier 3 Linking Expenditure to Performance	Version 0.4
SBPT3283	Uncertainty_Analysis_Stage_1	Rev 5 3rd Jan 2013
SBPT3296	Uncertainty_Analysis_Stages_2_and_3	

Appendix D

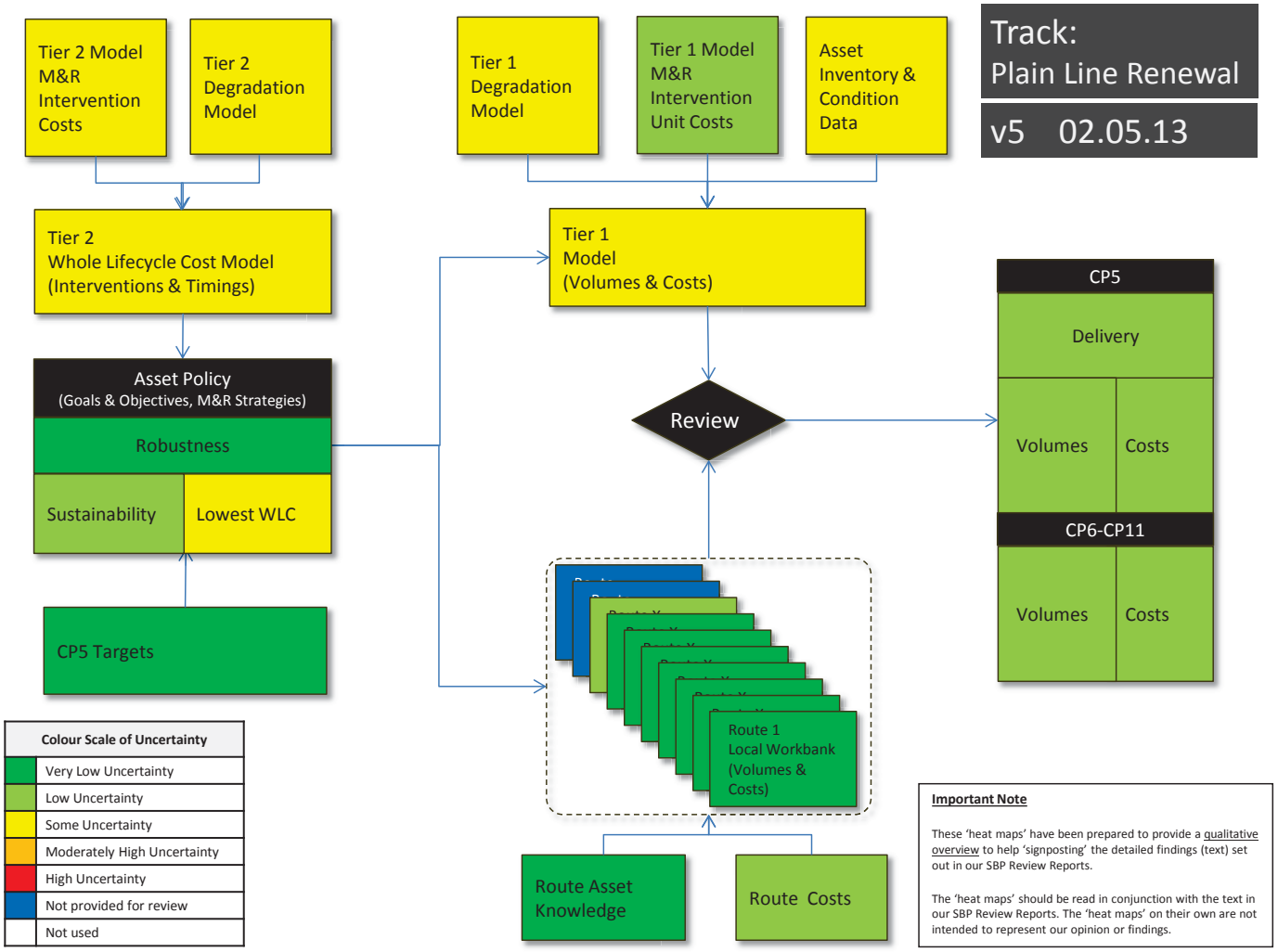
Asset Specific System Diagrams

D1 Track

Issue 1.2

Track: Plain Line Renewal

v5 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

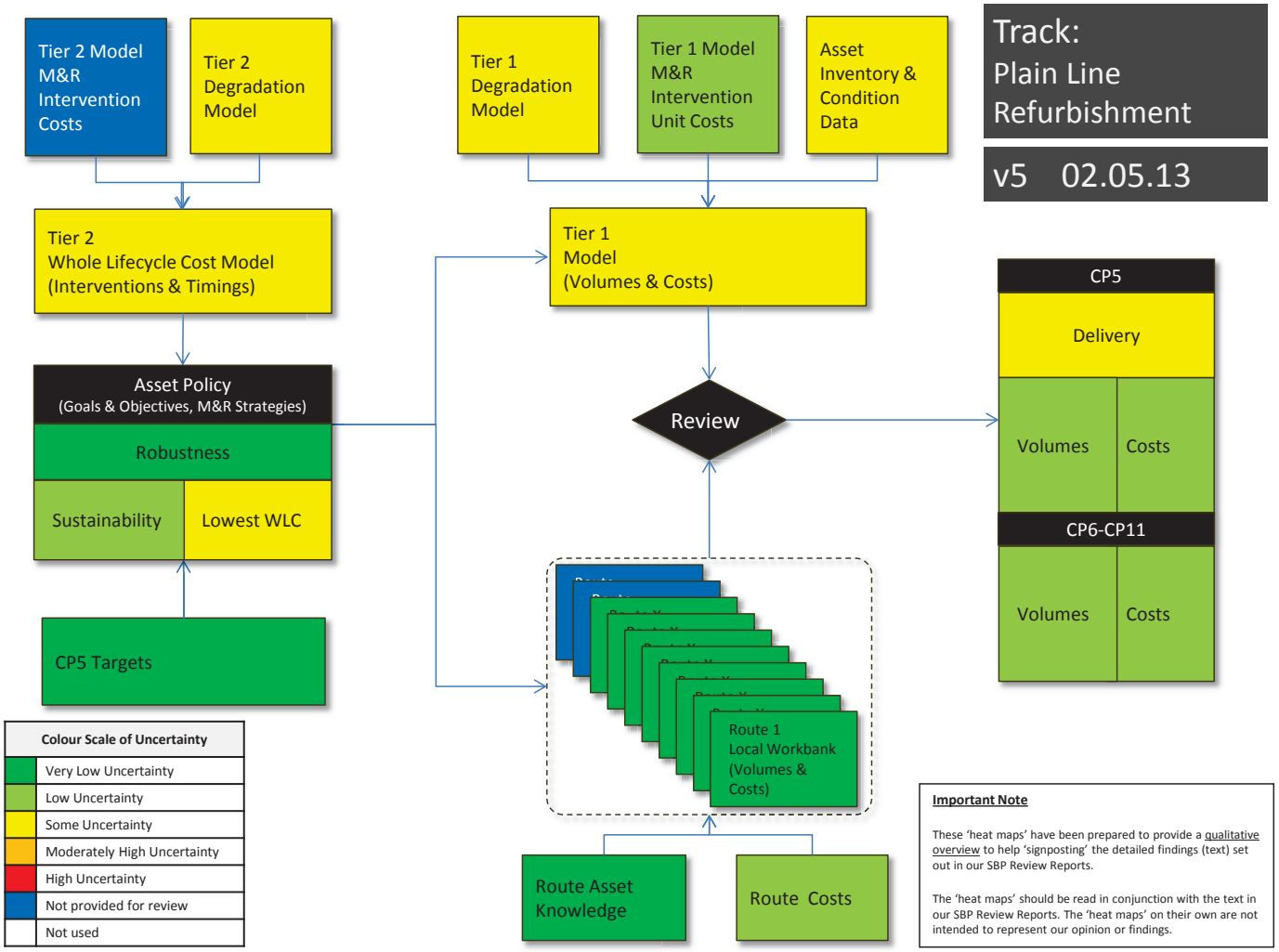
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Track: Plain Line Refurbishment

v5 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

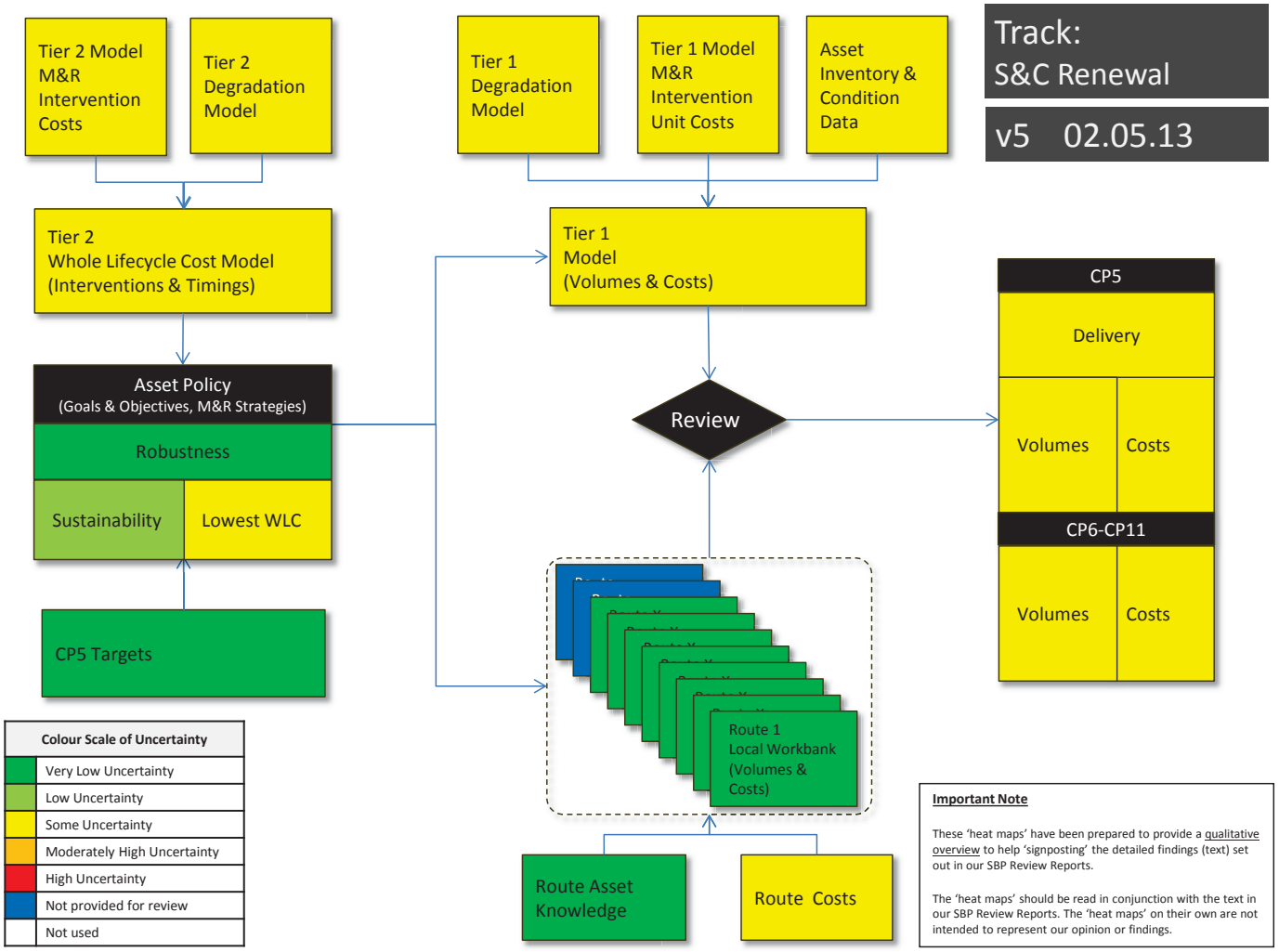
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Track: S&C Renewal

v5 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

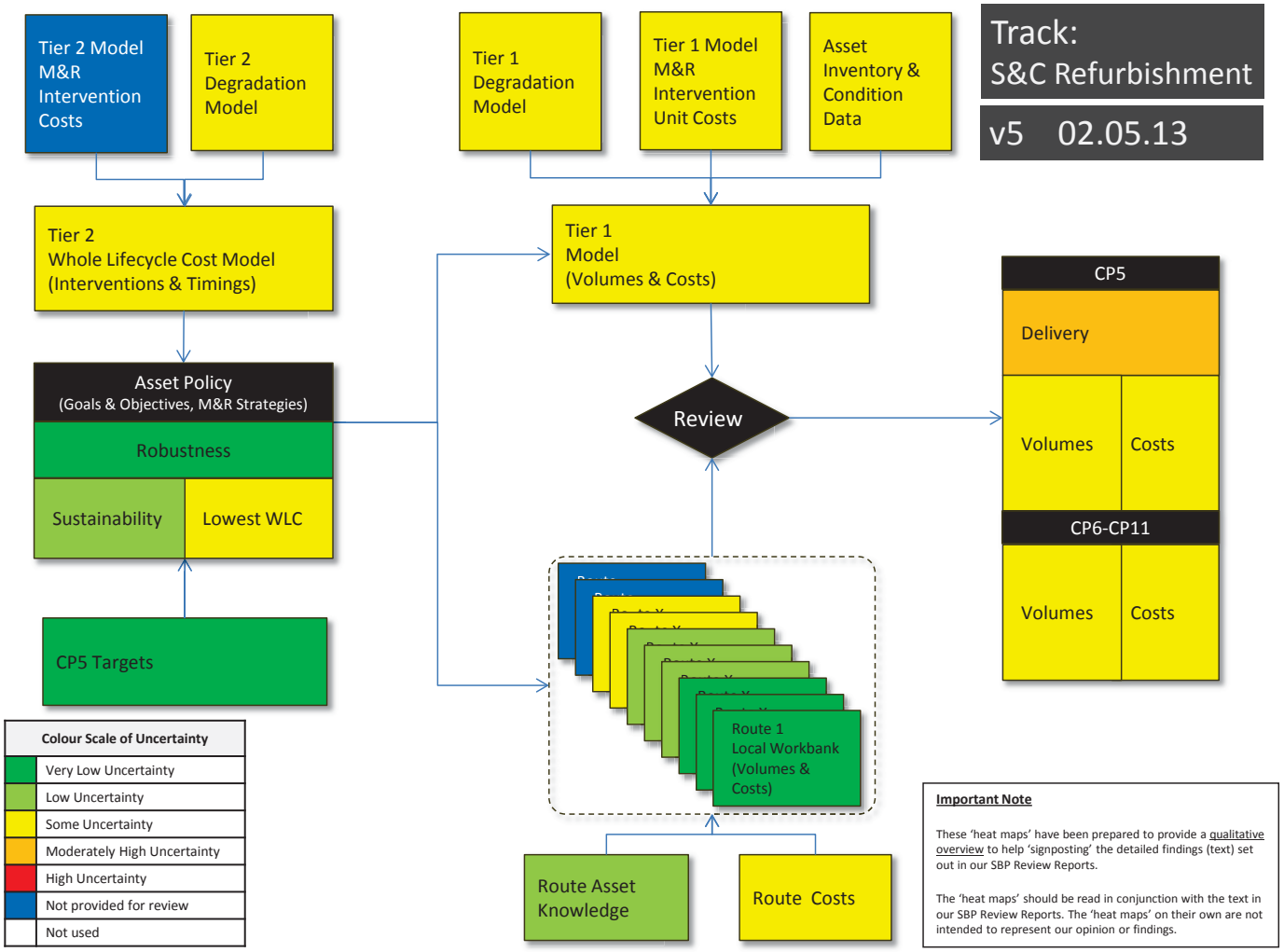
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Track: S&C Refurbishment

v5 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

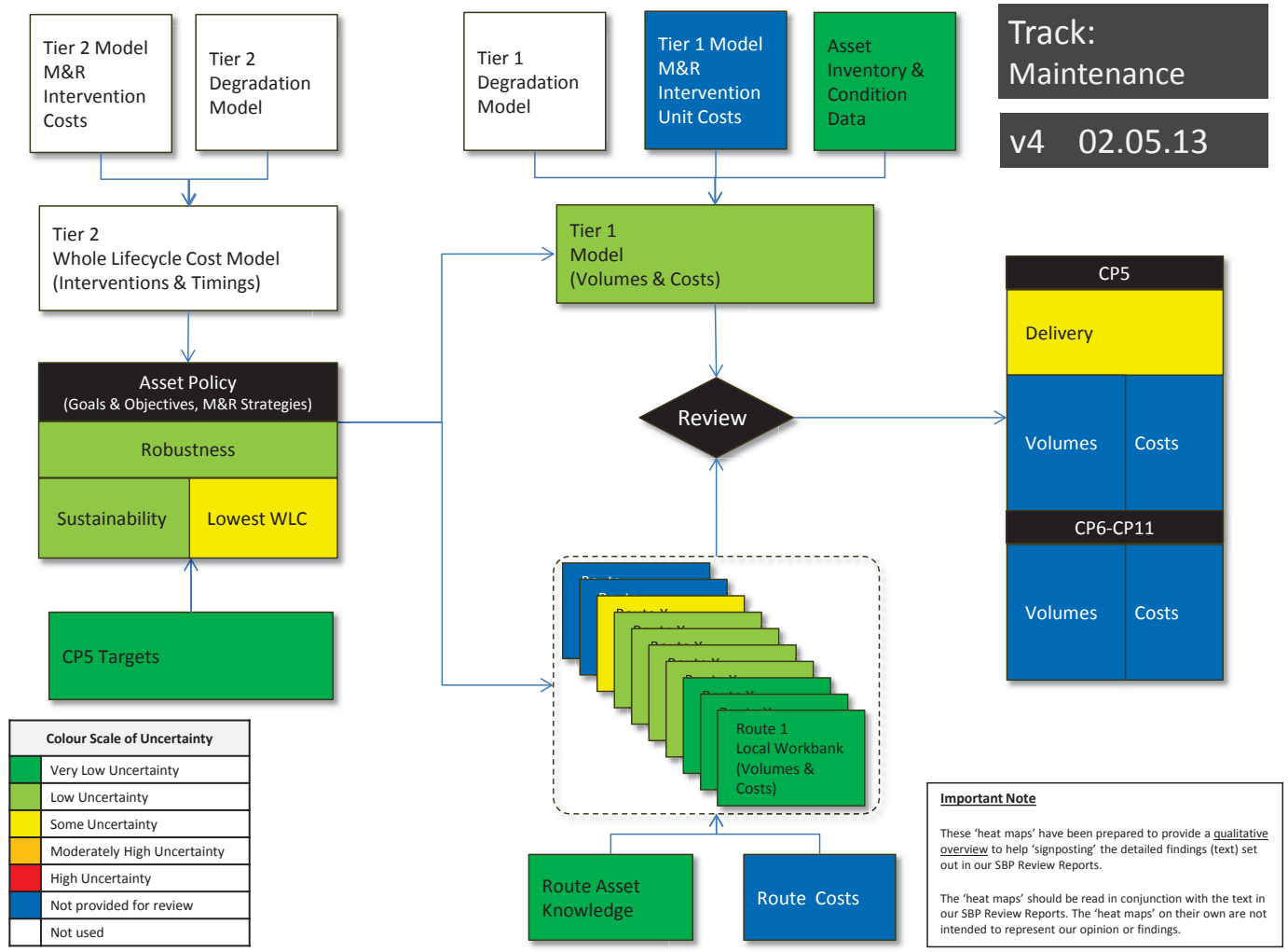
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Track: Maintenance

