Review of the Queensland Rail (QR) West Moreton System

Maintenance Costs

Capital Costs (Capex)

Operations Costs

Depreciated Optimised Replacement Cost (DORC)

for the Queensland Competition Authority

May 2014

B&H Strategic Services Pty Ltd

Integrated Review Executive Summary

A review of Queensland Rail's (QR's) AU1 Submission[1] for the West Moreton System has been conducted. The review scrutinised four elements of the Submission dealing with in Chapter 1, maintenance costs, Chapter 2, capital expenditure, Chapter 3, below rail operations costs and in Chapter 4, the Depreciated Optimised Replacement Cost (DORC). These elements are linked together because maintenance and operations informs capital spending which informs the understanding of the configuration of the asset and its condition and hence its remaining life.

The Optimised Replacement Cost (ORC) of the West Moreton System asset has previously been estimated[2] by referencing a hypothetical Modern Engineering Equivalent Replacement Asset (MEERA) which has the configuration of an asset that would be constructed today. A DORC was estimated at that time but with limited data. QR's West Moreton System existing infrastructure has a configuration vastly different to the MEERA as it was constructed in the 19th Century and historically maintained to a standard suitable for regional mixed traffic, not coal traffic.

While QR has within the last 10 years been slowly improving the quality of the infrastructure it still remains severely weaker and deteriorated from the ORC. Many sleepers remain timber, not concrete, the rail remains relatively small in size, the formation was built with rudimentary equipment and the bridges are very old timber construction, not concrete or steel.

In this review we have appraised the maintenance strategy and costs and found that the unit costs are very high for a line carrying the tonnage it does. We have also appraised the historical and planned capital spending. In both cases the maintenance and capital strategies are working toward establishing and keeping an asset to a standard that is fit for purpose in the face of the fundamental reality that the line was built for other lesser purposes.

Consequently the DORC has been assessed by discounting the ORC on account of the configuration of the existing asset and then decreased in value due to its condition which has been assessed by estimating its remaining life. This was done on a component by component basis.

The sleeper, rail and ballast assets of the infrastructure have received considerable attention over the last 10 years and their configuration and condition are reasonable. More work is planned through the Regulatory Period to 2016/17 and beyond to bring those assets up to a fully reliable condition. The formation, drainage and bridge assets are however greatly depleted, firstly by way of their configuration and secondly by way of their condition. The rail and sleeper strategy, which is to provide assets that exceed the theoretical need in strength terms for the operating axle load, is to compensate for the poor condition of the formation.

In assessing the work planned for maintenance we have found that some work is capital in nature but has been rolled up into a maintenance activity as it would be carried out at the same time. We have therefore adjusted QR's maintenance estimates. In assessing

[1] (Access Undertaking) AU1 West Moreton Reference Tariff Reset Submission provided in a number of documents dealing with "Overall", Maintenance, Capex, Explanatory and Reference Tariff topics

[2] Connell **Hatch** (2008) Final Estimate Report http://www.qca.org.au/files/R-2009DAU-QR-Vol1Atts-0908.PDF

the operations costs we have found that apart from train control costs, QR's proposal is reasonable. In assessing the capex past and future programs we believe QR could do more to explore options to achieve the same functional outcome.

We remain concerned that QR has not taken advantage of outsourcing opportunities. The private sector has established itself in every other state in Australia as being competent to carry out most maintenance and capital works. Apart from specialist activities there is very little work outsourced in QR presently and this could affect work program priorities where work is undertaken when resources are available rather than when the work needs to be done.

We have suggested methods to improve maintenance outcomes, alternative maintenance practice, and alternative capital spending options and estimated the DORC adjustments in the four Chapters of this review.

Table 1 shows a summary of the annual amounts for key tariff inputs that we have assessed as reasonable.

Table 1 Summary of Annual Amounts for Key Tariff Inputs

Rosewood to Macalister						
$m	2013-14	2014-15	2015-16	2016-17	TOTAL	Notes
Maintenance	$18.98	$17.92	$26.77	$23.04	$86.71	All traffics, and applying QR proposed gtk allocation
Capital Expenditure	$21.18	$18.64	$18.59	$17.92	$76.32	All traffics (figures include capitalised interest)
Operating Expenditure	$4.60	$4.72	$4.83	$4.95	$19.10	Coal only

Table 1 continued

Macalister to Columboola						
$m	2013-14	2014-15	2015-16	2016-17	TOTAL	Notes
Maintenance	$1.71	$1.61	$2.41	$2.07	$7.80	All traffics, and applying QR proposed gtk allocation
Capital Expenditure	$0.59	$0.62	$1.53	$2.61	$5.35	All traffics (figures include capitalised interest)
Operating Expenditure	$0.31	$0.32	$0.33	$0.34	$1.29	Coal only

Executive Summary: Maintenance Costs

A review of QR's West Moreton System Infrastructure Maintenance costs as proposed in their AU1 Submission "AU1 West Moreton Reference Tariff Reset Maintenance Submission" as well as the subsequent WorleyParsons report, "West Moreton Reference Tariff Submission Review", 5th September 2013, has been undertaken, in order to inform the QCA of technical matters that will assist the Authority in its assessment of the reasonableness of the proposed approach to calculating and the quantum of the proposed maintenance costs.

In this review we have addressed the task objectives being:

(a) Analysis of Queensland Rail's proposed Maintenance costs.

(b) Assess the quantum of the maintenance tasks proposed by Queensland Rail. Evaluate whether the proposed maintenance is commensurate with that expected for the rail infrastructure and forecast traffic volume.

(c) Assess Queensland Rail's proposed maintenance unit rates to ensure they are reasonable and efficient.

(d) In doing so, the consultant will benchmark Queensland Rail's proposed maintenance costs with industry averages (on an appropriate basis).

In this review we have acknowledged that this railway is in many respects one of the most difficult railways in Australia to maintain and that one could expect that on a unit per km basis, or per tonnage basis the maintenance costs would be at the high end of a cost spectrum. The historical construction of the line, its geomorphology and its train regime make it a railway where copious present day and legacy issues need to be addressed.