v4 02.05.13



Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

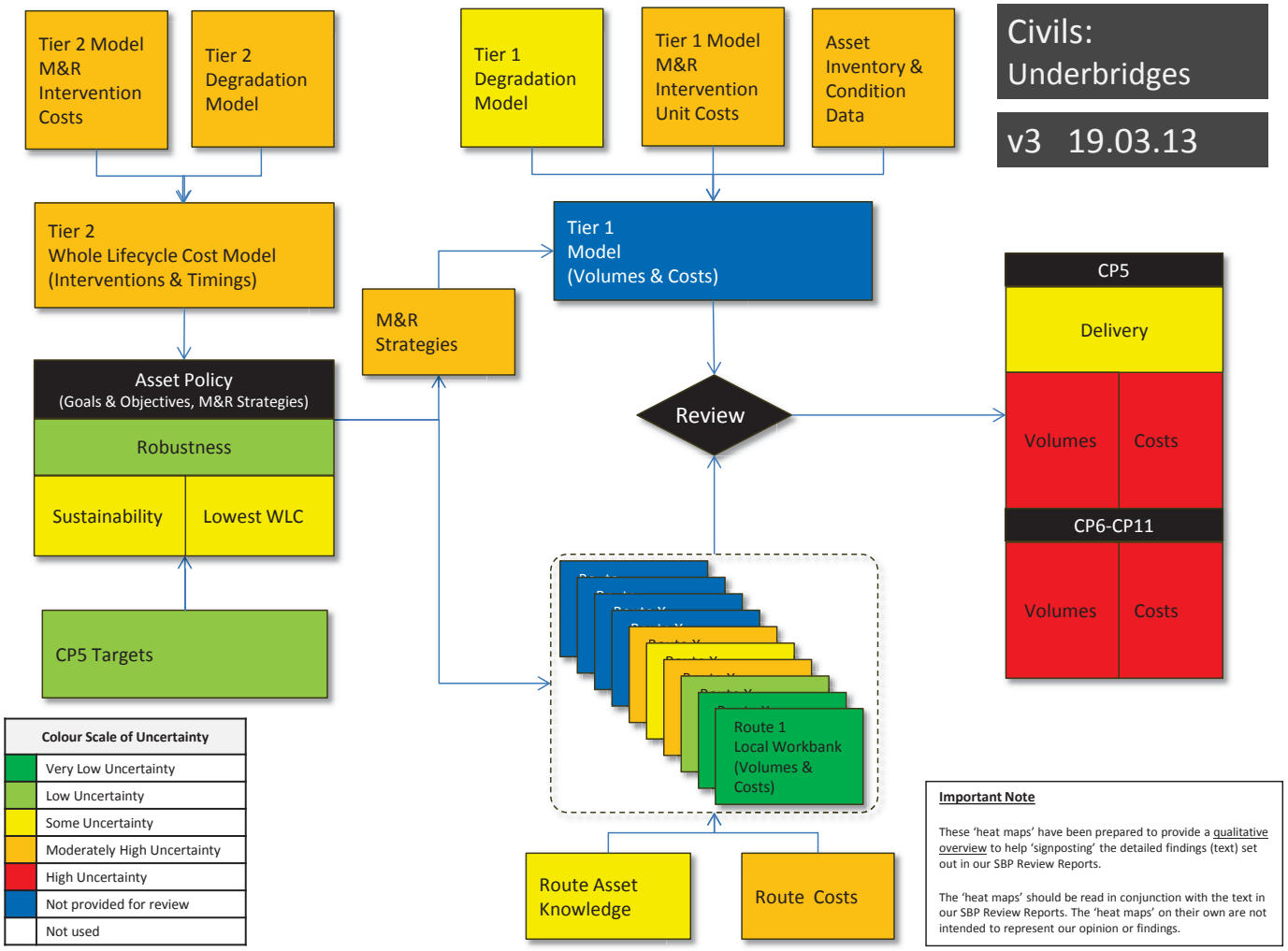
The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

D2 Structures

Issue 1.2

Civils: Underbridges

v3 19.03.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

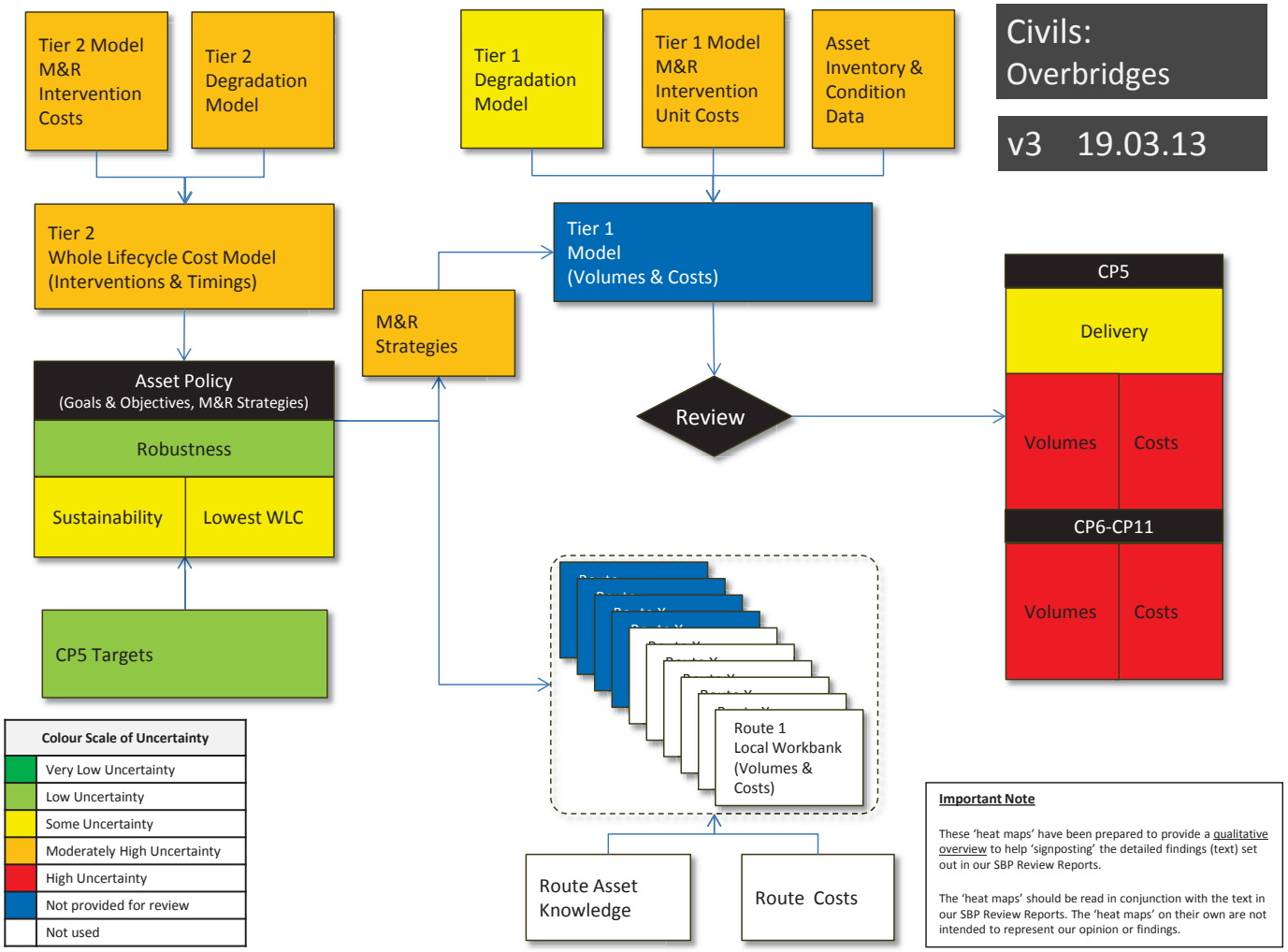
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Civils: Overbridges

v3 19.03.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Civils: Major Structures

v3 19.03.13

Tier 2 Model M&R Intervention Costs

Tier 2 Degradation Model

Tier 1 Degradation Model

Tier 1 Model M&R Intervention Unit Costs

Asset Inventory & Condition Data

Tier 2 Whole Lifecycle Cost Model (Interventions & Timings)

Tier 1 Model (Volumes & Costs)

Asset Policy (Goals & Objectives, M&R Strategies)

Robustness

Sustainability

Lowest WLC

CP5 Targets

Review

CP5

Delivery

Volumes

Costs

CP6-CP11

Volumes

Costs

Route 1 Local Workbank (Volumes & Costs)

Route Asset Knowledge

Route Costs

Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Civils: Tunnels

v3 19.03.13

Tier 2 Model M&R Intervention Costs

Tier 2 Degradation Model

Tier 1 Degradation Model

Tier 1 Model M&R Intervention Unit Costs

Asset Inventory & Condition Data

Tier 2 Whole Lifecycle Cost Model (Interventions & Timings)

Tier 1 Model (Volumes & Costs)

Asset Policy (Goals & Objectives, M&R Strategies)

Robustness

Sustainability

Lowest WLC

CP5 Targets

Review

CP5

Delivery

Volumes

Costs

CP6-CP11

Volumes

Costs

Route 1 Local Workbank (Volumes & Costs)

Route Asset Knowledge

Route Costs

Colour Scale of Uncertainty

Very Low Uncertainty

Low Uncertainty

Some Uncertainty

Moderately High Uncertainty

High Uncertainty

Not provided for review

Not used

Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

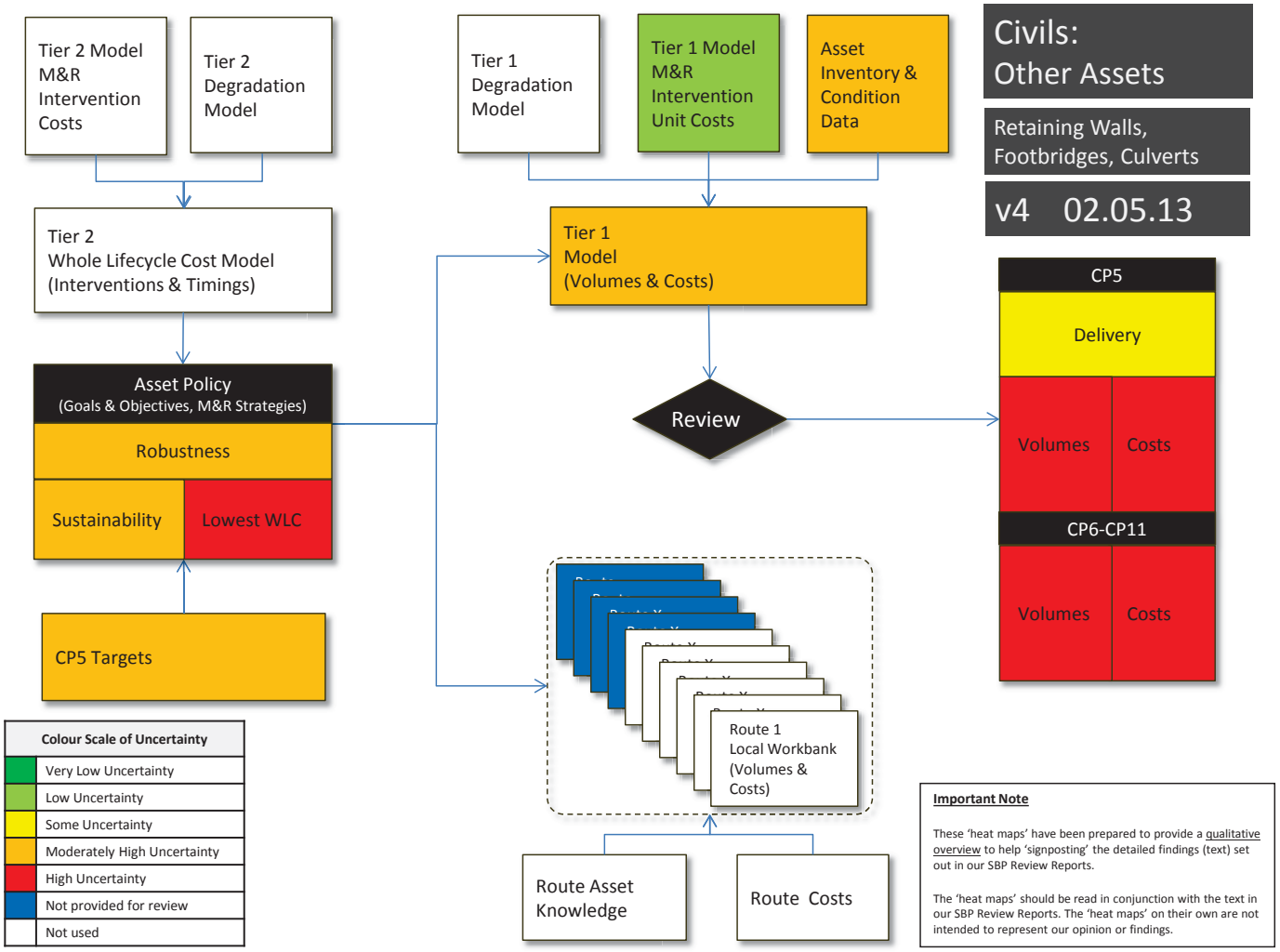
The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Civils: Other Assets

Retaining Walls, Footbridges, Culverts

v4 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

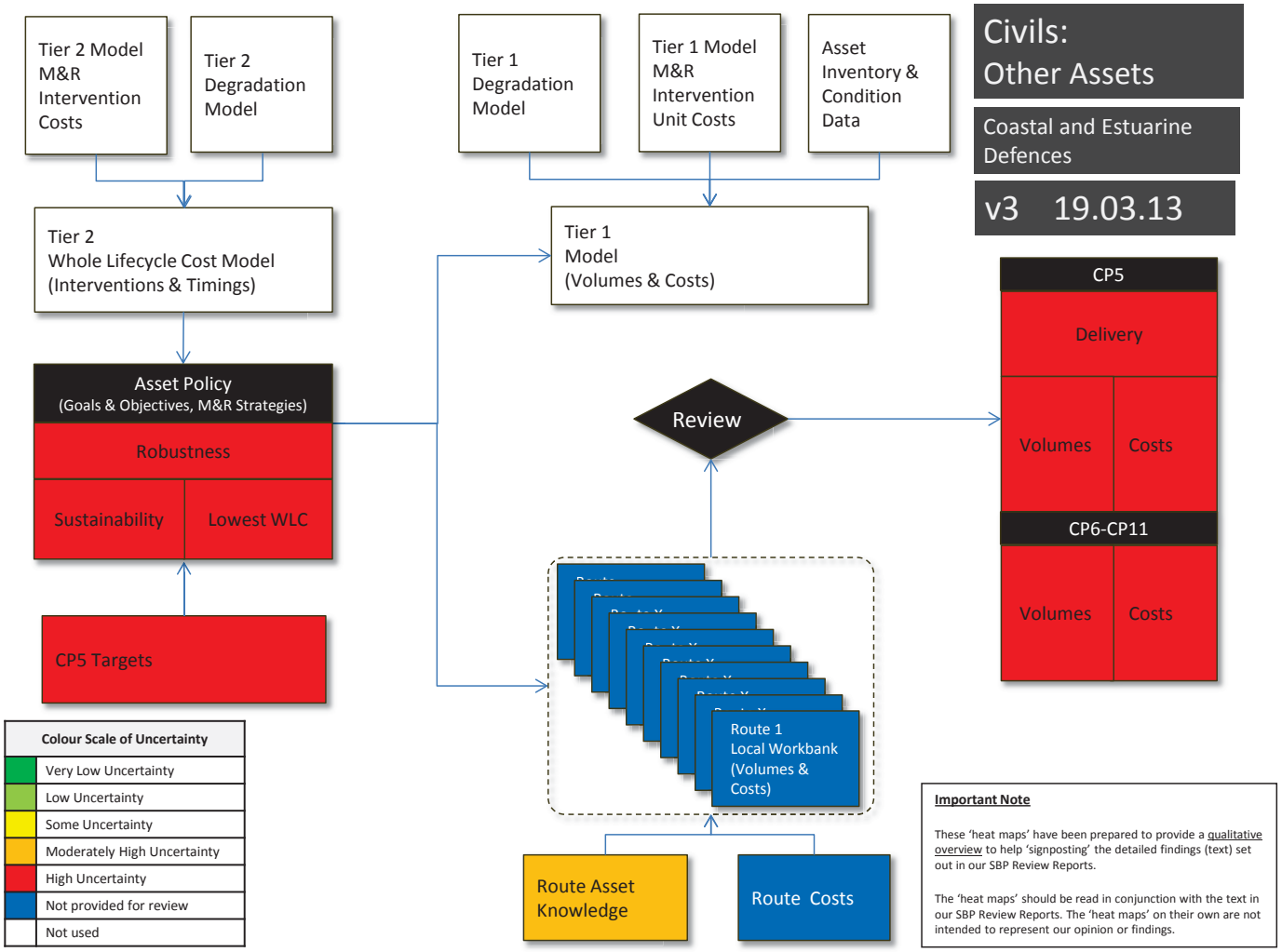
The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Civils: Other Assets

Coastal and Estuarine Defences

v3 19.03.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

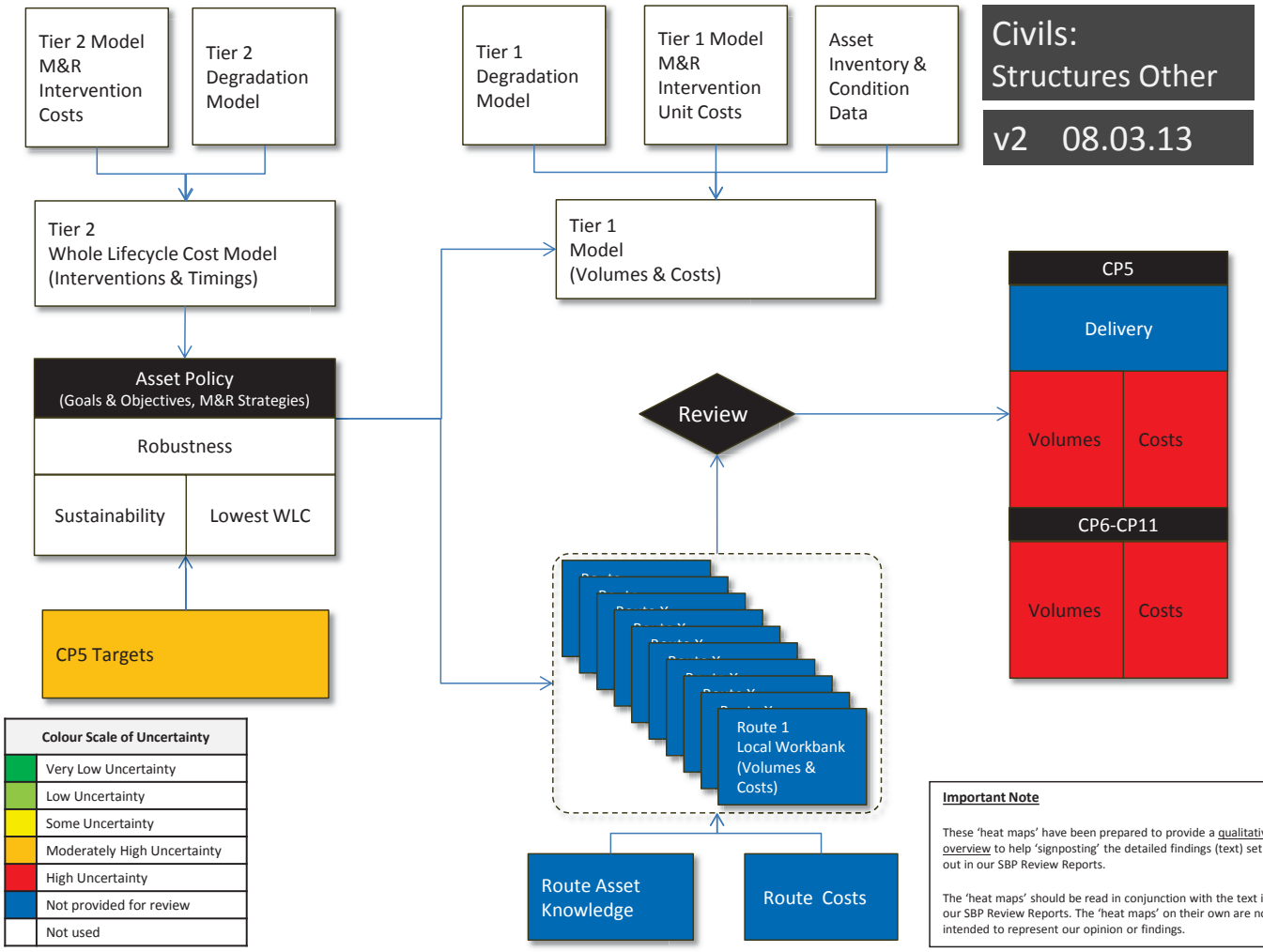
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Civils: Structures Other

v2 08.03.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

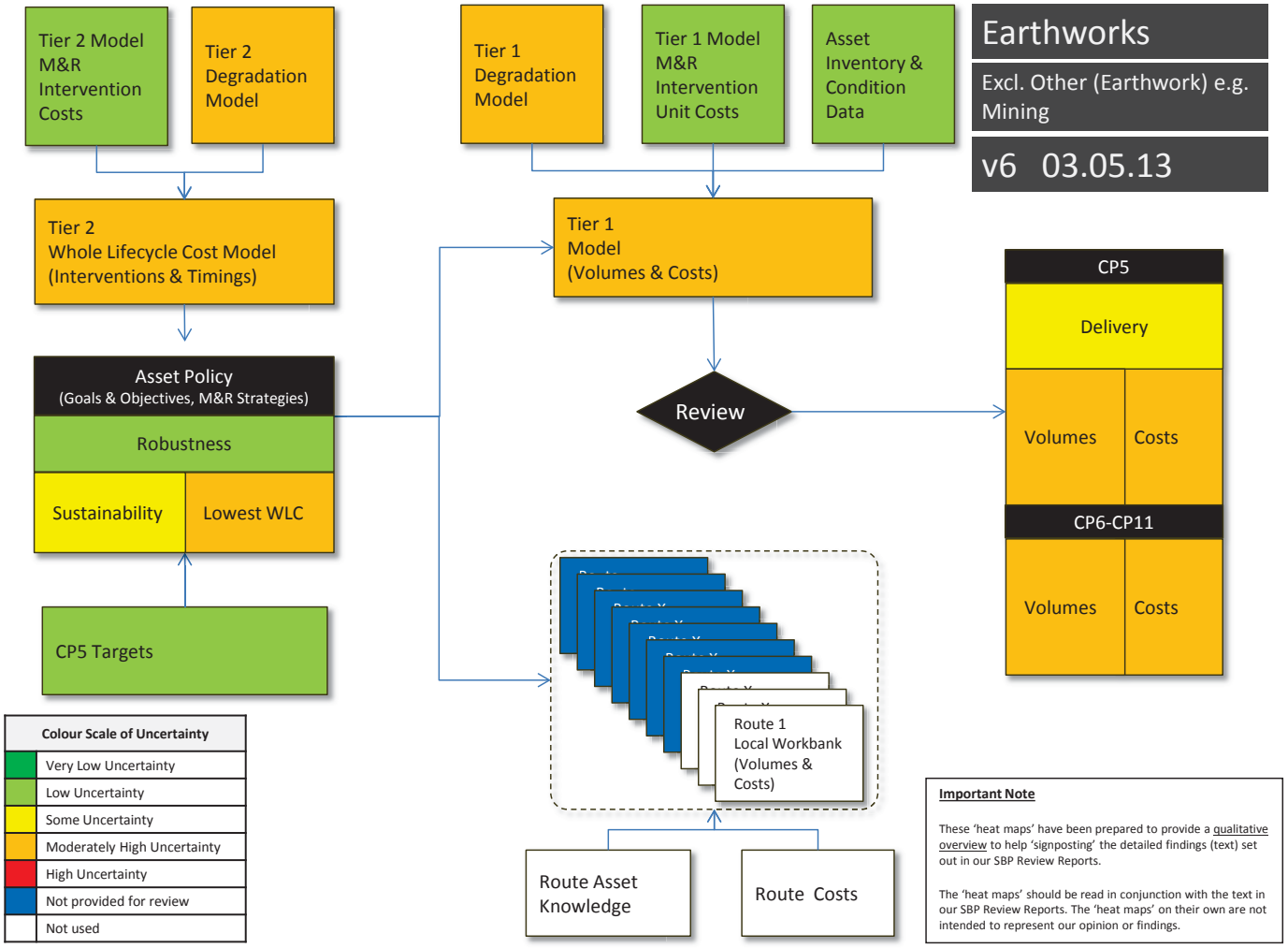
D3 Earthworks

Issue 1.2

Earthworks

Excl. Other (Earthwork) e.g. Mining

v6 03.05.13



Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

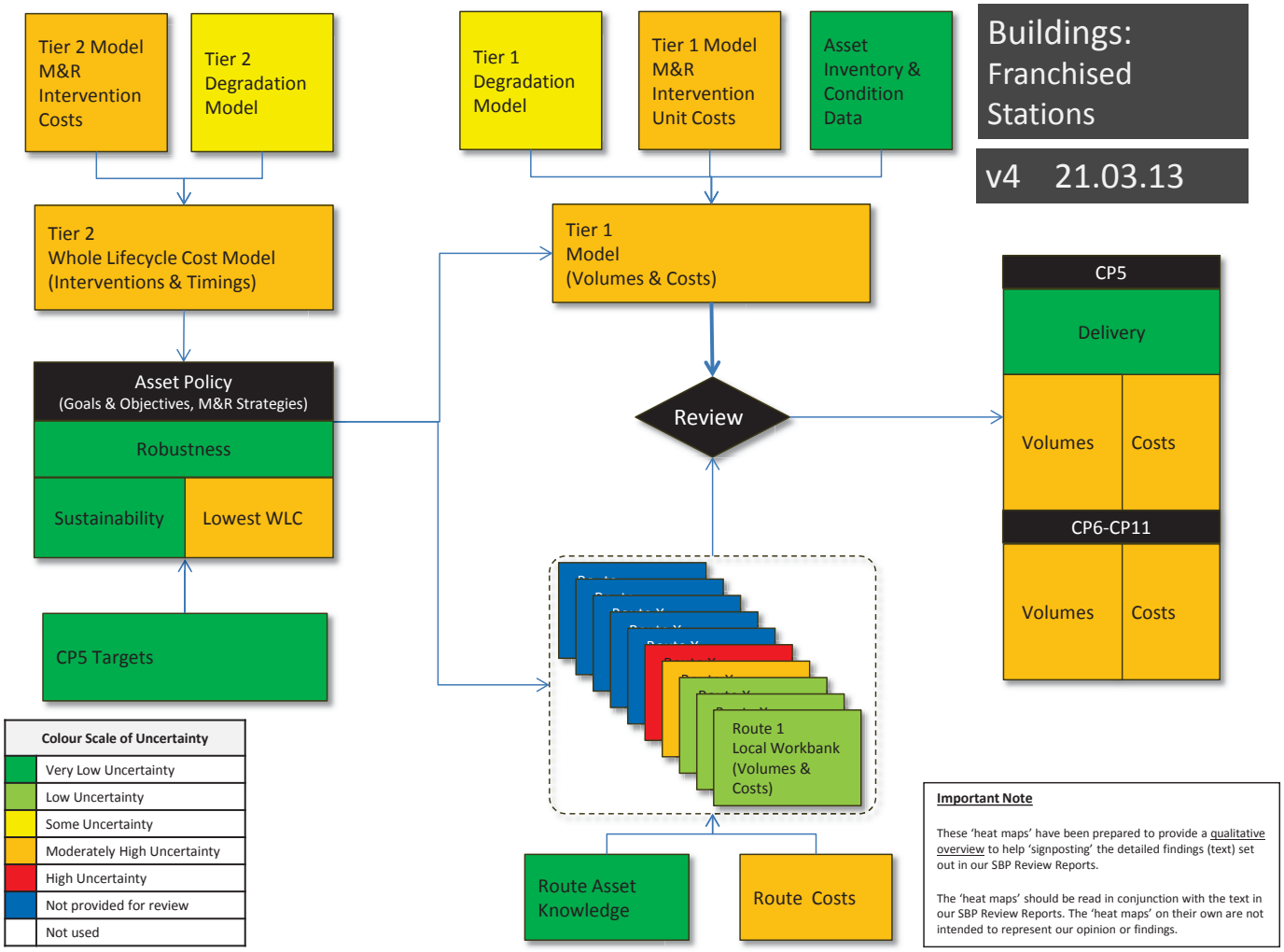
The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

D4 Buildings

Issue 1.2

Buildings: Franchised Stations

v4 21.03.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

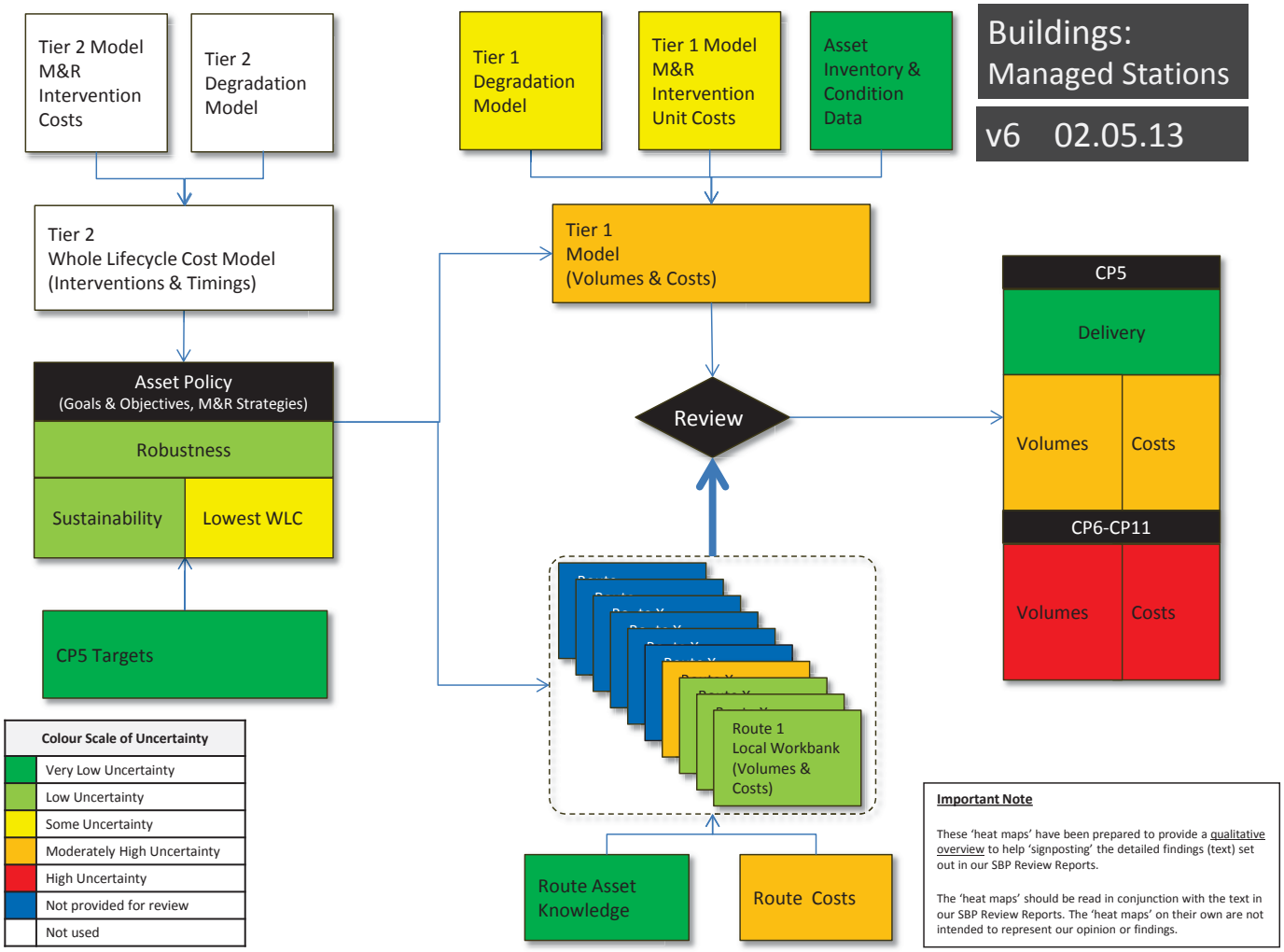
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Buildings: Managed Stations

v6 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

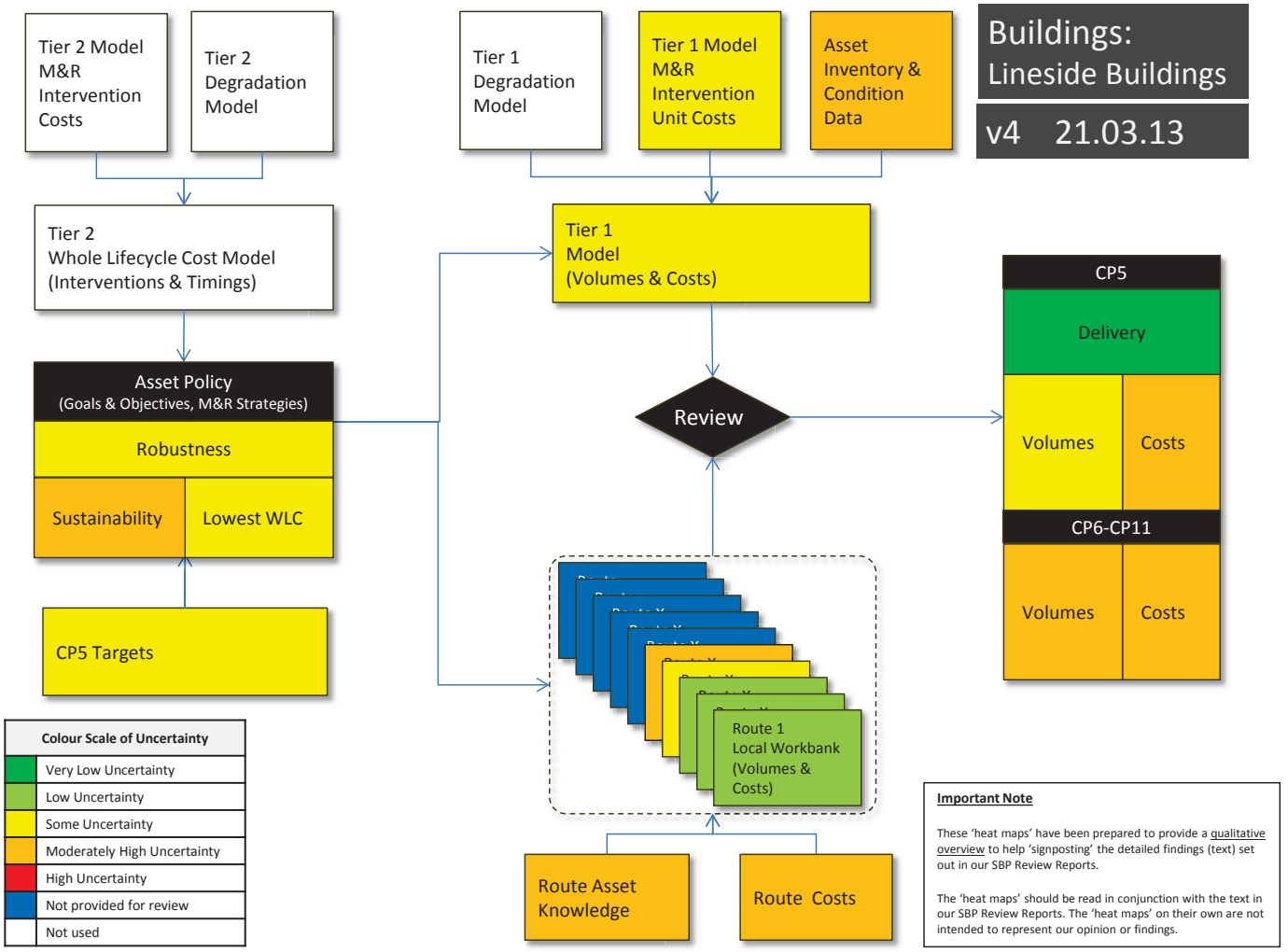
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Buildings: Lineside Buildings

v4 21.03.13



Important Note

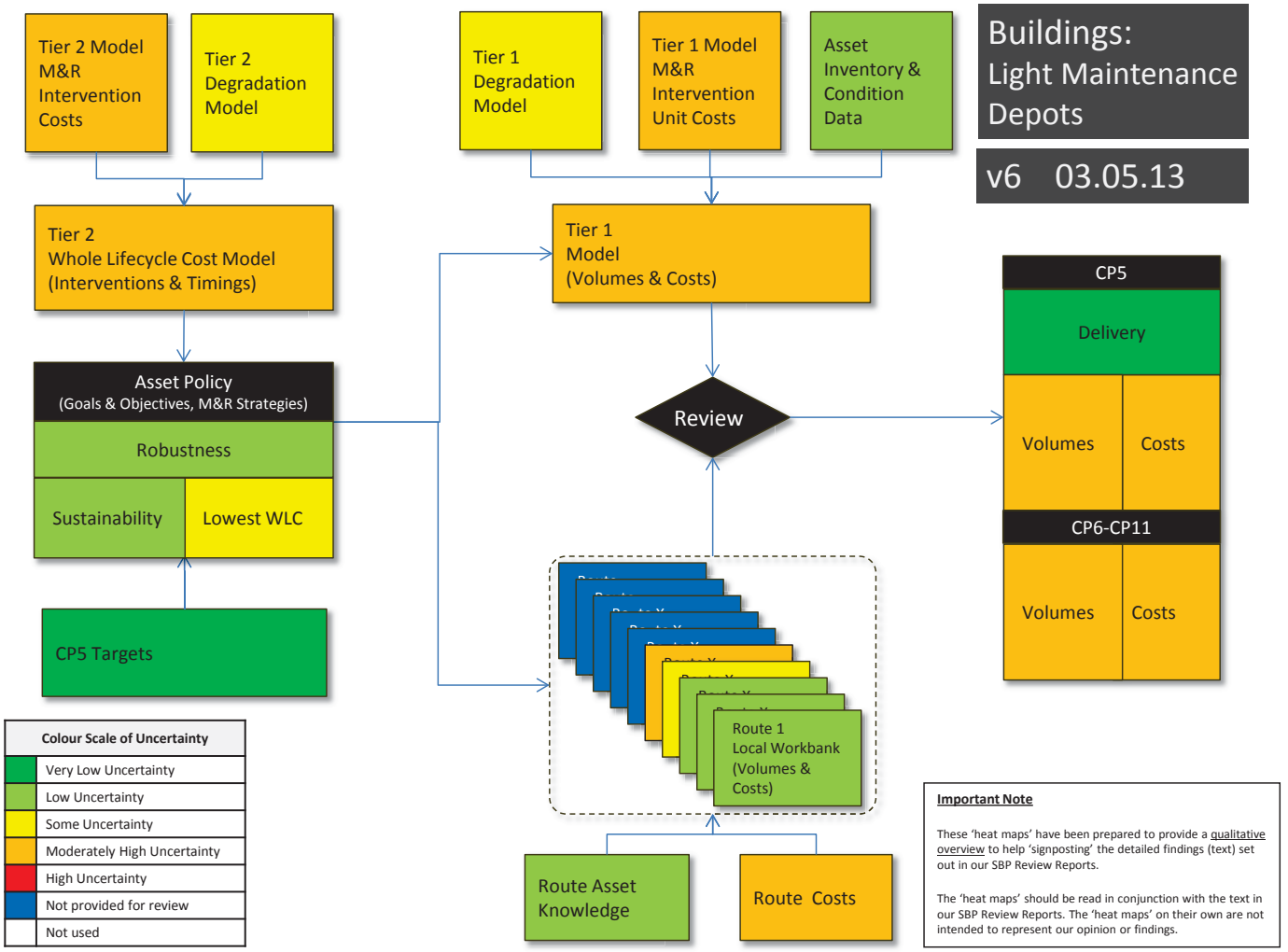
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Buildings: Light Maintenance Depots