Having said that however, we find that the maintenance activities to deal with these issues are not bound together in a coherent strategy and that would otherwise provide clarity as to the cause of unit rates as high as they are for many of the activities.

The maintenance activities are on the one hand designed to improve the functionality of the railway by delivering better reliability and availability but are hampered by the use of technical standards that are not flexible enough to respond to the particular conditions of the railway. For example, the Queensland Rail standard CETS7 is rigid in its application rather than risk based or condition based.

The absence of a clear strategy for future use of the railway has resulted in standards being applied that are inconsistent: On the one hand maintenance activities that will embed the railway to low axle load capability such as bridge maintenance suited to 15.75 tonnes axle load but with the use of other standards that could give much higher axle load capability such as the use of 50 kg/m rail that could provide 21 tonne axle load. This has resulted in an approach where opportunities are taken to apply the best technology in some areas and historical solutions in others.

This approach has also prevented any transparent evaluation of alternative solutions to the particular shortcomings in the adequacy of the infrastructure for the current and future task and we have concluded that QR maintenance costs are likely to be sub-optimal.

However, the pattern of costs and approach to maintenance shown in QR's submission as well as our own personal site visit observations clearly points to the fact that the Rosewood to Jondaryan section, which is the highest tonnage section, has a formation which is unable to accommodate a normal specification fit for purpose standard of track structure. Instead, a strengthened track structure is needed to compensate for the inadequacies of the formation and the maintenance program reflects this improvement and strengthening strategy.

The actual application of the strengthening strategy has been uniform and while this is a convenient strategy for the purposes of uniformity in equipment and person skills, some greater application of a risk based approach may have led to the use of alternative track structures. In some sections there is no reason why steel sleepers could not have been used and in these sections the cost of resleepering would have been reduced. However, so much of the section has now been converted to concrete sleepers that there is little point introducing isolated sections of steel sleepers on the "Down[3]" or single sections of the line. We note an inexplicable strategy on a section of single line on the heaviest track section which will be resleepered with timber sleepers in this Regulatory Period but will be concrete resleepered before the life of replaced timber sleepers expire[4]. This strategy, while addressing a short term need perhaps, and then in a relatively short period moving ahead with the broader strategy to make the track more robust is potentially wasteful and we found no evidence of alternative strategy consideration, such as early concrete resleepering.

The costs of resleepering proposed by QR are concerning, not in their scope but in their unit rate. The unit rate calculated using QR's expenditure and the number of sleepers indicates an extremely high rate of approximately $320 to $350 per sleeper. Clarification received from QR about this high rate revealed that other work would also be performed when the resleepering occurred such as cutting widening, embankment widening or access road improvements. These activities are capex in nature and should not burden the maintenance cost estimates in our view. We recommend a resleepering unit cost rate of $200 per sleeper would adequately cover a like for like replacement of the timber sleepers proposed. We have therefore adjusted the maintenance resleepering estimates.

We have recommended adjustments be made to the DORC on the basis that the formation is heavily dilapidated and that the non-50kg/m rail and non-concrete sleeper assets are also heavily run-down in the section between Rosewood and Jondaryan.

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[3] The "Down" direction is the loaded traffic direction, to the port.

[4] Meeting 12th Feb 2014 QR and QCA to explain the timber resleepering strategy

The maintenance strategy to the west of Jondaryan is in accord with the lower tonnages in that area.

Once the improvements and strengthening are completed in the Rosewood to Jondaryan section, beyond this Regulatory Period, there is sufficient evidence to suggest that the West Moreton system maintenance costs will revert to more normal levels.

Executive Summary: Capital Expenditure

A review of QR's West Moreton System Infrastructure Capex costs as proposed in their AU1 Submission "AU1 West Moreton Reference Tariff Reset Capital Submission" as well as the subsequent WorleyParsons report, "West Moreton Reference Tariff Submission Review", 5th September 2013, has been undertaken, in order to inform the QCA of technical matters that will assist the Authority in its assessment of the reasonableness of the proposed approach to calculating and the quantum of the proposed Capital Costs (Capex) and the DORC.

This review evaluates projects that have been recently completed or are substantially complete as well as future projects. Projects that are not yet complete will be more fully evaluated after their completion and this review estimates the ultimate impact on the closing RAB for this Regulatory Period.

In this review we have addressed the task objectives being:

(a) Analysis of Queensland Rail's proposed Capex costs.

(b) Assess the quantum of the Capex scope proposed by Queensland Rail. Evaluate whether the proposed Capex is commensurate with that expected for the proposed rail infrastructure and forecast traffic volume.

(c) Assess Queensland Rail's proposed Capex unit rates to ensure they are reasonable and efficient.

(d) In doing so, the consultant will benchmark Queensland Rail's proposed Capex costs with industry averages (on an appropriate basis).

In this review we have acknowledged that this railway is in many respects one of the most difficult railways in Australia to manage and that specific solutions will be employed on this railway that no other railway would address. The historical construction of the line, its geomorphology and its train regime make it a railway where copious present day and legacy issues need to be addressed.

Having said that however, we find that solutions have been presented where no alternatives have been considered[5]. Alternatives are presented that address the method of implementation but not the solution itself.

During the course of the review a number of clarifying questions were asked of QR and these are shown in Appendix 2.

The Capex proposals are feasible and are reasonably costed for the solutions offered but they may not be if alternatives had been considered.

[5] at least in the documentation supplied by QR

Executive Summary: Below Rail Operations Costs

A review of QR's West Moreton System Infrastructure Operating costs as proposed in their "AU1 West Moreton Reference Tariff Reset Overall Submission", undated, has been undertaken, in order to inform the QCA of technical matters that will assist the Authority in its assessment of the reasonableness of the proposed approach to calculating and the quantum of the proposed operating costs.

In this review we have addressed the task objectives being:

(a) Analysis of Queensland Rail's proposed Operating[6] costs.

(b) Assess the quantum of the operating tasks proposed by Queensland Rail. Evaluate whether the proposed operations is commensurate with that expected for the forecast traffic volume.

(c) Assess Queensland Rail's proposed operating cost unit rates to ensure they are reasonable and efficient.