v6 03.05.13



Important Note

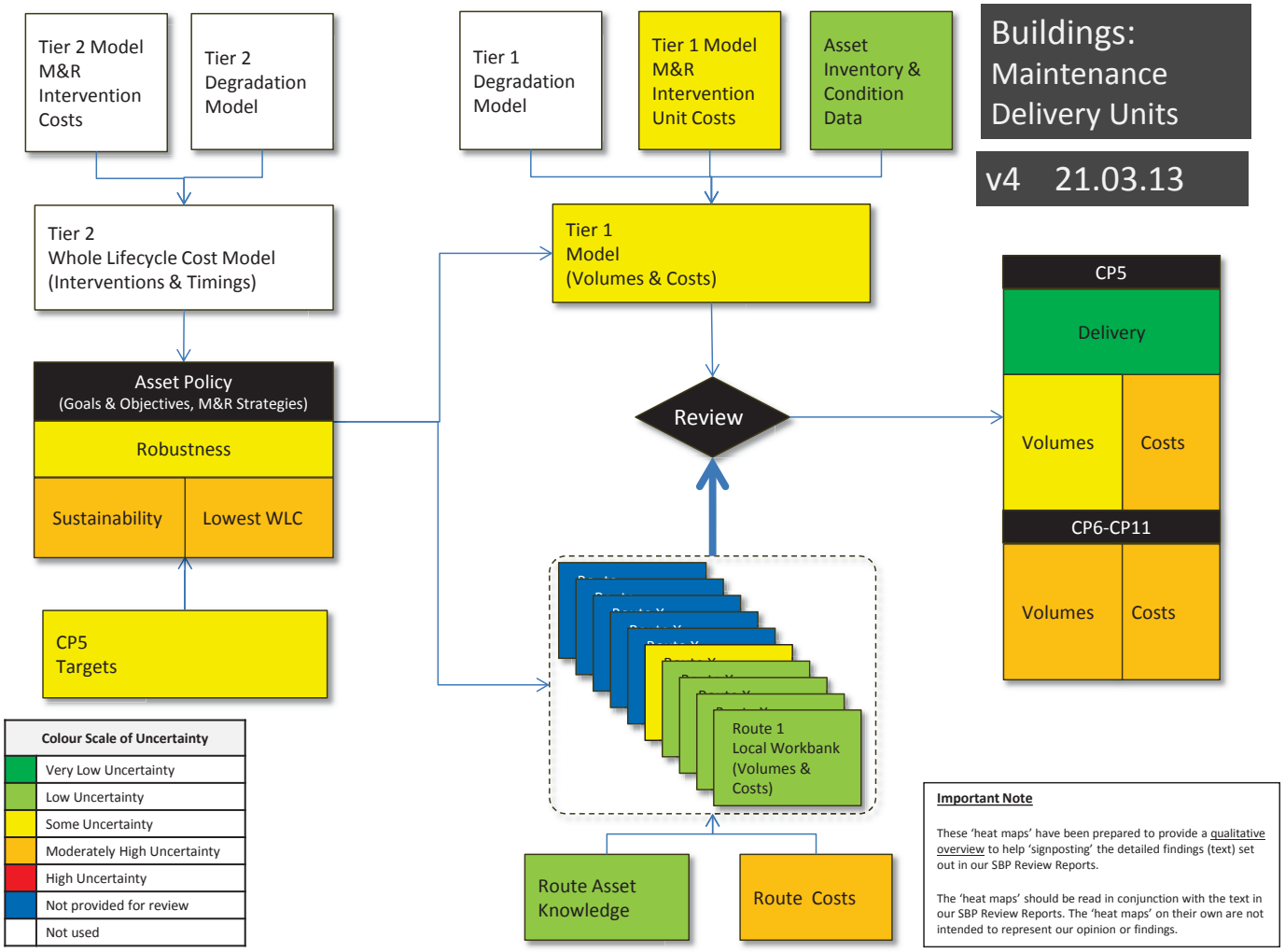
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

Issue 1.2

Buildings: Maintenance Delivery Units

v4 21.03.13



Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

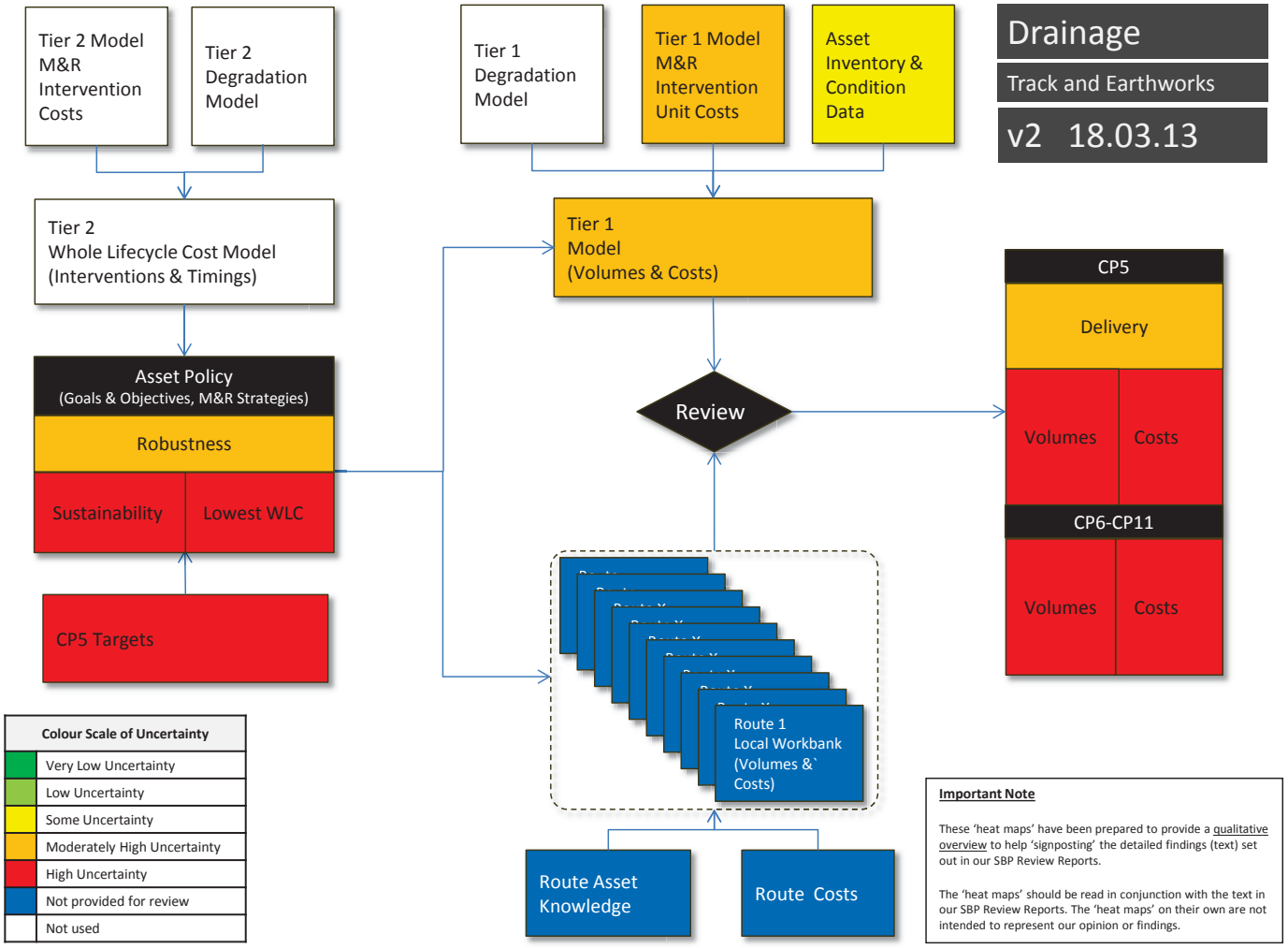
D5 Drainage

Issue 1.2

Drainage

Track and Earthworks

v2 18.03.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

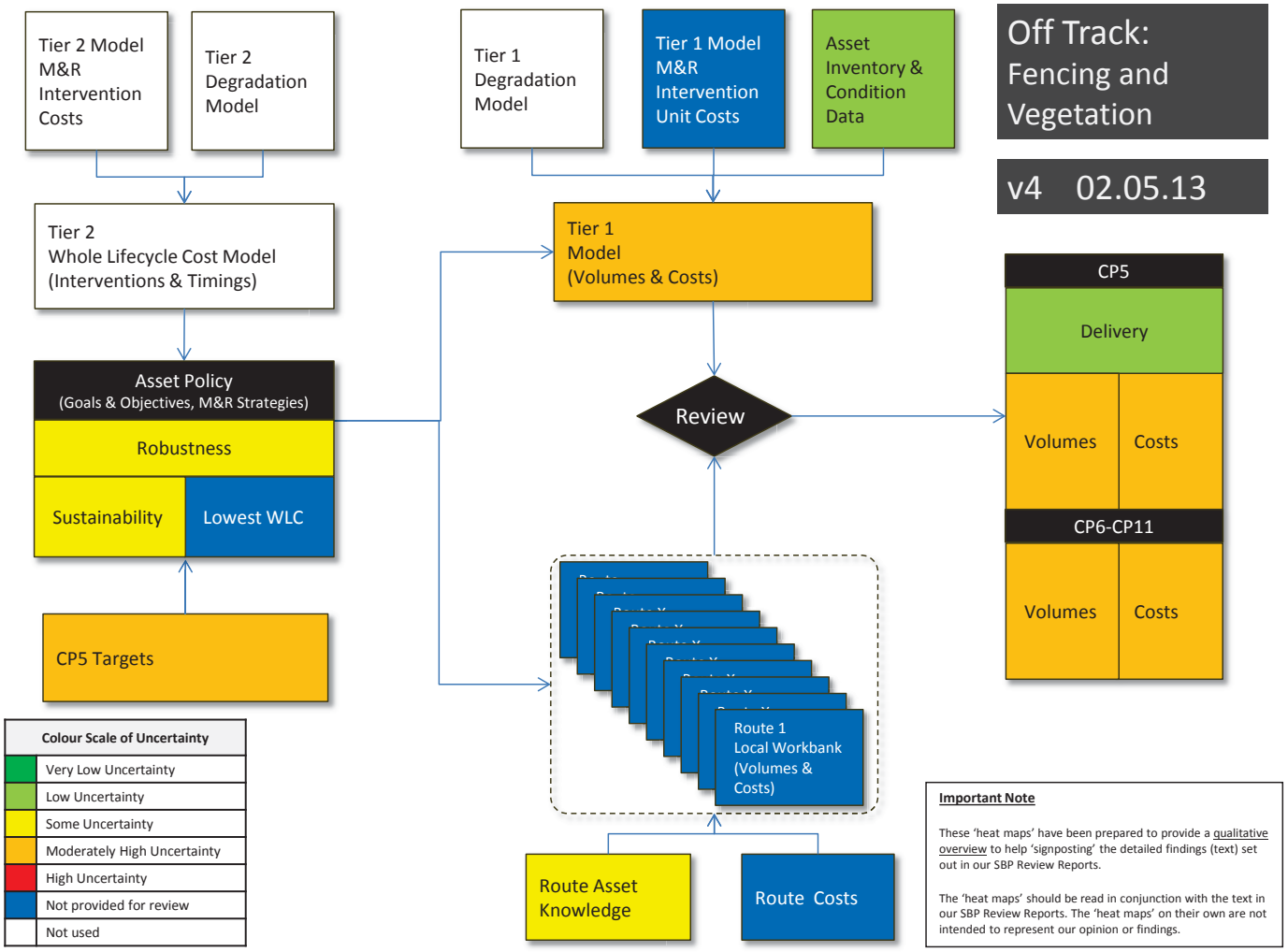
The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

D6 Off-Track

Issue 1.2

Off Track: Fencing and Vegetation

v4 02.05.13



Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used

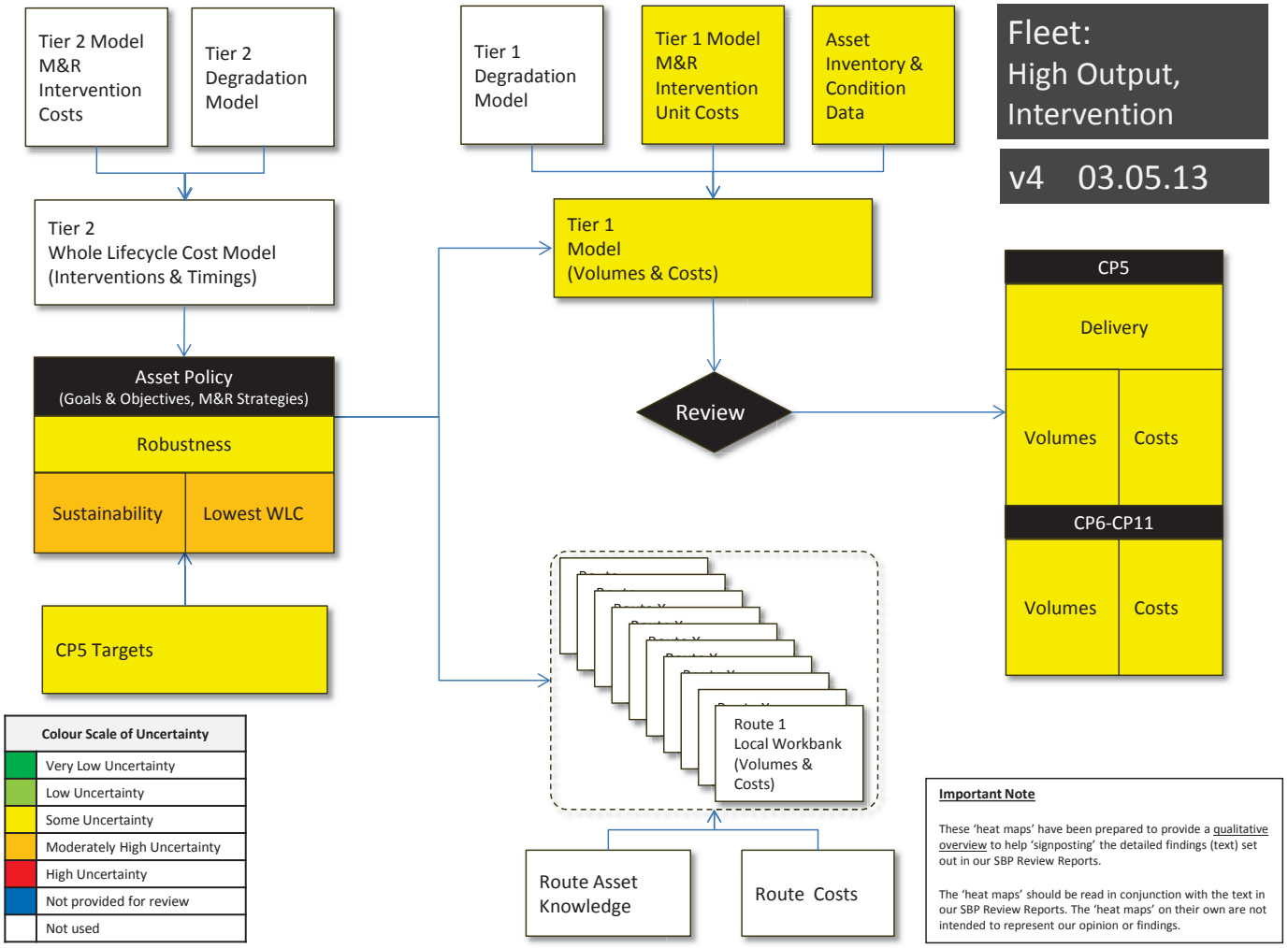
Important Note

These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.

The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

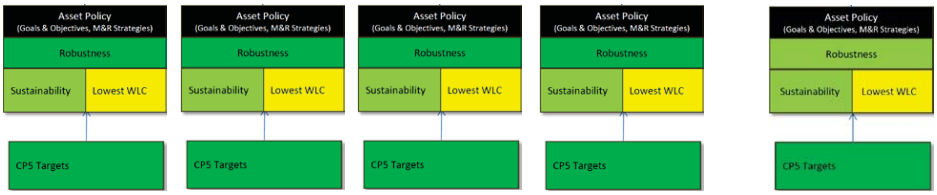
D7 Fleet

Issue 1.2


Tier 2 Model M&R Intervention Costs
Tier 2 Degradation Model
Tier 1 Degradation Model
Tier 1 Model M&R Intervention Unit Costs
Asset Inventory & Condition Data
Fleet: High Output, Intervention
v4 03.05.13
Tier 2 Whole Lifecycle Cost Model (Interventions & Timings)
Tier 1 Model (Volumes & Costs)
Asset Policy (Goals & Objectives, M&R Strategies)
Robustness
Sustainability
Lowest WLC
CP5 Targets
Review
CP5
Delivery
Volumes
Costs
CP6-CP11
Volumes
Costs
Route 1 Local Workbank (Volumes & Costs)
Route Asset Knowledge
Route Costs
Colour Scale of Uncertainty
Very Low Uncertainty
Low Uncertainty
Some Uncertainty
Moderately High Uncertainty
High Uncertainty
Not provided for review
Not used
Important Note
These 'heat maps' have been prepared to provide a qualitative overview to help 'signposting' the detailed findings (text) set out in our SBP Review Reports.
The 'heat maps' should be read in conjunction with the text in our SBP Review Reports. The 'heat maps' on their own are not intended to represent our opinion or findings.

D8 Summary of Confidence in Asset Policies

Track

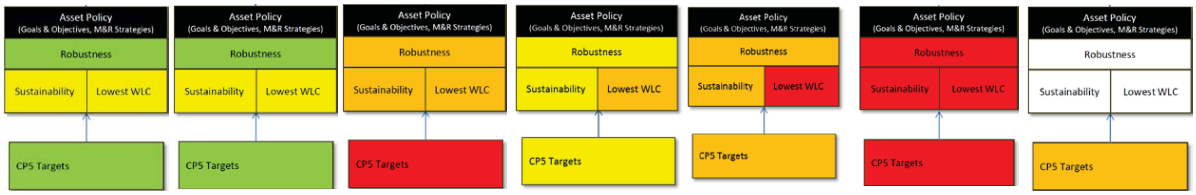


Plain Line Renewal | Plain Line Refurbishment | S&C Renewal | S&C Refurbishment | Maintenance

Buildings

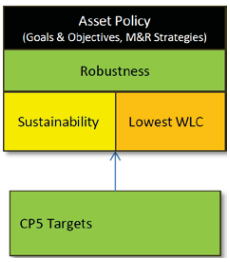
Franchised Stations | Managed Stations | Lineside Buildings | Light Maintenance Depots | Maintenance Delivery Units

Structures



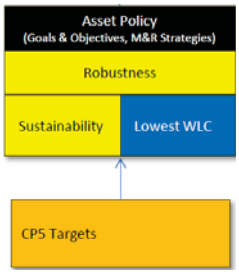
Underbridges | Overbridges | Major Structures | Tunnels | Other Assets (Retaining Walls, Footbridges, Culverts) | Other Assets (Coastal and Estuarine Defences) | Structures Other

Earthworks



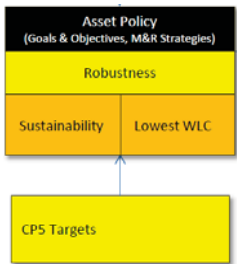
Excl. Other (Earthwork) e.g. Mining

Off Track



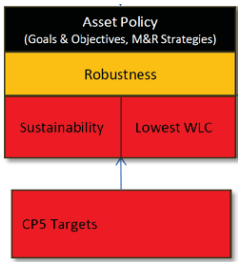
Fencing and Vegetation

Fleet



High Output, Intervention

Drainage



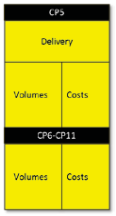
Track and Earthworks

D9 Summary of Confidence in Application of Asset Policies in the SBP

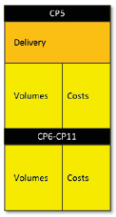
Track

Plain Line Renewal

Plain Line Refurbishment



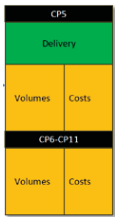
S&C Renewal



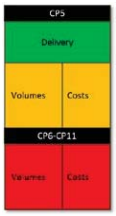
S&C Refurbishment

Maintenance

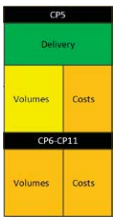
Buildings



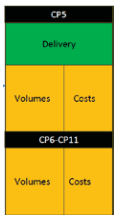
Franchised Stations



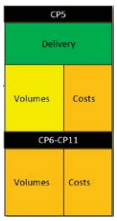
Managed Stations



Lineside Buildings

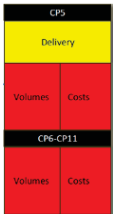


Light Maintenance Depots

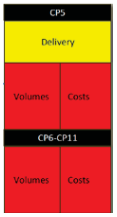


Maintenance Delivery Units

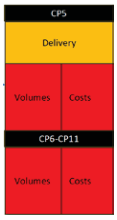
Structures



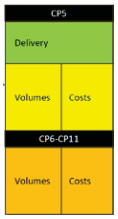
Underbridges



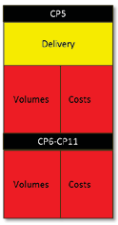
Overbridges



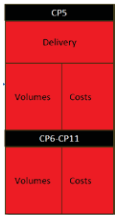
Major Structures



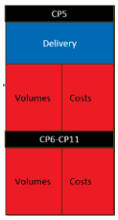
Tunnels



Other Assets (Retaining Walls, Footbridges, Culverts)



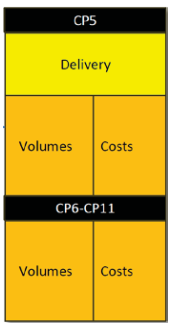
Other Assets (Coastal and Estuarine Defences)



Structures Other

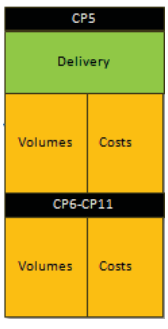
Issue 1.2

Earthworks



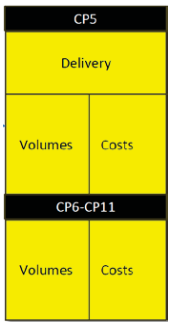
Excl. Other (Earthwork) e.g. Mining

Off Track



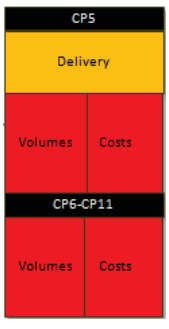
Fencing and Vegetation

Fleet



High Output, Intervention

Drainage



Track and Earthworks

Appendix E

Volume and Pre-Efficient Cost Tables

E1 Track, Off Track and Track Drainage

Track Tier 0 Summary

Track Detail by Control Period - SBP Fully Allocated pre-efficient

		D	F	G	H	I	J	K	L
	MAINTENANCE COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
8	**Track**	**2,317**	**2,185**	**2,174**	**-**	**-**	**-**	**-**	**-**
9	**Direct**	-	-	-	-	-	-	-	-
10	Replenishment of Ballast Manual	-	-	-	-	-	-	-	-
11	Replenishment of Ballast Train	-	-	-	-	-	-	-	-
12	S&C - renew crossing	-	-	-	-	-	-	-	-
13	CWR - Stressing	-	-	-	-	-	-	-	-
14	Manual Correction of PL Track Geometry (CWR)	-	-	-	-	-	-	-	-
15	Jointed Track Hot Weather Preparation	-	-	-	-	-	-	-	-
16	Installation of Pre-Fabricated IRJs	-	-	-	-	-	-	-	-
17	Level 1 Patrolling Track Inspection	-	-	-	-	-	-	-	-
18	Lift & Replace Level Crossing for PWAY	-	-	-	-	-	-	-	-
19	Maintenance of Longitudinal Timber	-	-	-	-	-	-	-	-
20	Rail Lubricators Install / Remove	-	-	-	-	-	-	-	-
21	Manual Reprofiling of Ballast	-	-	-	-	-	-	-	-
22	Manual Rail Grinding	-	-	-	-	-	-	-	-
23	Transportation of Materials (To/From Site)	-	-	-	-	-	-	-	-
24	Manual Wet Bed Removal	-	-	-	-	-	-	-	-
25	Mechanical Reprofiling of Ballast	-	-	-	-	-	-	-	-
26	Mechanised Patrolling Track Inspection	-	-	-	-	-	-	-	-
27	Mechanical Spot Re-sleepering	-	-	-	-	-	-	-	-
28	Mechanical Wet Bed Removal	-	-	-	-	-	-	-	-
29	Manual Spot Re-sleepering (Concrete)	-	-	-	-	-	-	-	-
30	Manual Spot Re-sleepering (Wood / Steel)	-	-	-	-	-	-	-	-
31	Replacement of Pads & Insulators	-	-	-	-	-	-	-	-
32	Tamping	-	-	-	-	-	-	-	-
33	PWAY Other	-	-	-	-	-	-	-	-
34	Rail Changing - Al-Thermic Weld - Standard Gap	-	-	-	-	-	-	-	-
35	Rail Changing - CWR - Renew (Defects)	-	-	-	-	-	-	-	-
36	Rail Changing - CWR - Renew Due to Wear	-	-	-	-	-	-	-	-
37	Rail Changing - Jointed Rail - Renew (Defects)	-	-	-	-	-	-	-	-
38	Rail Changing - Jointed Rail - Renew Due to Wea	-	-	-	-	-	-	-	-
39	Maintenance of Rail Lubricators	-	-	-	-	-	-	-	-
40	S&C Stoneblowing	-	-	-	-	-	-	-	-
41	Stoneblowing	-	-	-	-	-	-	-	-
42	S&C Arc Weld Repair	-	-	-	-	-	-	-	-
43	Replacement of S&C Bearers	-	-	-	-	-	-	-	-
44	S&C Renew Half Set of Switches	-	-	-	-	-	-	-	-
45	S&C Inspection (Other)	-	-	-	-	-	-	-	-
46	S&C Maintenance (Other)	-	-	-	-	-	-	-	-
47	S&C Tamping	-	-	-	-	-	-	-	-
48	Train Grinding - S&C	-	-	-	-	-	-	-	-
49	Track Inspection (Other)	-	-	-	-	-	-	-	-
50	Complete Treatment of S&C unit	-	-	-	-	-	-	-	-
51	Manual Ultrasonic Inspection - (Plain Line)	-	-	-	-	-	-	-	-
52	Manual Ultrasonic Inspection - RCF	-	-	-	-	-	-	-	-
53	Manual Ultrasonic Inspection - (S&C)	-	-	-	-	-	-	-	-
54	Patrolling Track Inspection (Video) Plain Line	-	-	-	-	-	-	-	-
55	Patrolling Track Inspection (Video) S&C	-	-	-	-	-	-	-	-
56	Weld Repair of Defective Rail	-	-	-	-	-	-	-	-
57	Other	-	-	-	-	-	-	-	-
58	**NDS delivery**	-	-	-	-	-	-	-	-
59	Grinding	-	-	-	-	-	-	-	-
60	Track recording car (inc NMT)	-	-	-	-	-	-	-	-
61	UTU	-	-	-	-	-	-	-	-
62	S&C machine grinding	-	-	-	-	-	-	-	-
63	**Offtrack**	-	-	-	-	-	-	-	-
64	Spoil & Debris Clearance Outside Station Area	-	-	-	-	-	-	-	-
65	Drainage	-	-	-	-	-	-	-	-
66	Fencing	-	-	-	-	-	-	-	-
67	Inspections (Fencing, Vegetation, Drainage)	-	-	-	-	-	-	-	-
68	Inspections (Level Crossing - Access Points)	-	-	-	-	-	-	-	-
69	Level Crossings Management (Off Track)	-	-	-	-	-	-	-	-
70	Other	-	-	-	-	-	-	-	-
71	Vegetation Management	-	-	-	-	-	-	-	-
72	**Indirect**	-	-	-	-	-	-	-	-
73	Labour	-	-	-	-	-	-	-	-
74	Plant	-	-	-	-	-	-	-	-
75	Materials	-	-	-	-	-	-	-	-
76	Other	-	-	-	-	-	-	-	-
77	**Other**	-	-	-	-	-	-	-	-
78	Plant	-	-	-	-	-	-	-	-
79	Materials	-	-	-	-	-	-	-	-
80	Subcontractors	-	-	-	-	-	-	-	-
81	Redundancy	-	-	-	-	-	-	-	-
82	Other	-	-	-	-	-	-	-	-
83	Other operating income	-	-	-	-	-	-	-	-

Track Detail by Control Period - SBP Fully Allocated Post-efficient

		R	T	U	V	W	X	Y	Z
	MAINTENANCE COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
8	**Track**	**-**	**1,969**	**1,861**	**1,861**	**1,861**	**1,861**	**1,861**	**1,861**
9	**Direct**	**-**	**963**	**891**	**891**	**891**	**891**	**891**	**891**
10	Replenishment of Ballast Manual	-	-	-	-	-	-	-	-
11	Replenishment of Ballast Train	-	-	-	-	-	-	-	-
12	S&C - renew crossing	-	-	-	-	-	-	-	-
13	CWR - Stressing	-	-	-	-	-	-	-	-
14	Manual Correction of PL Track Geometr	-	-	-	-	-	-	-	-
15	Jointed Track Hot Weather Preparation	-	-	-	-	-	-	-	-
16	Installation of Pre-Fabricated IRJs	-	-	-	-	-	-	-	-
17	Level 1 Patrolling Track Inspection	-	-	-	-	-	-	-	-
18	Lift & Replace Level Crossing for PWAY	-	-	-	-	-	-	-	-
19	Maintenance of Longitudinal Timber	-	-	-	-	-	-	-	-
20	Rail Lubricators Install / Remove	-	-	-	-	-	-	-	-
21	Manual Reprofiling of Ballast	-	-	-	-	-	-	-	-
22	Manual Rail Grinding	-	-	-	-	-	-	-	-
23	Transportation of Materials (To/From Sit	-	-	-	-	-	-	-	-
24	Manual Wet Bed Removal	-	-	-	-	-	-	-	-
25	Mechanical Reprofiling of Ballast	-	-	-	-	-	-	-	-
26	Mechanised Patrolling Track Inspection	-	-	-	-	-	-	-	-
27	Mechanical Spot Re-sleepering	-	-	-	-	-	-	-	-
28	Mechanical Wet Bed Removal	-	-	-	-	-	-	-	-
29	Manual Spot Re-sleepering (Concrete)	-	-	-	-	-	-	-	-
30	Manual Spot Re-sleepering (Wood / Ste	-	-	-	-	-	-	-	-
31	Replacement of Pads & Insulators	-	-	-	-	-	-	-	-
32	Tamping	-	-	-	-	-	-	-	-
33	PWAY Other	-	-	-	-	-	-	-	-
34	Rail Changing - Al-Thermic Weld - Stand	-	-	-	-	-	-	-	-
35	Rail Changing - CWR - Renew (Defects)	-	-	-	-	-	-	-	-
36	Rail Changing - CWR - Renew Due to W	-	-	-	-	-	-	-	-
37	Rail Changing - Jointed Rail - Renew (D	-	-	-	-	-	-	-	-
38	Rail Changing - Jointed Rail - Renew Du	-	-	-	-	-	-	-	-
39	Maintenance of Rail Lubricators	-	-	-	-	-	-	-	-
40	S&C Stoneblowing	-	-	-	-	-	-	-	-
41	Stoneblowing	-	-	-	-	-	-	-	-
42	S&C Arc Weld Repair	-	-	-	-	-	-	-	-
43	Replacement of S&C Bearers	-	-	-	-	-	-	-	-
44	S&C Renew Half Set of Switches	-	-	-	-	-	-	-	-
45	S&C Inspection (Other)	-	-	-	-	-	-	-	-
46	S&C Maintenance (Other)	-	-	-	-	-	-	-	-
47	S&C Tamping	-	-	-	-	-	-	-	-
48	Train Grinding - S&C	-	-	-	-	-	-	-	-
49	Track Inspection (Other)	-	-	-	-	-	-	-	-
50	Complete Treatment of S&C unit	-	-	-	-	-	-	-	-
51	Manual Ultrasonic Inspection - (Plain Lin	-	-	-	-	-	-	-	-
52	Manual Ultrasonic Inspection - RCF	-	-	-	-	-	-	-	-
53	Manual Ultrasonic Inspection - (S&C)	-	-	-	-	-	-	-	-
54	Patrolling Track Inspection (Video) Plain	-	-	-	-	-	-	-	-
55	Patrolling Track Inspection (Video) S&C	-	-	-	-	-	-	-	-
56	Weld Repair of Defective Rail	-	-	-	-	-	-	-	-
57	Other	-	963	891	891	891	891	891	891
58	**NDS delivery**	**-**	**147**	**147**	**147**	**147**	**147**	**147**	**147**
59	Grinding	-	93	93	93	93	93	93	93
60	Track recording car (inc NMT)	-	-	-	-	-	-	-	-
61	UTU	-	-	-	-	-	-	-	-
62	S&C machine grinding	-	54	54	54	54	54	54	54
63	**Offtrack**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
64	Spoil & Debris Clearance Outside Statio	-	-	-	-	-	-	-	-
65	Drainage	-	-	-	-	-	-	-	-
66	Fencing	-	-	-	-	-	-	-	-
67	Inspections (Fencing, Vegetation, Draina	-	-	-	-	-	-	-	-
68	Inspections (Level Crossing - Access Po	-	-	-	-	-	-	-	-
69	Level Crossings Management (Off Track	-	-	-	-	-	-	-	-
70	Other	-	-	-	-	-	-	-	-
71	Vegetation Management	-	-	-	-	-	-	-	-
72	**Indirect**	**-**	**324**	**316**	**316**	**316**	**316**	**316**	**316**
73	Labour	-	-	-	-	-	-	-	-
74	Plant	-	-	-	-	-	-	-	-
75	Materials	-	-	-	-	-	-	-	-
76	Other	-	324	316	316	316	316	316	316
77	**Other**	**-**	**535**	**507**	**507**	**507**	**507**	**507**	**507**
78	Plant	-	238	227	227	227	227	227	227
79	Materials	-	199	189	189	189	189	189	189
80	Subcontractors	-	98	95	95	95	95	95	95
81	Redundancy	-	-	-	-	-	-	-	-
82	Other	-	7	4	4	4	4	4	4
83	Other operating income	-	(7)	(7)	(7)	(7)	(7)	(7)	(7)

Rolled up figures advised in error

Rolled up figures advised in error

	RENEWAL COSTS	D	F	G	H	I	J	K	L
		Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
88	**Track**	**3,762**	**3,954**	**3,276**	**3,114**	**3,041**	**3,170**	**3,247**	**3,118**
89	**Conventional plain line renewal**	**1,804**	**1,269**	**1,226**	**1,105**	**1,120**	**1,191**	**1,216**	**1,169**
90	Heavy refurb (concrete, MO)	-	233	260	217	218	247	264	272
91	Rail renewal	-	221	181	201	204	206	206	206
92	Single rail	-	15	17	19	19	19	19	19
93	Steel relay	-	40	0	0	0	0	0	1
94	Complete Trax	-	760	768	668	678	719	726	670
95	Thameslink overlay	-	-	-	-	-	-	-	-
96	**High output renewal**	**720**	**594**	**596**	**596**	**539**	**582**	**593**	**524**
97	High output (ABC)	-	194	133	134	120	129	131	112
98	Heavy refurb (concrete, HO)	-	39	150	146	135	148	152	147
99	High output (rail sleeper relay)	-	361	313	316	283	305	310	266
100	**Plain line refurbishment**	**63**	**144**	**93**	**94**	**96**	**96**	**96**	**96**
101	Heavy refurb (other)	-	34	17	17	17	17	17	17
102	Medium refurb (concrete)	-	34	33	33	34	34	34	34
103	Medium refurb (other)	-	75	43	44	45	45	45	45
104	**S&C renewal**	**863**	**801**	**747**	**714**	**686**	**697**	**740**	**729**
105	Abandonment	-	39	35	33	31	32	31	31
106	Full renewal	-	763	713	681	654	665	709	697
107	**S&C refurbishment**	**34**	**203**	**226**	**217**	**213**	**215**	**214**	**212**
108	Heavy refurb	-	129	140	132	128	129	128	128
109	Medium refurb	-	74	86	86	85	86	86	84
110	**Track non-volume**	**182**	**563**	**150**	**150**	**150**	**150**	**150**	**150**
111	Components	-	23	23	23	23	23	23	23
112	Engineering improvement schemes	-	11	11	11	11	11	11	11
113	Long timbers	-	43	47	47	47	47	47	47
114	Level crossings	-	50	36	36	36	36	36	36
115	Other	-	341	16	16	16	16	16	16
116	S&C system improvements	-	18	18	18	18	18	18	18
117	Slab installation	-	5	-	-	-	-	-	-
118	Slab renewal	-	63	-	-	-	-	-	-
119	Systems	-	5	-	-	-	-	-	-
120	Depot threshold claims	-	5	-	-	-	-	-	-
121	**Off track**	**96**	**380**	**238**	**238**	**238**	**238**	**238**	**238**
122	Drainage	-	209	129	129	129	129	129	129
123	Fencing	-	171	108	108	108	108	108	108