(d) In doing so, the consultant will benchmark Queensland Rail's proposed operating costs with industry averages (on an appropriate basis).

In this review we are cognisant of the varying train path loadings and the complexity of operating a railway both through the Brisbane Metropolitan system, over a notoriously difficult alignment and terrain which affects train running and across the western slopes of Southern Queensland.

In many respects the West Moreton system as proposed is three different railways each of which exerts different pressures on the train control function and the secondary effects of that function. On the one hand the coal traffic has a single unvarying purpose and pattern, regional traffic is seasonal being composed of grain and passenger mixed traffic and then there is the impact that the suburban system has on the scheduling of the system.

In this review we have benchmarked other regimes and compared QR's proposed costs for the forecast task to establish whether those costs fall within a reasonable range. We acknowledge there is no other system the same as this and therefore we wish to ensure the range of reasonableness is applicable. We have reviewed both QR's 2011/12 and 2012/13 costs and made comments comparing both.

In relation to QR's "glide path to efficiency"[7], while we acknowledge the laudable intention we caution the use of such targets in the first year of the regime because some time is required for systems and working practices to bed down after the restructuring that recently occurred in the creation of Aurizon. The previous regime would have benefitted from economies of scale even if it had previously been evaluated on a stand-alone basis as some inputs are allocative in nature.

[6] Called "Other Operating Costs", section 4.7 of the "Overall Submission"
[7] Page 19, section 4.7 of the Overall Submission

For the 2011/12 report of costs we conclude that QR's proposed Operating costs are within a reasonable range with the exception of Train Control which is clearly outside of similar network benchmarks.

For the 2012/13 report of costs, the overall cost result achieves the objective that QR had aimed for 2015/16. Again, Train Control does not meet benchmarks but the overall costs are close to QR's four year target for efficiency.

The dramatic reductions from 2011/12 to 2012/13 are welcomed except that there is the potential for incorrect cost categorisation and clarity is required to ensure Train Control is not unfairly burdened with costs from other areas that appear to be low.

Executive Summary: Depreciated Optimised Replacement Cost (DORC)

A review of QR's West Moreton System DORC as proposed in their AU1 Submission "AU1 West Moreton Reference Tariff Reset Maintenance Submission", has been undertaken, in order to inform the QCA of technical matters that will assist the Authority in its assessment of the reasonableness of the proposed approach to calculating and the quantum of the proposed DORC.

In this review we have addressed the task objectives being:

a) Identify the configuration of the network and compare that standard with the ORC standard assumed in the Connell Hatch (2008) estimate of DORC.

b) Using the maintenance and capex information proposed by QR for the 2013/14 to 2016/17 Regulatory Period, as well as historical information, deduce the likely condition of the assets in the network

c) Estimate the appropriate DORC by firstly taking into account the actual configuration and then secondly its condition

d) Provide a commentary on the assumptions made in the estimates, the appropriateness of QR's overall strategy and link the review with the maintenance, capex and operating costs review.

A DORC was calculated for the purposes of a Draft Decision by QCA in 2009 with Connell Hatch providing an ORC and then estimating a DORC using usual industry benchmark data.

Since that time QR has provided much more information about their capital programs and maintenance approach and it has become apparent that a reset of the factors that influence life expiry is required.

The capital program and the maintenance strategy indicates that the fundamental building blocks of the railway structure, the formation and the structures, are nothing like the ORC standard in either their configuration or their condition.

The ORC is the standard that the railway would be constructed today, using a Modern Engineering Equivalent Replacement Asset (MEERA). This was determined by Connell Hatch to be of concrete sleeper and 50kg/m rail standard and concrete bridges. More particularly, it also inferred an engineering formation with capping and structural material together with drainage and embankment stability.

The calculation of DORC requires the estimation of the amount of life of the asset that has expired. In the case of the West Moreton System the existing configuration is generally of a lower standard to the ORC and its condition is poor. The most recent capital expenditure on concrete sleepers, 50kg/m rail and refurbished formation assist in bringing the asset to ORC standard but most of the asset is not near that standard.

We have also estimated the impact that the "suburban black-out" period, of the peaks and other capacity constraints impose on the capacity of the total system in Appendix 3.

We have estimated that overall the reduction in the value of the West Moreton system asset is 57.2% compared with a MEERA ORC asset, after excluding the works funded by transport service contract payments from the Queensland government[8]. That is, the DORC at the beginning of the Regulatory Period is 42.8% of the ORC. In this estimation we have assessed the reduced network value due to configuration deficiencies[9,10], and due to the assets' condition. Table 2 shows the summary of the considerations for the DORC.

Table 2 Summary of ORC inflation and DORC adjustments – as at 30 June 2013

Rosewood To Columboola					
Asset Class	**ORC 2007 (From EI report)**	**ORC 2013 (adjusted by CPI)** [~]	**Adjustment factor**	**DORC 2013**	**Remaining Life (years/years)**
Sleepers	[redacted]	[redacted]	0.513	[redacted]	25.65/50
Rail	[redacted]	[redacted]	0.521	[redacted]	30.63/58.82
Turnouts	[redacted]	[redacted]	0.477	[redacted]	23.85/50
Ballast	[redacted]	[redacted]	0.5	[redacted]	10/20
Top 600	[redacted]	[redacted]	0.34	[redacted]	34/100
Roads	[redacted]	[redacted]	0.34	[redacted]	34/100
Fences	[redacted]	[redacted]	0.5	[redacted]	7.5/15
Track total	[redacted]	[redacted]		[redacted]	27.00/57.71[@]
Signals	[redacted]	[redacted]	0.5	[redacted]	10/20
Bridges	[redacted]	[redacted]	0.2634	[redacted]	26.34/100
Culverts	[redacted]	[redacted]	0.5	[redacted]	25/50
Earthworks	[redacted]	[redacted]	0.34	[redacted]	34/100
Tunnels	[redacted]	[redacted]	0.5	[redacted]	50/100
Land Acquisition	[redacted]	[redacted]	‡	[redacted]	‡
Telecom	[redacted]	[redacted]	0.5	[redacted]	10/20
Land	[redacted]	[redacted]	‡	[redacted]	‡
Power Systems	[redacted]	[redacted]	0.5	[redacted]	10/20
Total	**$845,973,468**	**$997,074,900**		**$427,032,254**[#]	31.12/69.82[@]

[8] This reflects revising down the aggregate DORC value for transport service contract (TSC) funding on the QCA's advice. We have not reviewed the level of TSC funding. We note the QCA has requested this change to ensure consistency with QR's estimate of opening asset value, which excludes TSC funded works.

[9] Where the configuration of the actual asset is a lesser standard than the configuration of the ORC asset, before any consideration of condition, such as timber sleepers with a 20 year life compared to concrete sleepers with a 50 year life

[10] Where the configuration of assets is materially different to that of MEERA a direct relationship can be established, in other cases it is implied in their replacement frequency

‡ Adjusted to value in Queensland Rail's 2013 DAU submission.
** Adjusted to incorporate a balancing adjustment from the EI report.*
˜ CPI adjusted figure provided by QCA
@ DORC weighted
 # this reflects a reduction in the aggregate DORC value by the amount of transport service contract payments from the Queensland government.

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Chapter 1 Maintenance Costs

1 Background Affecting Maintenance

The West Moreton System runs west from the edge of the Brisbane suburban network, across the ranges to Toowoomba and to Columboola, servicing the recently expanded coal province as well as general traffic such as grain and general freight plus a passenger service.

The Reference Tariff will take into account the proportion of the various traffics and while this evaluation of operating and maintenance costs will not directly distinguish between the various traffics, it will respond to the needs of the various traffic types and the way the maintenance has been formulated by QR.

QR has submitted various documents[11]. This review by B&H will consider these reports. In addition, B&H, together with officers of QCA and QR undertook a track inspection of the infrastructure in August 2013 and the observations of that inspection will also be taken into consideration.

Finally, B&H and QCA formulated clarification questions addressing items in the Maintenance Cost Submission to which QR responded with configuration details. Requests for condition data were not responded. A further meeting was arranged to discuss the timber sleeper strategy in detail.

[11] “WMRTR Maintenance Submission Final (Public)” (Maintenance Cost Submission) to QCA in support of their Reference Tariff submission and they have also submitted a review of the CAPEX and OPEX work programs over the Regulatory Period by their consultants WorleyParsons in “Queensland Rail - Attachment 4_Worley Report_Confidential(629497_1)” (the WorleyParsons report).

2 Maintenance Costs

2.1 QR's Approach

The Maintenance Cost Submission follows a fairly standard format, indicating major elements of the program, comments about the maintenance approach and summary tables of cost. Also some Performance Indicators of maintenance efficiency and efficacy are offered to indicate outcomes.

Following a desktop review of the submission by B&H and QCA a number of clarifying questions were submitted to QR in mid-2013. These are provided in Appendix 1.

It was hoped at the time that the WorleyParsons report, subsequently released in September 2013, would answer many of the questions, but unfortunately it did not. We have reviewed the WorleyParsons report and found that no comparisons were made with similar works in other jurisdictions. Evidence to support QR's unit costs was not provided in the report.

2.1.1 The Context of the QR Submission

The context of the methodology of QR is an important factor in considering the relevance of certain maintenance tactics.

The West Moreton System is certainly one of Australia's most challenging alignment and geotechnical railway lines. It was Queensland's first railway built in the mid-19th century. Consequently construction techniques and quality were likely to be much inferior to today's results on a greenfield[12] railway.

The West Moreton System has only recently seen coal demand of the magnitude it faces over the Regulatory Period, although coal has been a regular traffic since 1994. There is now an established coal export demand and long term contracts have been established. In contrast to earlier coal traffics, all coal is now exported and all coal travels over the problematic ranges between Toowoomba the Port of Brisbane and through the suburban area of Brisbane.

According to verbal advice from QR[13], transit through the metropolitan suburban area of Brisbane is not assured for the long term. This uncertainty has led to confusion about the standard of works required. On the one hand there is a very limited bridge replacement and improvement program, and on the other, an extensive concrete resleepering and heavy rail program. The overall strategy for the line has not been discussed in any of QR's documents.

Lastly, being a Queensland Government entity, QR is subject to government budget processes, which while not evident in any QR documentation as being a problem, will distract otherwise "commercial" efforts, or at least simply form another boundary condition to the strategy. QR's knowledge[14], for example, of the detail of recent

[12] A new railway
[13] Site visit August 2013
[14] At the site visit in August 2013

government announcements to increase the number of passing loops on the "range" and the implications for grain and other traffic and consequently the capacity for coal and the resulting maintenance availability is unknown at this time. After the site visit and in response to the Clarification Questions, QR has responded with details that indicate the new loops will not be included in the West Moreton RAB but the loops will be constructed for use by coal trains if needed. The loops are part of an Agricultural Freight Strategy.

These factors have resulted in an approach to maintenance by QR which is both corrective and improvement oriented. Maintenance tasks are opportunistic, applying improvements whenever budget conditions allow but at the same time scrambling to correct age old defects and more recent flood damage. Direct injection of funds by coal companies has been a useful approach to improve the infrastructure.

QR's overall strategy, as yet undocumented by QR, is to respond to the current and growing coal task, recover from recent damage, and to mend the infrastructure that has been inadequate for years[15].

This approach has lead QR to budget for various types of objective, some of which are operating costs and some of which are probably capital costs.

2.2 The QR Maintenance Cost Estimates

The table[16] in the Introduction of QR's submission[17] covering the Regulatory Period 2013/14 to 2016/17, shows total cost at broad discipline based levels, and repeated here in Table 3 with a calculation to provide some context on unit costs.