Unsure if CP4 total in Tier 0 =pre or post enhanced spend

	RENEWAL COSTS	R	T	U	V	W	X	Y	Z
		Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
88	**Track**	**-**	**3,431**	**2,924**	**2,781**	**2,715**	**2,831**	**2,898**	**2,781**
89	**Conventional plain line renewal**	-	**1,180**	**1,090**	**982**	**996**	**1,059**	**1,081**	**1,039**
90	Heavy refurb (concrete, MO)	-	214	231	193	194	219	234	242
91	Rail renewal	-	209	161	178	182	183	183	183
92	Single rail	-	15	15	17	17	17	17	17
93	Steel relay	-	37	0	0	0	0	0	1
94	Complete Trax	-	706	683	594	603	639	646	596
95	Thameslink overlay	-	-	-	-	-	-	-	-
96	**High output renewal**	-	**550**	**551**	**552**	**498**	**539**	**548**	**485**
97	High output (ABC)	-	175	123	124	111	119	121	104
98	Heavy refurb (concrete, HO)	-	34	139	135	125	137	140	136
99	High output (rail sleeper relay)	-	341	290	292	262	282	287	246
100	**Plain line refurbishment**	-	**137**	**88**	**89**	**91**	**91**	**91**	**91**
101	Heavy refurb (other)	-	30	16	16	16	16	16	16
102	Medium refurb (concrete)	-	33	31	32	32	32	32	33
103	Medium refurb (other)	-	74	41	42	42	43	43	43
104	**S&C renewal**	**-**	**734**	**624**	**596**	**573**	**582**	**618**	**608**
105	Abandonment	-	39	31	29	28	28	28	28
106	Full renewal	-	695	593	567	545	554	590	580
107	**S&C refurbishment**	**-**	**210**	**215**	**207**	**202**	**205**	**204**	**201**
108	Heavy refurb	-	131	133	125	122	123	122	122
109	Medium refurb	-	78	82	82	81	82	82	80
110	**Track non-volume**	**-**	**266**	**150**	**150**	**150**	**150**	**150**	**150**
111	Components	-	22	23	23	23	23	23	23
112	Engineering improvement schemes	-	11	11	11	11	11	11	11
113	Long timbers	-	40	47	47	47	47	47	47
114	Level crossings	-	46	36	36	36	36	36	36
115	Other	-	57	16	16	16	16	16	16
116	S&C system improvements	-	17	18	18	18	18	18	18
117	Slab installation	-	5	-	-	-	-	-	-
118	Slab renewal	-	60	-	-	-	-	-	-
119	Systems	-	5	-	-	-	-	-	-
120	Depot threshold claims	-	5	-	-	-	-	-	-
121	**Off track**	**-**	**354**	**206**	**206**	**206**	**206**	**206**	**206**
122	Drainage	-	195	112	112	112	112	112	112
123	Fencing	-	159	94	94	94	94	94	94

Unsure if CP4 total in Tier 0 =pre or post enhanced spend

	RENEWAL VOLUMES	see note	D	F	G	H	I	J	K	L
			Control period totals							
			CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
128	**Conventional plain line**									
129	Heavy refurbishment (con	km	-	926	1,159	974	984	1,086	1,162	1,167
130	Rail renewal	km	-	1,294	1,047	1,160	1,182	1,191	1,191	1,191
131	Single rail	km	-	180	197	218	222	224	224	224
132	Steel relay	km	-	70	0	0	0	0	1	2
133	Complete Trax	km	-	1,001	1,016	880	892	950	960	884
134	0									
135	**High output**									
136	High output (ABC)	km	-	915	639	644	577	623	632	543
137	Heavy refurbishment (con	km	-	171	673	658	611	670	685	668
138	High output (rail sleeper re	km	-	757	639	644	577	623	632	543
139	0									
140	**Plan line refurbisment**									
141	Heavy refurbishment (othe	km	-	189	107	107	107	107	107	107
142	Medium refurbishment (co	km	-	1,054	1,014	1,032	1,051	1,061	1,061	1,061
143	Medium refurbishment (ot	km	-	898	512	520	529	533	533	533
144	0									
145	**S&C**									
146	Abandon	S&C units	-	399	350	330	319	324	319	319
147	Full renewal	S&C units	-	1,510	1,415	1,353	1,301	1,324	1,407	1,386
148	Heavy refurbishment	S&C units	-	1,841	1,978	1,861	1,810	1,827	1,815	1,810
149	Medium refurbishment	S&C units	-	2,130	2,372	2,360	2,336	2,368	2,367	2,304

	RENEWAL VOLUMES		R	T	U	V	W	X	Y	Z
			Control period totals							
			CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
128	**Conventional plain line**									
129	Heavy refurbishment (cor	km	-	926	1,159	974	984	1,086	1,162	1,167
130	Rail renewal	km	-	1,294	1,047	1,160	1,182	1,191	1,191	1,191
131	Single rail	km	-	180	197	218	222	224	224	224
132	Steel relay	km	-	70	0	0	0	0	1	2
133	Complete Trax	km	-	1,001	1,016	880	892	950	960	884
134	0									
135	**High output**									
136	High output (ABC)	km	-	915	639	644	577	623	632	543
137	Heavy refurbishment (cor	km	-	171	673	658	611	670	685	668
138	High output (rail sleeper r	km	-	757	639	644	577	623	632	543
139	0									
140	**Plan line refurbisment**									
141	Heavy refurbishment (oth	km	-	189	107	107	107	107	107	107
142	Medium refurbishment (c	km	-	1,054	1,014	1,032	1,051	1,061	1,061	1,061
143	Medium refurbishment (o	km	-	898	512	520	529	533	533	533
144	0									
145	**S&C**									
146	Abandon	S&C units	-	399	350	330	319	324	319	319
147	Full renewal	S&C units	-	1,510	1,415	1,353	1,301	1,324	1,407	1,386
148	Heavy refurbishment	S&C units	-	1,841	1,978	1,861	1,810	1,827	1,815	1,810
149	Medium refurbishment	S&C units	-	2,130	2,372	2,360	2,336	2,368	2,367	2,304

		D	F	G	H	I	J	K	L
	MAINTENANCE VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
154	**Track**	-	-	-	-	-	-	-	-
155	**Direct**	-	-	-	-	-	-	-	-
156	Replenishment of Ballast Manual	-	-	-	-	-	-	-	-
157	Replenishment of Ballast Train	-	-	-	-	-	-	-	-
158	S&C - renew crossing	-	-	-	-	-	-	-	-
159	CWR - Stressing	-	-	-	-	-	-	-	-
160	Manual Correction of PL Track Geometry (CWR)	-	-	-	-	-	-	-	-
161	Jointed Track Hot Weather Preparation	-	-	-	-	-	-	-	-
162	Installation of Pre-Fabricated IRJs	-	-	-	-	-	-	-	-
163	Level 1 Patrolling Track Inspection	-	-	-	-	-	-	-	-
164	Lift & Replace Level Crossing for PWAY	-	-	-	-	-	-	-	-
165	Maintenance of Longitudinal Timber	-	-	-	-	-	-	-	-
166	Rail Lubricators Install / Remove	-	-	-	-	-	-	-	-
167	Manual Reprofiling of Ballast	-	-	-	-	-	-	-	-
168	Manual Rail Grinding	-	-	-	-	-	-	-	-
169	Transportation of Materials (To/From Site)	-	-	-	-	-	-	-	-
170	Manual Wet Bed Removal	-	-	-	-	-	-	-	-
171	Mechanical Reprofiling of Ballast	-	-	-	-	-	-	-	-
172	Mechanised Patrolling Track Inspection	-	-	-	-	-	-	-	-
173	Mechanical Spot Re-sleepering	-	-	-	-	-	-	-	-
174	Mechanical Wet Bed Removal	-	-	-	-	-	-	-	-
175	Manual Spot Re-sleepering (Concrete)	-	-	-	-	-	-	-	-
176	Manual Spot Re-sleepering (Wood / Steel)	-	-	-	-	-	-	-	-
177	Replacement of Pads & Insulators	-	-	-	-	-	-	-	-
178	Tamping	-	-	-	-	-	-	-	-
179	PWAY Other	-	-	-	-	-	-	-	-
180	Rail Changing - Al-Thermic Weld - Standard Gap	-	-	-	-	-	-	-	-
181	Rail Changing - CWR - Renew (Defects)	-	-	-	-	-	-	-	-
182	Rail Changing - CWR - Renew Due to Wear	-	-	-	-	-	-	-	-
183	Rail Changing - Jointed Rail - Renew (Defects)	-	-	-	-	-	-	-	-
184	Rail Changing - Jointed Rail - Renew Due to Wea	-	-	-	-	-	-	-	-
185	Maintenance of Rail Lubricators	-	-	-	-	-	-	-	-
186	S&C Stoneblowing	-	-	-	-	-	-	-	-
187	Stoneblowing	-	-	-	-	-	-	-	-
188	S&C Arc Weld Repair	-	-	-	-	-	-	-	-
189	Replacement of S&C Bearers	-	-	-	-	-	-	-	-
190	S&C Renew Half Set of Switches	-	-	-	-	-	-	-	-
191	S&C Inspection (Other)	-	-	-	-	-	-	-	-
192	S&C Maintenance (Other)	-	-	-	-	-	-	-	-
193	S&C Tamping	-	-	-	-	-	-	-	-
194	Train Grinding - S&C	-	-	-	-	-	-	-	-
195	Track Inspection (Other)	-	-	-	-	-	-	-	-
196	Complete Treatment of S&C unit	-	-	-	-	-	-	-	-
197	Manual Ultrasonic Inspection - (Plain Line)	-	-	-	-	-	-	-	-
198	Manual Ultrasonic Inspection - RCF	-	-	-	-	-	-	-	-
199	Manual Ultrasonic Inspection - (S&C)	-	-	-	-	-	-	-	-
200	Patrolling Track Inspection (Video) Plain Line	-	-	-	-	-	-	-	-
201	Patrolling Track Inspection (Video) S&C	-	-	-	-	-	-	-	-
202	Weld Repair of Defective Rail	-	-	-	-	-	-	-	-
203	Other	-	-	-	-	-	-	-	-
204	**NDS delivery**	-	-	-	-	-	-	-	-
205	Grinding	-	-	-	-	-	-	-	-
206	Track recording car (inc NMT)	-	-	-	-	-	-	-	-
207	UTU	-	-	-	-	-	-	-	-
208	S&C machine grinding	-	-	-	-	-	-	-	-
209	**Offtrack**	-	-	-	-	-	-	-	-
210	Spoil & Debris Clearance Outside Station Area	-	-	-	-	-	-	-	-
211	Drainage	-	-	-	-	-	-	-	-
212	Fencing	-	-	-	-	-	-	-	-
213	Inspections (Fencing, Vegetation, Drainage)	-	-	-	-	-	-	-	-
214	Inspections (Level Crossing - Access Points)	-	-	-	-	-	-	-	-
215	Level Crossings Management (Off Track)	-	-	-	-	-	-	-	-
216	Other	-	-	-	-	-	-	-	-
217	Vegetation Management	-	-	-	-	-	-	-	-
218	**Indirect**	-	-	-	-	-	-	-	-
219	Labour	-	-	-	-	-	-	-	-
220	Plant	-	-	-	-	-	-	-	-
221	Materials	-	-	-	-	-	-	-	-
222	Other	-	-	-	-	-	-	-	-
223	**Other**	-	-	-	-	-	-	-	-
224	Plant	-	-	-	-	-	-	-	-
225	Materials	-	-	-	-	-	-	-	-
226	Subcontractors	-	-	-	-	-	-	-	-
227	Redundancy	-	-	-	-	-	-	-	-
228	Other	-	-	-	-	-	-	-	-
229	Other operating income	-	-	-	-	-	-	-	-

		R	T	U	V	W	X	Y	Z
	MAINTENANCE VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
154	**Track**	-	-	-	-	-	-	-	-
155	**Direct**	-	-	-	-	-	-	-	-
156	Replenishment of Ballast Manual	-	-	-	-	-	-	-	-
157	Replenishment of Ballast Train	-	-	-	-	-	-	-	-
158	S&C - renew crossing	-	-	-	-	-	-	-	-
159	CWR - Stressing	-	-	-	-	-	-	-	-
160	Manual Correction of PL Track Geometr	-	-	-	-	-	-	-	-
161	Jointed Track Hot Weather Preparation	-	-	-	-	-	-	-	-
162	Installation of Pre-Fabricated IRJs	-	-	-	-	-	-	-	-
163	Level 1 Patrolling Track Inspection	-	-	-	-	-	-	-	-
164	Lift & Replace Level Crossing for PWAY	-	-	-	-	-	-	-	-
165	Maintenance of Longitudinal Timber	-	-	-	-	-	-	-	-
166	Rail Lubricators Install / Remove	-	-	-	-	-	-	-	-
167	Manual Reprofiling of Ballast	-	-	-	-	-	-	-	-
168	Manual Rail Grinding	-	-	-	-	-	-	-	-
169	Transportation of Materials (To/From Sit	-	-	-	-	-	-	-	-
170	Manual Wet Bed Removal	-	-	-	-	-	-	-	-
171	Mechanical Reprofiling of Ballast	-	-	-	-	-	-	-	-
172	Mechanised Patrolling Track Inspection	-	-	-	-	-	-	-	-
173	Mechanical Spot Re-sleepering	-	-	-	-	-	-	-	-
174	Mechanical Wet Bed Removal	-	-	-	-	-	-	-	-
175	Manual Spot Re-sleepering (Concrete)	-	-	-	-	-	-	-	-
176	Manual Spot Re-sleepering (Wood / Ste	-	-	-	-	-	-	-	-
177	Replacement of Pads & Insulators	-	-	-	-	-	-	-	-
178	Tamping	-	-	-	-	-	-	-	-
179	PWAY Other	-	-	-	-	-	-	-	-
180	Rail Changing - Al-Thermic Weld - Stand	-	-	-	-	-	-	-	-
181	Rail Changing - CWR - Renew (Defects)	-	-	-	-	-	-	-	-
182	Rail Changing - CWR - Renew Due to W	-	-	-	-	-	-	-	-
183	Rail Changing - Jointed Rail - Renew (D	-	-	-	-	-	-	-	-
184	Rail Changing - Jointed Rail - Renew Du	-	-	-	-	-	-	-	-
185	Maintenance of Rail Lubricators	-	-	-	-	-	-	-	-
186	S&C Stoneblowing	-	-	-	-	-	-	-	-
187	Stoneblowing	-	-	-	-	-	-	-	-
188	S&C Arc Weld Repair	-	-	-	-	-	-	-	-
189	Replacement of S&C Bearers	-	-	-	-	-	-	-	-
190	S&C Renew Half Set of Switches	-	-	-	-	-	-	-	-
191	S&C Inspection (Other)	-	-	-	-	-	-	-	-
192	S&C Maintenance (Other)	-	-	-	-	-	-	-	-
193	S&C Tamping	-	-	-	-	-	-	-	-
194	Train Grinding - S&C	-	-	-	-	-	-	-	-
195	Track Inspection (Other)	-	-	-	-	-	-	-	-
196	Complete Treatment of S&C unit	-	-	-	-	-	-	-	-
197	Manual Ultrasonic Inspection - (Plain Lin	-	-	-	-	-	-	-	-
198	Manual Ultrasonic Inspection - RCF	-	-	-	-	-	-	-	-
199	Manual Ultrasonic Inspection - (S&C)	-	-	-	-	-	-	-	-
200	Patrolling Track Inspection (Video) Plain	-	-	-	-	-	-	-	-
201	Patrolling Track Inspection (Video) S&C	-	-	-	-	-	-	-	-
202	Weld Repair of Defective Rail	-	-	-	-	-	-	-	-
203	Other	-	-	-	-	-	-	-	-
204	**NDS delivery**	-	-	-	-	-	-	-	-
205	Grinding	-	-	-	-	-	-	-	-
206	Track recording car (inc NMT)	-	-	-	-	-	-	-	-
207	UTU	-	-	-	-	-	-	-	-
208	S&C machine grinding	-	-	-	-	-	-	-	-
209	**Offtrack**	-	-	-	-	-	-	-	-
210	Spoil & Debris Clearance Outside Statio	-	-	-	-	-	-	-	-
211	Drainage	-	-	-	-	-	-	-	-
212	Fencing	-	-	-	-	-	-	-	-
213	Inspections (Fencing, Vegetation, Draina	-	-	-	-	-	-	-	-
214	Inspections (Level Crossing - Access Po	-	-	-	-	-	-	-	-
215	Level Crossings Management (Off Track	-	-	-	-	-	-	-	-
216	Other	-	-	-	-	-	-	-	-
217	Vegetation Management	-	-	-	-	-	-	-	-
218	**Indirect**	-	-	-	-	-	-	-	-
219	Labour	-	-	-	-	-	-	-	-
220	Plant	-	-	-	-	-	-	-	-
221	Materials	-	-	-	-	-	-	-	-
222	Other	-	-	-	-	-	-	-	-
223	**Other**	-	-	-	-	-	-	-	-
224	Plant	-	-	-	-	-	-	-	-
225	Materials	-	-	-	-	-	-	-	-
226	Subcontractors	-	-	-	-	-	-	-	-
227	Redundancy	-	-	-	-	-	-	-	-
228	Other	-	-	-	-	-	-	-	-
229	Other operating income	-	-	-	-	-	-	-	-

E2 Structures and Earthworks

Civils Tier 0 Summary - update received from Network Rail on 28th February 2013

Civils Detail by Control Period - Pre-efficient

SBP - fully allocated scenario data

		D	E	F	G	H	I	J	K	L
	MAINTENANCE COSTS	Control period totals								
	£m, 2012/13	CP4	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
8	**Civils**	217		419	419					
9	**Earthworks examinations**									
10	Examinations									
11	Drainage inspections									
12	Drainage surveys									
13	**Structures assessments**									
14	**Structures examinations**									
15	**Structures other**									

SBP - fully allocated scenario data

		D	E	F	G	H	I	J	K	L
	RENEWAL COSTS	Control period totals								
		CP4[g]	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
20	**Civils**	1,944	249	2,903	2,717	2,221	2,246	2,261	2,287	2,343
21	**Underbridges**	526	-	1,296	744	631	637	665	676	722
22	Replace	-	-	336	334	324	319	319	319	323
23	Strengthen	-	-	136	159	156	147	147	147	147
24	Repair	-	-	255	20	14	11	14	13	38
25	Preventative	-	-	216	71	47	61	76	81	95
26	Waterproof[b]	-	-	-	-	-	-	-	-	-
27	Minor works	-	-	353	160	91	99	109	116	119
28	**Overbridges**	72	-	206	527	131	139	121	131	139
29	Replace	-	-	16	12	12	12	-	-	-
30	Strengthen	-	-	18	17	17	17	-	-	-
31	Repair	-	-	83	6	0	0	1	2	2
32	Preventative	-	-	5	0	1	1	1	1	1
33	Waterproof[b]	-	-	-	-	-	-	-	-	-
34	Minor works	-	-	84	492	101	109	119	128	135
35	**Bridgeguard 3[c]**	24	-	-	-	-	-	-	-	-
36	**Major structures[e]**	182	-	102	102	102	102	102	102	102
37	**Tunnels**	63	-	177	177	177	177	177	177	177
38	Repair	-	-	102	102	102	102	102	102	102
39	Preventative	-	-	48	48	48	48	48	48	48
40	Hazard management[d]	-	-	-	-	-	-	-	-	-
41	Minor works	-	-	27	27	27	27	27	27	27
42	**Other assets**	80	-	272	258	258	258	258	258	258
43	Retaining walls	-	-	102	102	102	102	102	102	102
44	Footbridges	-	-	57	57	57	57	57	57	57
45	Culverts	-	-	70	70	70	70	70	70	70
46	Coastal and estuarine defences	-	-	43	30	30	30	30	30	30
47	**Structures other**	536	168	218	218	218	218	218	218	218
48	**Earthworks**	460	81	633	691	704	715	721	725	728
49	Drainage			183	162	164	165	166	166	167
50	Embankments	196		136	314	320	325	327	328	329
51	Rock cuttings	90	36	48	39	37	36	35	34	33
52	Soil cuttings	79	44	214	131	138	144	148	152	154
53	Other (Earthwork)	95		52	45	45	45	45	45	45

		D	E	F	G	H	I	J	K	L
	RENEWAL VOLUMES		Control period totals							
			CP4	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
58	**Structures**										
59	Overbridges - major works	m2	46,707	-	50,062	10,841	8,057	8,206	661	1,035	1,088
60	Underbridges - major works	m2	384,766	-	774,337	206,732	175,690	171,563	201,854	196,465	233,511
61	Bridgeguard 3 - major works	m2	21,709	-	-	-	-	-	-	-	-
62	Footbridges - major works	m2	8,264	-	11,620	11,620	11,620	11,620	11,620	11,620	11,620
63	Tunnels - major works	m2	77,894	-	123,136	123,136	123,136	123,136	123,136	123,136	123,136
64	Culverts - major works	m2	8,377	-	8,637	8,637	8,637	8,637	8,637	8,637	8,637
65	Retaining walls - major works	m2	23,492	-	32,703	32,703	32,703	32,703	32,703	32,703	32,703
66	Coastal / estuary defences - ma	m	5,832	-	14,075	7,800	7,800	7,800	7,800	7,800	7,800
67	Major structures - major works[f]	m2	**110,074**	-	-	-	-	-	-	-	-
68											
69	**Earthworks**										
70	Embankments - renewal	5-chain length	1,206,277		317	1,064	1,103	1,133	1,150	1,162	1,171
71	Embankments - refurbishment	5-chain lengths			2,355	4,050	4,001	3,959	3,921	3,889	3,862
72	Embankments - maintenance	5-chain lengths			4,183	3,914	3,913	3,913	3,912	3,914	3,912
73	Rock cuttings - renewal	5-chain length	729,461	102	306	178	170	166	161	157	153
74	Rock cuttings - refurbishment	5-chain lengths		174	341	400	382	370	359	348	337
75	Rock cuttings - maintenance	5-chain lengths		79	560	370	368	369	370	369	369
76	Soil cuttings - renewal	5-chain length	505,943	249	887	541	578	608	629	647	660
77	Soil cuttings - refurbishment	5-chain lengths		125	3,467	2,510	2,521	2,528	2,538	2,541	2,545
78	Soil cuttings - maintenance	5-chain lengths		119	5,341	2,722	2,723	2,724	2,723	2,724	2,722

		D	E	F	G	H	I	J	K	L
	MAINTENANCE VOLUMES	Control period totals								
		CP4	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
83	**Civils**	-	-	-	-	-	-	-	-	-
84	**Earthworks examinations**	-	-	-	-	-	-	-	-	-
85	Examinations	-	-	-	-	-	-	-	-	-
86	Drainage inspections	-	-	-	-	-	-	-	-	-
87	Drainage surveys	-	-	-	-	-	-	-	-	-
88	**Structures assessments**	-	-	-	-	-	-	-	-	-
89	**Structures examinations**	-	-	-	-	-	-	-	-	-
90	**Structures other**	-	-	-	-	-	-	-	-	-

Notes:
Maintenance costs are not reported pre-efficient.
CP5 earthworks OPEX has be replicated forward to CP11.
Earthworks renewal costs shown in CP6 to CP11 are from the National model.
Earthworks renewal costs shown in CP5, and in the earthworks policy for CP6 to CP11 are the sum of Route models.
Earthworks renewal volumes shown in CP6 to CP11 are from the National model.
Earthworks renewal volumes shown in CP5, and in the earthworks policy for CP6 to CP11 are the sum of Route models.
[a] Includes circa £86M for bridge painting and repair, remainder for Hidden critical elements, Scour protection and Spandrel stabilisation.
[b] Underbridges and Overbridges renewals costs for waterproofing have been captured as secondary work items reported as preventative, repair and strengthen.
[c] A contribution for Bridgeguard 3 type work activity has been included in the Overbridges Strengthen and Replace forecasts from CP5 onwards.
[d] Hazard Management activity volumes for tunnels has been captured but has been reported against preventative and repair works.
[e] Major Structures renewal costs reported in CP4 represent the former Major Structures Long List assets. The Major Structures renewal costs reported for CP5 to CP11 represent the assets defined as Major Structures in the Structures Asset Policy BCAM-TP-0165 Issue 1.0.
[f] Major Structures renewal volumes have not been reported.
[g] DP13 is the source of the CP4 renewal costs.
CP4 values are in m2
values are not held at this level of granularity
Area not included within the Enhanced Spend scope

Civils Detail by Control Period - Post-efficient

SBP - fully allocated scenario data

		R	S	T	U	V	W	X	Y	Z
	MAINTENANCE COSTS	Control period totals								
	£m, 2012/13	CP4	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
8	**Civils**	159	-	408	397	396	397	396	396	397
9	**Earthworks examinations**	12	*(3)	23	23	23	23	23	23	23
10	Examinations	11	*(3)	14	14	14	14	14	14	14
11	Drainage inspections	1	*(3)	6	6	6	6	6	6	6
12	Drainage surveys	*(2)	*(3)	2	2	2	2	2	2	2
13	**Structures assessments**	31	-	102	101	101	101	101	101	101
14	**Structures examinations**	102	-	246	238	237	238	238	238	238
15	**Structures other**	14	-	37	35	35	35	35	35	35

SBP - fully allocated scenario data

		R	S	T	U	V	W	X	Y	Z
	RENEWAL COSTS	Control period totals								
		CP4[g]	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
20	**Civils**	1,944	249	2,642	2,300	1,882	1,902	1,915	1,937	1,985
21	**Underbridges**	526	-	1,175	629	534	539	562	571	610
22	Replace	-	-	306	283	274	270	270	270	273
23	Strengthen	-	-	123	135	132	124	124	124	124
24	Repair	-	-	231	17	12	9	12	11	32
25	Preventative	-	-	195	60	39	51	64	69	81
26	Waterproof[b]	-	-	-	-	-	-	-	-	-
27	Minor works	-	-	319	136	77	84	92	98	100
28	**Overbridges**	72	-	187	445	111	118	102	111	117
29	Replace	-	-	15	10	10	10	-	-	-
30	Strengthen	-	-	-	14	14	14	-	-	-
31	Repair	-	-	75	5	0	0	1	2	2
32	Preventative	-	-	5	0	1	1	1	1	1
33	Waterproof[b]	-	-	-	-	-	-	-	-	-
34	Minor works	-	-	76	416	86	92	101	108	114
35	**Bridgeguard 3[c]**	24	-	-	-	-	-	-	-	-
36	**Major structures[e]**	182	-	93	86	86	86	86	86	86
37	**Tunnels**	63	-	161	149	149	149	149	149	149
38	Repair	-	-	93	86	86	86	86	86	86
39	Preventative	-	-	44	40	40	40	40	40	40
40	Hazard management[d]	-	-	-	-	-	-	-	-	-
41	Minor works	-	-	24	23	23	23	23	23	23
42	**Other assets**	80	-	247	218	218	218	218	218	218
43	Retaining walls	-	-	93	86	86	86	86	86	86
44	Footbridges	-	-	52	48	48	48	48	48	48
45	Culverts	-	-	64	59	59	59	59	59	59
46	Coastal and estuarine defences	-	-	40	25	25	25	25	25	25
47	**Structures other**	536	168	197	184	184	184	184	184	184
48	**Earthworks**	460	81	583	587	599	608	613	616	619
49	Drainage			168	138	139	140	141	141	142
50	Embankments	196		126	267	272	276	278	279	280
51	Rock cuttings	90	36	44	33	32	31	30	29	28
52	Soil cuttings	79	44	197	111	117	122	126	129	131
53	Other (Earthwork)	95		48	38	38	38	38	38	38

		R	S	T	U	V	W	X	Y	Z
	RENEWAL VOLUMES		Control period totals							
			CP4	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
58	**Structures**										
59	Overbridges - major works	m2	46,707	-	50,062	10,841	8,057	8,206	661	1,035	1,088
60	Underbridges - major works	m2	384,766	-	774,337	206,732	175,690	171,563	201,854	196,465	233,511
61	Bridgeguard 3 - major works	m2	21,709	-	-	-	-	-	-	-	-
62	Footbridges - major works	m2	8,264	-	11,620	11,620	11,620	11,620	11,620	11,620	11,620
63	Tunnels - major works	m2	77,894	-	123,136	123,136	123,136	123,136	123,136	123,136	123,136
64	Culverts - major works	m2	8,377	-	8,637	8,637	8,637	8,637	8,637	8,637	8,637
65	Retaining walls - major works	m2	23,492	-	32,703	32,703	32,703	32,703	32,703	32,703	32,703
66	Coastal / estuary defences - maj	m	5,832	-	14,075	7,800	7,800	7,800	7,800	7,800	7,800
67	Major structures - major works[f]	m2	-	-	-	-	-	-	-	-	-
68											
69	**Earthworks**										
70	Embankments - renewal	5-chain lengths	1,206,277		317	1,064	1,103	1,133	1,150	1,162	1,171
71	Embankments - refurbishment	5-chain lengths			2,355	4,050	4,001	3,959	3,921	3,889	3,862
72	Embankments - maintenance	5-chain lengths			4,183	3,914	3,913	3,913	3,912	3,914	3,912
73	Rock cuttings - renewal	5-chain lengths	729,461	102	306	178	170	166	161	157	153
74	Rock cuttings - refurbishment	5-chain lengths		174	341	400	382	370	359	348	337
75	Rock cuttings - maintenance	5-chain lengths		79	560	370	368	369	370	369	369
76	Soil cuttings - renewal	5-chain lengths	505,943	249	887	541	578	608	629	647	660
77	Soil cuttings - refurbishment	5-chain lengths		125	3,467	2,510	2,521	2,528	2,538	2,541	2,545
78	Soil cuttings - maintenance	5-chain lengths		119	5,341	2,722	2,723	2,724	2,723	2,724	2,722

		R	S	T	U	V	W	X	Y	Z
	MAINTENANCE VOLUMES	Control period totals								
		CP4	CP4 incl enhanced spend	CP5	CP6	CP7	CP8	CP9	CP10	CP11
83	**Civils**	-	-	-	-	-	-	-	-	-
84	**Earthworks examinations**	-	-	-	-	-	-	-	-	-
85	Examinations	-	-	-	-	-	-	-	-	-
86	Drainage inspections	-	-	-	-	-	-	-	-	-
87	Drainage surveys	-	-	-	-	-	-	-	-	-
88	**Structures assessments**	-	-	-	-	-	-	-	-	-
89	**Structures examinations**	-	-	-	-	-	-	-	-	-
90	**Structures other**	-	-	-	-	-	-	-	-	-

E3 Buildings

Buildings Tier 0 Summary

Buildings Detail by Control Period - SBP Fully Allocated Pre-efficient

		D	F	G	H	I	J	K	L
	MAINTENANCE COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
	Buildings								
9	Managed stations	-	-	-	-	-	-	-	-
10	Franchised stations	-	-	-	-	-	-	-	-
11	Light maintenance depots	-	-	-	-	-	-	-	-
12	Depot plant	-	-	-	-	-	-	-	-
13	Lineside buildings	-	-	-	-	-	-	-	-
14	MDU buildings	-	-	-	-	-	-	-	-
15	NDS depots	-	-	-	-	-	-	-	-
16	Capitalised overheads	-	-	-	-	-	-	-	-

		D	F	G	H	I	J	K	L
	RENEWAL COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
21	Buildings	1,284	1,328	1,206	1,252	1,317	1,187	1,301	1,100
22	Managed stations	303	214	184	155	164	158	177	148
23	Buildings	-	20	4	4	4	4	4	5
24	Platforms	-	8	81	52	69	16	40	38
25	Canopies	-	13	-	-	-	-	-	1
26	Train sheds	-	56	26	22	19	51	48	30
27	Footbridges	-	-	-	-	-	-	-	-
28	Lifts and escalators	-	26	11	12	11	15	22	13
29	Mechanical and electrical	-	18	2	5	2	5	3	5
30	Inspections	-	4	4	4	4	4	4	4
31	Other Fabric	-	11	14	13	13	21	15	17
32	Minor Work	-	47	30	30	30	30	30	26
33	PPM	-	11	12	12	12	12	12	10
34	Franchised stations	723	753	722	782	802	732	771	659
35	Buildings	-	36	47	52	59	68	58	63
36	Platforms	-	169	166	159	189	92	151	100
37	Canopies	-	72	112	150	104	114	74	94
38	Train sheds	-	28	19	27	42	33	69	44
39	Footbridges	-	89	50	64	54	58	46	35
40	Other Fabric	-	24	19	19	19	19	19	19
41	Lifts and escalators	-	34	25	25	49	62	69	19
42	Mechanical and electrical	-	66	62	62	62	62	62	62
43	Inspections	-	39	36	36	36	36	36	36
44	Minor Work	-	148	159	159	159	159	159	159
45	PPM	-	48	29	29	29	29	29	29
46	Light maintenance depots	77	89	79	78	74	78	80	69
47	Fabric	-	27	50	49	45	49	51	40
48	Mechanical and electrical	-	29	25	25	25	25	25	25
49	Inspections	-	7	4	4	4	4	4	4
50	Minor Work & PPM	-	25	-	-	-	-	-	-
51	Depot plant	20	56	33	45	55	51	64	37
52	Lineside buildings	91	128	72	65	76	76	76	76
53	Fabric	-	26	28	21	32	32	32	32
54	Mechanical and electrical	-	16	22	22	22	22	22	22
55	Inspections	-	6	3	3	3	3	3	3
56	Minor Work & PPM	-	81	19	19	19	19	19	19
57	MDU buildings	53	72	64	64	64	64	64	64
58	NDS depots	12	16	52	63	83	28	70	48
59	Capitalised overheads	-	-	-	-	-	-	-	-

Unsure if CP4 total in Tier 0 =pre or post enhanced spend

		D	F	G	H	I	J	K	L
	RENEWAL VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
64	Franchised stations								
65	Building - Roof Structure (m2	-	33,515	-	-	-	-	-	-
66	Platform - Surface (m2)	-	303,337	-	-	-	-	-	-
67	Canopy - Roof Structure (m2	-	94,380	-	-	-	-	-	-
68	Train Shed - Roof Structur	-	66,622	-	-	-	-	-	-
69	Footbridge - Surface (m2)	-	21,482	-	-	-	-	-	-
70	Managed stations								
71	Building - Roof Structure (m2	-	456,058	-	-	-	-	-	-
72	Platform - Surface (m2)	-	39,461	-	-	-	-	-	-
73	Canopy - Roof Structure (m2	-	15,974	-	-	-	-	-	-
74	Train Shed - Roof Structur	-	98,123	-	-	-	-	-	-
75	Footbridge - Surface (m2)	-	2,282	-	-	-	-	-	-

		D	F	G	H	I	J	K	L
	MAINTENANCE VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
	Buildings								
81	Managed stations	-	-	-	-	-	-	-	-
82	Franchised stations	-	-	-	-	-	-	-	-
83	Light maintenance depots	-	-	-	-	-	-	-	-
84	Depot plant	-	-	-	-	-	-	-	-
85	Lineside buildings	-	-	-	-	-	-	-	-
86	MDU buildings	-	-	-	-	-	-	-	-
87	NDS depots	-	-	-	-	-	-	-	-
88	Capitalised overheads	-	-	-	-	-	-	-	-

Buildings Detail by Control Period - SBP Fully Allocated Post-efficient

		R	T	U	V	W	X	Y	Z
	MAINTENANCE COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
	Buildings								
9	Managed stations	-	-	-	-	-	-	-	-
10	Franchised stations	-	-	-	-	-	-	-	-
11	Light maintenance depots	-	-	-	-	-	-	-	-
12	Depot plant	-	-	-	-	-	-	-	-
13	Lineside buildings	-	-	-	-	-	-	-	-
14	MDU buildings	-	-	-	-	-	-	-	-
15	NDS depots	-	-	-	-	-	-	-	-
16	Capitalised overheads	-	-	-	-	-	-	-	-

		R	T	U	V	W	X	Y	Z
	RENEWAL COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
21	Buildings	-	1,187	1,011	1,050	1,104	995	1,091	923
22	Managed stations	-	189	154	130	137	132	148	124
23	Buildings	-	17	3	3	3	3	3	4
24	Platforms	-	7	68	44	58	14	33	32
25	Canopies	-	12	-	-	-	-	-	1
26	Train sheds	-	48	22	19	16	43	40	25
27	Footbridges	-	-	-	-	-	-	-	-
28	Lifts and escalators	-	23	10	10	10	13	19	11
29	Mechanical and electrical	-	16	2	4	2	4	2	4
30	Inspections	-	4	4	3	4	4	4	3
31	Other Fabric	-	10	12	11	11	17	12	14
32	Minor Work	-	42	25	25	25	25	25	21
33	PPM	-	10	10	10	10	10	10	8
34	Franchised stations	-	675	606	656	672	614	647	553
35	Buildings	-	32	39	44	49	57	49	52
36	Platforms	-	156	139	134	159	77	127	84
37	Canopies	-	65	94	126	87	96	62	79
38	Train sheds	-	25	16	23	35	28	58	37
39	Footbridges	-	79	42	53	45	48	39	30
40	Other Fabric	-	21	16	16	16	16	16	16
41	Lifts and escalators	-	30	21	21	41	52	58	16
42	Mechanical and electrical	-	61	52	52	52	52	52	52
43	Inspections	-	35	30	30	30	30	30	30
44	Minor Work	-	130	134	134	134	134	134	134
45	PPM	-	42	24	24	24	24	24	24
46	Light maintenance depots	-	79	66	65	62	65	67	58
47	Fabric	-	25	42	41	37	41	43	34
48	Mechanical and electrical	-	26	21	21	21	21	21	21
49	Inspections	-	6	3	3	3	3	3	3
50	Minor Work & PPM	-	22	-	-	-	-	-	-
51	Depot plant	-	51	27	38	46	43	53	31
52	Lineside buildings	-	115	61	55	64	64	64	64
53	Fabric	-	23	23	18	27	27	27	27
54	Mechanical and electrical	-	15	19	19	19	19	19	19
55	Inspections	-	5	3	3	3	3	3	3
56	Minor Work & PPM	-	73	16	16	16	16	16	16
57	MDU buildings	-	64	54	54	54	54	54	54
58	NDS depots	-	15	43	53	69	23	59	40
59	Capitalised overheads	-	-	-	-	-	-	-	-

Unsure if CP4 total in Tier 0 =pre or post enhanced spend

		R	T	U	V	W	X	Y	Z
	RENEWAL VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
64	Franchised stations								
65	Building - Roof Structure (m2	-	33,515	-	-	-	-	-	-
66	Platform - Surface (m2)	-	303,337	-	-	-	-	-	-
67	Canopy - Roof Structure (m2	-	94,380	-	-	-	-	-	-
68	Train Shed - Roof Structur	-	66,622	-	-	-	-	-	-
69	Footbridge - Surface (m2)	-	21,482	-	-	-	-	-	-
70	Managed stations								
71	Building - Roof Structure (m2	-	456,058	-	-	-	-	-	-
72	Platform - Surface (m2)	-	39,461	-	-	-	-	-	-
73	Canopy - Roof Structure (m2	-	15,974	-	-	-	-	-	-
74	Train Shed - Roof Structur	-	98,123	-	-	-	-	-	-
75	Footbridge - Surface (m2)	-	2,282	-	-	-	-	-	-