Table 3 QR's Total Maintenance Costs ($'000)

West Moreton Coal Maintenance	2013/14	2014/15	2015/16	2016/17	Total over Regulatory period	Calculated Annual Average Cost per track km (356km)
Track (excl. Mechanised Resleepering)	16,237	15,094	15,887	15,425	62,643	$43,991
Mechanised Resleepering	0	0	14,497	9,384	23,881	$33,541
Trackside Systems	2,300	2,288	2,271	2,250	9,109	$6,397
Facilities	144	150	156	162	612	$430

15 QR Network Access Undertaking (2009), Submission to the QCA – Western System Coal Maintenance Costs November 2008, Section 2

16 Unnumbered, called Total Maintenance Costs – AU1 reset period ($'000)

17 AU1 West Moreton Reference Tariff Reset Maintenance Submission, undated

West Moreton Coal Maintenance	2013/14	2014/15	2015/16	2016/17	Total over Regulatory period	Calculated Annual Average Cost per track km (356km)
Structures	2,004	2,001	2,315	1,951	8,271	$5,808
TOTAL	**20,686**	**19,533**	**35,126**	**29,172**	**104,517**	**$73,397**

We note that the extent of the West Moreton System to be maintained for coal traffic has increased from Macalister to Cameby Downs since the previous review in 2009, a distance of approximately 86kms. This is an old line now subject to coal traffic and its legacy is being addressed by QR in its submission.

The average unit cost shown in the last column of Table 3 are almost as high as the unit costs per track km for the Goonyella System which is approximately $80,000 per track km where 100 million tonnes or more are transported and with electrification assets.

It is immediately apparent that this railway is attracting work scope, accessibility or efficiency levels way in excess of industry norms. The question is whether these levels are reasonable in the context of the situation.

2.3 Breakdown Elements of Maintenance Cost

The Maintenance Cost Submission does not help much in understanding the quantum of costs applied to each activity in this category. In fact only Mechanised Resurfacing is afforded the detailed breakdown. Clarification questions were asked of QR as detailed in Appendix 1.

The WorleyParsons report Table 9 gives some insight into the breakdown of costs in the Track discipline although only 70% of the total cost is included in the analysis. The maintenance items[18] called “Track Structure Management: Mechanised Resleepering” and “Track Structure Management: Mechanised resurfacing” make up 40.7% of the total maintenance budget, including Signal Maintenance and all other types. It is not said how the analysis was performed and there is opportunity for gross misinterpretation of their results because only years 2015/16 and 2016/17 have a Mechanised Resleepering activity. But on the basis that the calculations were made for the aggregated period, Table 4 indicates the breakdown implications using the Table 9 WorleyParsons analysis[19].

[18] This is a deliverable from a maintenance activity expressed in the number of kilometres or number of units completed and referred to as a Product by QR

[19] Despite only 70% of the total cost being identified

Table 4 Maintenance Cost Elements ($'000)

No	Product	Percentage from total maintenance task of $104,517,000	Total Cost over 4 years[20] ($'000)
1	Track Structure Management: Mechanised resleepering	23%	$24,039
2	Track Structure Management: Mechanised resurfacing 17.7%	17.7%	$18,500
3	Structures Management: Major repairs timber bridges	5.5%	$5,748
4	Preventative Signalling Field Maintenance	5.1%	$5,330
5	Off track maintenance management: Fire and vegetation control	4.7%	$4,912
6	Major Earthworks – non-formation & formation	3.27%	$3,418
7	Maintenance ballast	2.7%	$2,822
8	Rail grinding (mainline & turnouts)	2.65%	$2,770
9	Top & Line resurfacing	2.4%	$2,508
10	Major rail joint elimination	2.3%	$2,404

In as much as the quantum for Mechanised resleepering is approximately equal to the total indicated in Table 3 for that activity, we can assume the analysis by WorleyParsons was an aggregated approach. Of the estimates provided for Track (exc Mechanised Resleepering) only $37,334,000 of the $62,643,000 can be reviewed, since neither QR nor WorleyParsons has provided any breakdown.

Observations from Table 4 are indicated below.

2.3.1 Item number 1 - Mechanised Resleepering

The Maintenance Cost Submission makes no explanation of this activity which is puzzling given it constitutes the single largest component of maintenance costs. The WorleyParsons Report evaluates a unit cost for resleepering.

We originally believed from the site visit[21], but not from any documentation, that the resleepering strategy in the maintenance program consisted of replacing all of the current sleepers, in a contiguous face, with new concrete sleepers. This impression was

[20] Using the WorleyParsons breakdown which uses rounded percentage numbers resulting in a slightly different result to the direct comparisons in Table 3

[21] Site visit August 2013

given because of the high unit rate for resleepering and the absence of the explanation that was to be revealed at a later time and detailed below.

Alternative strategies for sleeper replacement have not been documented. The WorleyParsons report indicates that the (timber) resleepering program is based on a 5% deterioration rate which corresponds to a life of 20 years. Our view is that this is a conservative assumption because when intermittent with steel sleepers, on a patterned basis, timber sleepers have been found to exhibit much longer lives[22] than when in track solely. This is because the steel sleepers hold the track rigid and the timber sleepers are protected from adverse load.

Only one alternative to Capex concrete resleepering was discussed during the August 2013 site visit and no other documentation is evident to discuss or justify the strategy, nor was the subsequently revealed steel and timber strategy in the maintenance program made apparent. The discussed alternative was the replacement of timber sleepers with steel sleepers so as to make for a continuous steel sleeper pattern. The current pattern consists of 1 in 2, 1 in 3, or 1 in 4 steel sleepers.

This steel sleeper strategy was believed to have shortcomings in that the steel sleepers had not had enough "weight", that they were not stable laterally in all circumstances and that their fastenings were not suitable for the 50kg/m rail that would eventually replace the current 41kg/m rail. In fact it was said that "one can't buy 41kg/m rail anymore" but we note that the OneSteel catalogue[23] plainly exhibits 41kg/m. Purchase from OneSteel in any event is not necessarily required as alternatives exist from overseas.

As well, given the constraints already indicated with access for coal trains through the Brisbane metropolitan area, continuation of a 15.75 tonne axle load regime on account of the massive task to replace bridges and poor formation conditions as well as the practical constraints of 10 year maximum agreements with coal miners, we question the need to use other than 41kg/m rail, especially on the relatively light tonnage projected[24] for west of Jondaryan or certainly beyond Macalister[25]. On the Kalgoorlie to Esperance line, Brookfield Rail has been successfully passing 23 tonne axle loads over 80lb/yd rail at the rate of 8 million net tonnes per year for the last 15 years. Moreover, this tonnage, with this axle load on this rail was satisfactorily performed on 100% steel sleepers, albeit with better formation conditions. It has recently been rerailed in 50kg/m rail in response to increasing tonnage and speed levels.

As to the unit cost rate of resleepering, WorleyParsons reports[26] that "42,743 sleepers replaced for $14,497,000" and "26,629 sleepers replaced for $9,384,000" corresponding to the two years in the Regulatory Period where Mechanical Resleepering will occur. These equate to a rate of $339 for 2015/16 program of timber sleeper replacement and

[22] Syers, J. (1993), Performance of composite steel-timber sleeper track structure, The Permanent Way Institution, Journal, The Permanent Way Institution Journal and Report of Proceedings, Part 1, Vol. 3, pp.58-70, Brisbane, Aust.
[23] http://www.onesteel.com/images/db_images/productspecs/Rail_Track_Material_Catalogue_A5.pdf
[24] Section 4.4 AU1 West Moreton Reference Tariff Reset Overall Submission
[25] Railings from the Macalister were suspended during the course of this review
[26] Section 6.3.2 AU1 West Moreton Reference Tariff Submission Review, 5th September 2013

$352 for the 2016/17 program. WorleyParsons indicates that “the costs for these works are within an expected industry range for similar type activities”, but no evidence is offered for comparison or the activities elaborated.

At the QCA meeting with QR on 12th February 2014 an explanation was provided by QR as to why the unit rate appeared to be so high in comparison to rates experienced in Victoria, ARTC and Western Australia[27]. Other works are performed alongside the resleepering such as drainage improvements, access road improvements and cutting widening. QR stated that it prefers to see the area “fully completed” when resleepering is performed.

Our view is that approximately $200 of the unit cost indicated is a resleepering cost. The identification of a budget item that incorporates all sorts of other activities does not assist in understanding the strategy, its reasonableness or whether activities are opex or Capex. These activities may well be justified and should be identified as such.

The unit costs also are inconsistent with the locations where the sleepers are to be deployed since on the empty train “Up” line where they are to be used in double track sections between Rosewood and Toowoomba, the insertion of concrete sleepers on the “Down” line would have incorporated the extra works at the time of their insertion. Further, the location of insertion of timber sleepers on single line correspond in part to locations west of Oakey which is flat country with most of the track on an embankment and in which little extra work should be required. We believe QR will not expend the budget proposed on the resleepering scope. The annual report required by the QCA is an opportunity to report on the actual activities and their cost.

The resleepering on the Willowburn Loop programmed for 2016/17 comprises 4,500 timber sleepers. No data was provided by QR in the information request to detail the configuration, whether timber or steel or concrete sleepers.

The loop is 3.361kms in length according to QR’s network schematics. At 1,550 sleepers per km a total of 5,210 sleepers are in the loop. It is unclear why there is a need for a substantial replacement or whether other works are included in the scope.

We recommend the replacement of timber sleepers with steel sleepers to provide 100% pattern beyond Jondaryan with appropriate formation attention and ballast rehabilitation which would provide the opportunity to weld out all the joints on the 41kg/m rail. This may require better management of rail stress and ballast compaction on the steel sleepers. We recommend the replacement of the older sections of 41kg/m[28] rail with like for like 41kg/m rail.

It is clear however that particular sections of line will require heavier quality track where formation issues are not able to be managed because of underlying conditions. We support the Capital item “Relay Program (Oakey – Jondaryan)” where particular attention

[27] “Maintenance Costs for Grain Branch Lines in NSW”, Consultant_Report_-_Sapere_Research_Group_-_Maintenance_costs_for_grain_branch_lines_in_NSW_-_FINAL_report_to_IPART_-_April_2012.pdf, with references

[28] Which is most probably older 80 lb/yd (we have not been given that detail) pre-metric size

is targeted at problem areas and we have commented on this program in the Capex review.

The timber resleepering proposed in 2016/17 for the Toowoomba to Jondaryan section is another example of unexplained and confused strategy. Hitherto, QR has indicated a desire to provide robust concrete sleepers for the heavier used section of the system Rosewood to Jondaryan on the “Down” line and single sections. But after the 4kms of concrete resleepering planned for Oakey to Jondaryan as part of the capital program, a further 11kms of steel/timber sleepers remain. This is the portion where 4,877 timber sleepers will be replaced in 2016/17.

All of the non-concrete sleepers in the Oakey to Jondaryan section are 1 in 2 steel/timber configuration. At approximately 1,550 sleepers per km, approximately 8,500 are timber sleepers and the same amount steel in this section. Thus more than 1 in 2 of the timber sleepers will be replaced probably resulting in a near new configuration. According to QR[29] this length of track will be concrete resleepered in a relatively short timeframe with the steel and timber recycled so that it too will be “compliant” with the overall policy of providing for concrete sleepers in this section. That would seem to be excessive.

Our concern is whether it is economical to carry out this program and not completion of the concrete resleepering if track stability and robustness are of great concern? While the concrete sleepers are a capital expense, the planned strategy of replacing the timber but then in a short period later, replacing the entire track with concrete sleepers must belie a proper NPV analysis.

The 4,877 timber sleepers to be replaced will cost $1.7m while a complete concrete resleepering of the remaining 11kms from Toowoomba to Jondaryan will cost approximately $4.3m when costed at a unit rate of $250. This rate is commensurate with a one for one[30] replacement but we note QR’s estimate is in the region of $580 per sleeper ($900,000 per km) when many other works are undertaken. These “other” works include formation repair and reballasting and is based on previous experience where we assume the conditions were worse as to warrant priority attention. In addition, when the steel sleepers are recovered their opportunity value will be approximately $1m at a unit value of $120 per sleeper. We note that 4,877 sleepers represents approximately one half of the timber sleepers in this section so this current resleepering strategy is not a stop gap measure pending concrete sleepers. However, QR have indicated[31] that their intention is to concrete sleeper this section in the near future, perhaps in the next Regulatory Period. Therefore, despite the fact that on an immediate cash flow basis there is value in performing timber resleepering rather than concrete resleepering, the economic strategy is not as plain and is not apparent in any consideration of alternative strategy. It is the absence of alternative strategy that is our concern.