		R	T	U	V	W	X	Y	Z
	MAINTENANCE VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
	Buildings								
81	Managed stations	-	-	-	-	-	-	-	-
82	Franchised stations	-	-	-	-	-	-	-	-
83	Light maintenance depots	-	-	-	-	-	-	-	-
84	Depot plant	-	-	-	-	-	-	-	-
85	Lineside buildings	-	-	-	-	-	-	-	-
86	MDU buildings	-	-	-	-	-	-	-	-
87	NDS depots	-	-	-	-	-	-	-	-
88	Capitalised overheads	-	-	-	-	-	-	-	-

E4 Fleet

Wheeled Plant Tier 0 Summary

Wheeled Plant and Machinery Detail by Control Period - SBP Fully Allocated Pre-efficient

		D	F	G	H	I	J	K	L
	MAINTENANCE COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
8	Wheeled plant and machinery								
9		-	-	-	-	-	-	-	-
10		-	-	-	-	-	-	-	-
11		-	-	-	-	-	-	-	-
12		-	-	-	-	-	-	-	-
13		-	-	-	-	-	-	-	-
14		-	-	-	-	-	-	-	-
15		-	-	-	-	-	-	-	-
16		-	-	-	-	-	-	-	-

		D	F	G	H	I	J	K	L
	RENEWAL COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
21	**Wheeled plant and machinery**	**345**	**637**	**670**	**605**	**619**	**520**	**478**	**534**
22	**High output**	**-**	**125**	**158**	**170**	**118**	**169**	**170**	**118**
23	High output system 1	-	10	2	65	2	6	65	2
24	High output system 2	-	13	64	10	13	64	10	13
25	High output system 3	-	4	43	5	7	43	5	7
26	High output system 4	-	11	-	75	8	6	75	8
27	Medium output ballast cleaner	-	80	5	12	77	5	12	77
28	High output OTMs	-	6	44	4	10	44	4	10
29	**Incident response**	**-**	**7**	**7**	**1**	**6**	**0**	**10**	**3**
30	Breakdown crane	-	5	7	1	4	-	8	1
31	Breakdown crane van	-	0	1	0	0	-	1	0
32	Severn Tunnel recovery fleet	-	1	0	0	1	0	0	2
33	**Infrastructure monitoring**	**-**	**24**	**62**	**13**	**15**	**17**	**38**	**14**
34	EM-Sats	-	0	3	-	0	3	-	0
35	Existing measurement fleet	-	7	-	-	-	-	-	-
36	New Infrastructure Monitoring Train	-	-	36	1	2	1	2	1
37	NMT	-	4	-	-	-	-	-	-
38	PLPR	-	1	1	1	1	1	23	1
39	Trainborne monitoring equipment	-	12	22	12	12	12	12	12
40	**Intervention**	**-**	**128**	**153**	**24**	**160**	**125**	**48**	**94**
41	Rail grinders	-	72	89	21	64	85	20	64
42	Regulator	-	-	-	-	-	-	-	-
43	Stoneblower	-	50	39	2	48	38	2	30
44	Wiring Fleet		7	26	-	48	2	26	-
45	**Materials delivery**	**-**	**12**	**14**	**162**	**21**	**15**	**16**	**14**
46	Ballast delivery	-	8	10	114	9	11	8	10
47	Rail delivery	-	3	5	46	11	5	6	3
48	Sleeper delivery	-	1	-	2	1	-	1	1
49	**On track plant**	**-**	**150**	**21**	**35**	**145**	**34**	**46**	**121**
50	Lorry	-	26	6	2	25	8	13	14
51	Mobile Elevated Work Platform	-	38	6	6	38	9	10	31
52	OTP MPV	-	8	3	2	6	3	5	3
53	Rail Mounted Portable Plant	-	3	0	2	1	2	1	1
54	RRV Excavator	-	75	3	15	68	8	13	65
55	Trailer	-	0	0	3	3	1	2	3
56	Trolley	-	0	2	5	3	3	3	4
57	**Seasonal**	**-**	**44**	**127**	**25**	**33**	**31**	**29**	**26**
58	De-icing fleet	-	-	3	0	1	9	2	1
59	MPV module	-	3	-	-	-	-	-	-
60	MPV master and slave	-	29	112	14	29	14	14	14
61	MPV master and slave (CP4)	-	6	-	-	-	-	-	-
62	RHTT module	-	1	3	7	0	1	3	7
63	RHTT wagon	-	0	-	4	0	0	0	4
64	Snowblower	-	3	3	-	1	3	3	0
65	Snowplough trains	-	0	-	0	0	2	0	-
66	Snow plough	-	2	8	-	2	2	8	-
67	**Locomotives**	**-**	**2**	**8**	**53**	**2**	**8**	**2**	**10**
68	ERTMS fleet	-	2	-	10	2	-	2	2
69	Infrastructure monitoring support	-	-	5	28	-	5	-	5
70	Mobile load bank	-	-	-	-	-	-	-	-
71	Seasons fleet support	-	-	3	15	-	3	-	3
72	Shunters	-	0	-	0	-	0	-	0
73	**Fleet support plant**	**-**	**28**	**2**	**3**	**5**	**2**	**1**	**5**
74	**Road vehicles**	**-**	**114**	**118**	**116**	**114**	**116**	**118**	**116**
75	Cars	-	15	20	18	16	18	20	18
76	Vans	-	98	98	98	98	98	98	98
77	**S&C delivery**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**14**
78	S&C tilting delivery beams	-	0	-	0	-	0	-	3
79	S&CtTilting delivery wagons	-	2	-	2	-	2	-	11

Unsure if CP4 total in Tier 0 =pre or post enhanced spend

Wheeled Plant and Machinery Detail by Control Period - SBP Fully Allocated Post-efficient

		R	T	U	V	W	X	Y	Z
	MAINTENANCE COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
8	Wheeled plant and machinery								
9		-	-	-	-	-	-	-	-
10		-	-	-	-	-	-	-	-
11		-	-	-	-	-	-	-	-
12		-	-	-	-	-	-	-	-
13		-	-	-	-	-	-	-	-
14		-	-	-	-	-	-	-	-
15		-	-	-	-	-	-	-	-
16		-	-	-	-	-	-	-	-

		R	T	U	V	W	X	Y	Z
	RENEWAL COSTS	Control period totals							
	£m, 2012/13	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
21	**Wheeled plant and machinery**	**-**	**598**	**620**	**560**	**572**	**481**	**442**	**494**
22	**High output**	**-**	**114**	**146**	**158**	**109**	**156**	**158**	**109**
23	High output system 1	-	10	2	60	2	6	60	2
24	High output system 2	-	12	59	9	12	59	9	12
25	High output system 3	-	4	39	5	6	39	5	6
26	High output system 4	-	10	-	69	8	6	69	8
27	Medium output ballast cleaner	-	72	5	11	72	5	11	72
28	High output OTMs	-	6	41	4	9	41	4	9
29	**Incident response**	**-**	**7**	**7**	**1**	**6**	**0**	**9**	**2**
30	Breakdown crane	-	5	6	1	4	-	8	1
31	Breakdown crane van	-	0	0	0	0	-	1	0
32	Severn Tunnel recovery fleet	-	1	0	0	1	0	0	1
33	**Infrastructure monitoring**	**-**	**23**	**57**	**12**	**14**	**15**	**35**	**13**
34	EM-Sats	-	0	3	-	0	3	-	0
35	Existing measurement fleet	-	7	-	-	-	-	-	-
36	New Infrastructure Monitoring Train	-	-	33	1	1	1	2	1
37	NMT	-	3	-	-	-	-	-	-
38	PLPR	-	1	1	1	1	1	21	1
39	Trainborne monitoring equipment	-	12	20	11	11	11	11	11
40	**Intervention**	**-**	**119**	**142**	**22**	**148**	**116**	**45**	**87**
41	Rail grinders	-	67	82	20	59	79	19	59
42	Regulator	-	-	-	-	-	-	-	-
43	Stoneblower	-	46	36	2	45	36	2	28
44	Wiring Fleet	-	6	24	-	44	2	24	-
45	**Materials delivery**	**-**	**11**	**13**	**150**	**20**	**14**	**14**	**13**
46	Ballast delivery	-	7	9	105	8	10	7	9
47	Rail delivery	-	3	4	42	10	4	6	3
48	Sleeper delivery	-	1	-	2	1	-	1	1
49	**On track plant**	**-**	**141**	**19**	**33**	**134**	**32**	**43**	**112**
50	Lorry	-	24	6	2	23	7	12	13
51	Mobile Elevated Work Platform	-	36	5	5	35	8	9	29
52	OTP MPV	-	8	3	2	6	3	5	3
53	Rail Mounted Portable Plant	-	3	0	2	1	2	0	1
54	RRV Excavator	-	71	3	14	63	7	12	60
55	Trailer	-	0	0	3	3	1	1	3
56	Trolley	-	0	2	4	3	3	3	4
57	**Seasonal**	**-**	**41**	**118**	**23**	**31**	**29**	**27**	**24**
58	De-icing fleet	-	-	2	0	1	8	2	1
59	MPV module	-	3	-	-	-	-	-	-
60	MPV master and slave	-	27	103	13	27	13	13	13
61	MPV master and slave (CP4)	-	5	-	-	-	-	-	-
62	RHTT module	-	1	2	6	0	1	3	6
63	RHTT wagon	-	0	-	3	0	0	0	3
64	Snowblower	-	3	3	-	1	3	3	0
65	Snowplough trains	-	0	-	0	0	2	0	-
66	Snow plough	-	2	7	-	2	2	7	-
67	**Locomotives**	**-**	**2**	**7**	**49**	**2**	**7**	**2**	**9**
68	ERTMS fleet	-	2	-	9	2	-	2	2
69	Infrastructure monitoring support	-	-	4	25	-	4	-	4
70	Mobile load bank	-	-	-	-	-	-	-	-
71	Seasons fleet support	-	-	3	14	-	3	-	3
72	Shunters	-	0	-	0	-	0	-	0
73	**Fleet support plant**	**-**	**26**	**2**	**2**	**5**	**2**	**1**	**4**
74	**Road vehicles**	**-**	**111**	**109**	**108**	**105**	**107**	**109**	**108**
75	Cars	-	15	18	17	14	16	18	17
76	Vans	-	96	91	91	91	91	91	91
77	**S&C delivery**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**13**
78	S&C tilting delivery beams	-	0	-	0	-	0	-	3
79	S&CtTilting delivery wagons	-	2	-	2	-	2	-	10

Unsure if CP4 total in Tier 0 =pre or post enhanced spend

		D	F	G	H	I	J	K	L
	RENEWAL VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
84	**Wheeled plant and machinery**	-	-	-	-	-	-	-	-
85	**High output**	-	-	-	-	-	-	-	-
86	High output system 1	-	-	-	-	-	-	-	-
87	High output system 2	-	-	-	-	-	-	-	-
88	High output system 3	-	-	-	-	-	-	-	-
89	High output system 4	-	-	-	-	-	-	-	-
90	Medium output ballast cleaner	-	-	-	-	-	-	-	-
91	High output OTMs	-	-	-	-	-	-	-	-
92	**Incident response**	-	-	-	-	-	-	-	-
93	Breakdown crane	-	-	-	-	-	-	-	-
94	Breakdown crane van	-	-	-	-	-	-	-	-
95	Severn Tunnel recovery fleet	-	-	-	-	-	-	-	-
96	**Infrastructure monitoring**	-	-	-	-	-	-	-	-
97	EM-Sats	-	-	-	-	-	-	-	-
98	Existing measurement fleet	-	-	-	-	-	-	-	-
99	New Infrastructure Monitoring Train	-	-	-	-	-	-	-	-
100	NMT	-	-	-	-	-	-	-	-
101	PLPR	-	-	-	-	-	-	-	-
102	Trainborne monitoring equipment	-	-	-	-	-	-	-	-
103	**Intervention**	-	-	-	-	-	-	-	-
104	Rail grinders	-	-	-	-	-	-	-	-
105	Regulator	-	-	-	-	-	-	-	-
106	Stoneblower	-	-	-	-	-	-	-	-
107	Wiring Fleet		-	-	-	-	-	-	-
108	**Materials delivery**	-	-	-	-	-	-	-	-
109	Ballast delivery	-	-	-	-	-	-	-	-
110	Rail delivery	-	-	-	-	-	-	-	-
111	Sleeper delivery	-	-	-	-	-	-	-	-
112	**On track plant**	-	-	-	-	-	-	-	-
113	Lorry	-	-	-	-	-	-	-	-
114	Mobile Elevated Work Platform	-	-	-	-	-	-	-	-
115	OTP MPV	-	-	-	-	-	-	-	-
116	Rail Mounted Portable Plant	-	-	-	-	-	-	-	-
117	RRV Excavator	-	-	-	-	-	-	-	-
118	Trailer	-	-	-	-	-	-	-	-
119	Trolley	-	-	-	-	-	-	-	-
120	**Seasonal**	-	-	-	-	-	-	-	-
121	De-icing fleet	-	-	-	-	-	-	-	-
122	MPV module	-	-	-	-	-	-	-	-
123	MPV master and slave	-	-	-	-	-	-	-	-
124	MPV master and slave (CP4)	-	-	-	-	-	-	-	-
125	RHTT module	-	-	-	-	-	-	-	-
126	RHTT wagon	-	-	-	-	-	-	-	-
127	Snowblower	-	-	-	-	-	-	-	-
128	Snowplough trains	-	-	-	-	-	-	-	-
129	Snow plough	-	-	-	-	-	-	-	-
130	**Locomotives**	-	-	-	-	-	-	-	-
131	ERTMS fleet	-	-	-	-	-	-	-	-
132	Infrastructure monitoring support	-	-	-	-	-	-	-	-
133	Mobile load bank	-	-	-	-	-	-	-	-
134	Seasons fleet support	-	-	-	-	-	-	-	-
135	Shunters	-	-	-	-	-	-	-	-
136	**Fleet support plant**	-	-	-	-	-	-	-	-
137	**Road vehicles**	-	-	-	-	-	-	-	-
138	Cars	-	-	-	-	-	-	-	-
139	Vans	-	-	-	-	-	-	-	-
140	**S&C delivery**	-	-	-	-	-	-	-	-
141	S&C tilting delivery beams	-	-	-	-	-	-	-	-
142	S&CtTilting delivery wagons	-	-	-	-	-	-	-	-

		D	F	G	H	I	J	K	L
	MAINTENANCE VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
147	**Wheeled plant and machinery**								
148		-	-	-	-	-	-	-	-
149		-	-	-	-	-	-	-	-
150		-	-	-	-	-	-	-	-
151		-	-	-	-	-	-	-	-
152		-	-	-	-	-	-	-	-
153		-	-	-	-	-	-	-	-
154		-	-	-	-	-	-	-	-
155		-	-	-	-	-	-	-	-

		R	T	U	V	W	X	Y	Z
	RENEWAL VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
84	**Wheeled plant and machinery**	-	-	-	-	-	-	-	-
85	**High output**	-	-	-	-	-	-	-	-
86	High output system 1	-	-	-	-	-	-	-	-
87	High output system 2	-	-	-	-	-	-	-	-
88	High output system 3	-	-	-	-	-	-	-	-
89	High output system 4	-	-	-	-	-	-	-	-
90	Medium output ballast cleaner	-	-	-	-	-	-	-	-
91	High output OTMs	-	-	-	-	-	-	-	-
92	**Incident response**	-	-	-	-	-	-	-	-
93	Breakdown crane	-	-	-	-	-	-	-	-
94	Breakdown crane van	-	-	-	-	-	-	-	-
95	Severn Tunnel recovery fleet	-	-	-	-	-	-	-	-
96	**Infrastructure monitoring**	-	-	-	-	-	-	-	-
97	EM-Sats	-	-	-	-	-	-	-	-
98	Existing measurement fleet	-	-	-	-	-	-	-	-
99	New Infrastructure Monitoring Train	-	-	-	-	-	-	-	-
100	NMT	-	-	-	-	-	-	-	-
101	PLPR	-	-	-	-	-	-	-	-
102	Trainborne monitoring equipment	-	-	-	-	-	-	-	-
103	**Intervention**	-	-	-	-	-	-	-	-
104	Rail grinders	-	-	-	-	-	-	-	-
105	Regulator	-	-	-	-	-	-	-	-
106	Stoneblower	-	-	-	-	-	-	-	-
107	Wiring Fleet		-	-	-	-	-	-	-
108	**Materials delivery**	-	-	-	-	-	-	-	-
109	Ballast delivery	-	-	-	-	-	-	-	-
110	Rail delivery	-	-	-	-	-	-	-	-
111	Sleeper delivery	-	-	-	-	-	-	-	-
112	**On track plant**	-	-	-	-	-	-	-	-
113	Lorry	-	-	-	-	-	-	-	-
114	Mobile Elevated Work Platform	-	-	-	-	-	-	-	-
115	OTP MPV	-	-	-	-	-	-	-	-
116	Rail Mounted Portable Plant	-	-	-	-	-	-	-	-
117	RRV Excavator	-	-	-	-	-	-	-	-
118	Trailer	-	-	-	-	-	-	-	-
119	Trolley	-	-	-	-	-	-	-	-
120	**Seasonal**	-	-	-	-	-	-	-	-
121	De-icing fleet	-	-	-	-	-	-	-	-
122	MPV module	-	-	-	-	-	-	-	-
123	MPV master and slave	-	-	-	-	-	-	-	-
124	MPV master and slave (CP4)	-	-	-	-	-	-	-	-
125	RHTT module	-	-	-	-	-	-	-	-
126	RHTT wagon	-	-	-	-	-	-	-	-
127	Snowblower	-	-	-	-	-	-	-	-
128	Snowplough trains	-	-	-	-	-	-	-	-
129	Snow plough	-	-	-	-	-	-	-	-
130	**Locomotives**	-	-	-	-	-	-	-	-
131	ERTMS fleet	-	-	-	-	-	-	-	-
132	Infrastructure monitoring support	-	-	-	-	-	-	-	-
133	Mobile load bank	-	-	-	-	-	-	-	-
134	Seasons fleet support	-	-	-	-	-	-	-	-
135	Shunters	-	-	-	-	-	-	-	-
136	**Fleet support plant**	-	-	-	-	-	-	-	-
137	**Road vehicles**	-	-	-	-	-	-	-	-
138	Cars	-	-	-	-	-	-	-	-
139	Vans	-	-	-	-	-	-	-	-
140	**S&C delivery**	-	-	-	-	-	-	-	-
141	S&C tilting delivery beams	-	-	-	-	-	-	-	-
142	S&CtTilting delivery wagons	-	-	-	-	-	-	-	-

		R	T	U	V	W	X	Y	Z
	MAINTENANCE VOLUMES	Control period totals							
		CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
147	**Wheeled plant and machinery**								
148		-	-	-	-	-	-	-	-
149		-	-	-	-	-	-	-	-
150		-	-	-	-	-	-	-	-
151		-	-	-	-	-	-	-	-
152		-	-	-	-	-	-	-	-
153		-	-	-	-	-	-	-	-
154		-	-	-	-	-	-	-	-
155		-	-	-	-	-	-	-	-