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[29] Meeting of QR and QCA 12th February 2014
[30] Sleeper replacement only, one concrete for each and every steel and timber sleeper
[31] Meeting of QR and QCA 12th February 2014

We note WorleyParsons observation that "*It is clear that Queensland Rail is working towards a mainline standard of 1067 mm gauge, 50kgm rail on concrete sleepers* [32]". We support this conclusion but it is not a direct observation from any QR document. We support this strategy in view of the poor condition of the formation but there is little explained logic and transparency in QR's submission, nor is there consistency in application or alternatives considered.

In relation to the unit cost of timber resleepering we recommend an adjustment to the mechanised resleepering estimate to reflect a unit rate of $200 per sleeper. That would adjust the QR proposal for Mechanised Resleepering downwards by approximately 43%. If other works are required then QR should provide for capex justification if they are improvements to the asset or should submit further maintenance work estimates categorising those works and indicating why they are maintenance rather than capex.

2.3.2 Item number 2 - Mechanised Resurfacing

This item is different from spot resurfacing. Spot resurfacing may be achieved using either manual or mechanised means[33] and responds to track geometry defects and therefore is a corrective rather than preventative method of bringing the geometry back to a near new standard. Section 6.3.3 of the WorleyParsons report appears to indicate that Mechanised Resurfacing is performed in response to defects, as a corrective response, but since a separate activity known as "Spot Resurfacing" has been created, Mechanised Resurfacing is not likely to be corrective but rather associated with wholesale preventative[34] geometry adjustment. We have reviewed Spot Resurfacing at section 2.3.9.

Over the 4 year Period, a total of 1225 km and 183 turnouts are to be resurfaced[35]. This is the equivalent of each kilometre of track for each year being resurfaced in addition to spot resurfacing. It was observed[36] and reported in the WorleyParsons report that the turnouts are in good condition with the exception of some lightweight turnouts between Toowoomba and Columboola, of which 16 will be replaced in a Capital program during the Period. The use of 60kg/m swing nose turnouts for 15.75t axle load is in any circumstance excessive as this weight of rail is usually applied to 25t and greater situations. It is understood[37] that a previous state wide policy related to coal systems, was responsible for this decision. Future new turnouts are to be more modest. The current resurfacing requirement for turnouts is minimal and represents only one turnout per week over the Period.

The average Mechanised Resurfacing cost per kilometre is $12,000 per km to $15,000 per km according to the WorleyParsons report[38] and our own calculations. This item is

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[32] Page 47 WorleyParsons report
[33] Table 6.2 of QR's Maintenance Cost Submission
[34] The track geometry has not reached the condition of being a defect where a speed restriction needs to applied but is showing evidence that it will reach this condition in a short period
[35] Tables 6.3 and 6.4 of the Maintenance Cost Submission
[36] Site visit August 2013
[37] Site visit August 2013
[38] Table 10, taking 1 turnout to be equivalent to 1 km of track

not "single pass tamping" where a resurfacing machine (called a tamper) proceeds progressively to eliminate track geometry with a single treatment which is what could be expected with preventive geometry tamping. At this rate, which is approximately triple the usual "maintenance tamping" industry rate, the machine is performing multiple passes, probably lifting the track at 50mm each time, essentially to create a new "top of ballast" bed and is commensurate with the large amount of ballast being used, commented elsewhere.

Using the unit costs as a guide, this activity would appear to be associated with preventative track rehabilitation. It uses maintenance resources and performs preventative geometry adjustment and improvements in ballast depths at the same time.

2.3.3 Item number 3 Structures Management: Major repairs timber bridges

The use of the word "major" in this category would indicate that the activity is where a large effort is required, possible possessions and component replacement but to result in the same functionality for the structure. Inspections of bridges and minor work would be expected in routine maintenance and inspections for which no information from either the QR Submission or the WorleyParsons report is available.

2.3.4 Item number 4 - Preventative Signalling Field Maintenance

This category is mainly concerned with inspections and cleaning with minor repairs to cabinets and replacement of rotables[39] and defective parts such as lights. There is no improvement to functionality resulting from this activity.

2.3.5 Item number 5 - Fire and vegetation control

This activity is a manually intensive activity taking nearly 1 in 20 of the entire resources to maintain the line. This perhaps is not surprising given the country and the acute awareness in agriculturally sensitive regions of the potential damage that can occur from fire, but also to continually facilitate access to the track for maintenance.

2.3.6 Item number 6 - Major Earthworks – non-formation & formation

This item does not appear to relate to usual drain clearing type activities that occur in a routine manner. WorleyParsons reports "*This item includes the renewal of the top 600mm of the formation, installation of drains and track reinstatement (inclusive of any welding and resurfacing associated). It does not include CAPEX formation renewals which include the total removal and repair of long lengths of section formation inclusive of geotechnical design and often to a greater depth than the top 600mm*".

The definition of "long lengths" is not clear from any of the documentation but appears to respond to sections of line that have had particular drainage problems, perhaps associated with black soil or other drainage structure such as culvert of bridge. It is probably symptomatic of the original construction standards but in any event the

[39] Small items that are refurbished in a workshop and returned to replace other similar items with the activity occurring on a regular basis.

formation is not up to standard for this type of traffic. The reconstruction standard adopts a 20 tonne axle load type standard[40], with “top 600” replacement and 50kg/m rail.

There appears to be a clear strategy to improve the functionality of the drainage and earthworks by way of improving its reliability to bring it up to the standard needed for the coal task in particular. In other railways this type of activity would be classified as Maintenance Capex, with expenditures so great as to attract capital treatment, but “maintenance” in the sense is that it has not upgraded the whole length of track or significant portions so as to increase the capacity of the network.

We recommend that the QCA carefully monitor the scope of these services to ascertain the exact nature of the scope so that future treatment of these expenditures can be appropriately allocated.

2.3.7 Item number 7 - Maintenance Ballast

This item would usually relate to the distribution of ballast when maintenance spot tamping/resurfacing occurs or where for reason where the ballast shoulder is inadequate, called “top-up”.

The sum identified, $2,822,000 over 4 years would purchase 141,100 tonnes or 70,000 cubic metres of ballast at a rate commensurate with the 2009 draft decision and ORC calculations. This amount is sufficient to construct approximately 60 kms of new track (1100 cubic metres of ballast per km) or approximately one fifth of the length between Rosewood and Columboola/Cameby.

It is doubtful that this amount of ballast would be used for just topping-up. However, it is also unknown in the submission or the WorleyParsons report as to whether this cost also incorporates travel and distribution costs that would occur with QR rollingstock and QR track labour.

Being an individual item as such, and such a high proportion of the overall cost, our interpretation is that this is ballast associated with mechanised resleepering and other preventative rehabilitation works.

2.3.8 Item number 8 - Rail Grinding (mainline & turnouts)

This item is a regular and necessary function to retain the rail in a fit condition. It is preventative in nature in the majority of situations but can also be used to recover badly damaged rail to its original function.

2.3.9 Item number 9 - Top & Line resurfacing

This item is identified in both the WorleyParsons report and in QR’s 2013 submission, as spot resurfacing in a corrective manner by either manual or mechanical means and is designed to bring the railway back to its original functionality.

It differs from Item 2 in that it is undertaken as a response to a single or clustered set of defects that are likely or have required speed restrictions. If the formation was of Modern

[40] The type of 20 to 25 tonne range reflecting the 50kg/m rail, concrete sleeper and formation combination

Engineering Equivalent Replacement Asset (MEERA) quality there should be little need for anything other than corrective resurfacing perhaps undertaken on a programmed basis. However in QR's West Moreton system it appears much more major work is required in addition to corrective resurfacing as indicated in Item 2.

2.3.10 Item number 10 - Major rail joint elimination

This item is a progressive program to eliminate as many joints as possible to avoid joint maintenance requirements and is sensible when a railway is attempting to respond to increasing pressure of tonnages and performance enhancement.

2.4 Track (excl. Mechanised Resleepering)

This particular item in the QR Maintenance Cost Submission has little breakdown but represents 60% of the total cost, of $62,643,000,

We have observed in Section 2.3 a number of elements of this cost and these are shown in Table 5 as being derived from those observations.

Table 5 Derived Cost Elements of Track (excl. Mechanised Resleepering) ($'000)

Cost Element	Regulatory Period (4 Year Estimate) $'000	Comment
Track Structure Management: Mechanised resurfacing	$18,500	Associated with preventative geometry and ballast strengthening or major rehabilitation
Off track maintenance management: Fire and vegetation control	$4,912	Usual activity
Major Earthworks – non-formation & formation	$3,418	Recovery or improvements to provide reliability of infrastructure
Maintenance ballast	$2,822	Associated with major programs of work but particularly mechanised resurfacing and ballast strengthening activities
Rail grinding (mainline & turnouts)	$2,770	Usual activity
Top & Line resurfacing	$2,508	Usual activity associated with corrective action
Major rail joint elimination	$2,404	For improvement to reliability and reduction of maintenance

Cost Element	Regulatory Period (4 Year Estimate) $'000	Comment
Total Derived from above elements	$37,334	Represents 60% of “Track (excl Mechanised Resleepering)” (Total $62,643)

Table 5 has itemised 60% of the maintenance category “Track (excl Mechanised Resleepering)” and identified what would mainly be called Major Program Maintenance activities. The remainder of that activity is likely to consist of inspections and small manual jobs carried out by track gangs.

QR in its submission has identified some of those activities and explained the rationale for inspection frequencies. These activities are reasonable in a railway with this task and estimate of costs of approximately $25m over the Regulatory period is reasonable.

In the list in Table 5 only WorleyParsons “top-10” have been identified but other activities likely to be included are:

- Ultrasonic rail inspections
- Track geometry inspections
- Hi-rail and walking inspections
- Joint maintenance
- Bridge inspections
- Call out for failure of track or signalling system including level crossings
- Level crossing maintenance including road patching
- Fence maintenance
- Access road maintenance
- Assistance to other authorities
- Clearing culverts and bridges
- Minor rerailing or the maintenance of joints
- Top up ballasting for spot resurfacing or deficiencies
- Turnout maintenance of fastenings (Signal teams usually look after the mechanisms)

All of these items are “routine” in nature.

3 Maintenance Approach Implications

In QR's apparent strategy of progressive improvement to provide a fit for purpose railway, and notwithstanding the particular standards used in achieving this objective, there are certain activities in the maintenance schedules that are characteristically "improvements".

Whether they are improvements to permit higher axle load, speed, reliability or maintainability, they are nevertheless designed to improve the quality of the infrastructure so that it is fit for the purpose in terms of tonnage and train path frequency that the railway is being called upon to perform.

We conclude that the railway is not yet fit for purpose on the basis of some of the activities suggested in the program.

These activities are, over the 4 year Regulatory Period

Mechanised Resleepering	$24,039,000
Mechanised Resurfacing	$18,500,000
Major earthworks	$3,418,000
Maintenance ballast	$2,822,000
Major Rail Joint Elimination	$2,404,000
TOTAL of these activities	$51,183,000 (based on WorleyParsons' analysis)

This amount is approximately half of the total amount indicated in QR's Submission.

These activities are a measure of the degree to which the railway is not yet fit for purpose and while they are necessary to achieve QR's objectives, they indicate the deteriorated state of the assets in comparison to the requirements of the task.

In this review we have sought only to adjust the Mechanised Resleepering on a more "like for like" approach by adjusting the unit rate for the activity. Therefore using QR's proposed amount of $23,881,000, this item is estimated as $13,874,400, a reduction of $10,006,600.

Other items, while being noted as bordering on "improvement" candidates, and therefore capex in nature, are not recommended for adjustment pending close monitoring of the scope for future Regulatory Periods.

4 Efficiency of QR's Track Maintenance Practices

The identification of certain so-called maintenance items as being "improvement" in nature in the preceding section has not been to suggest that the activities will be performed inefficiently. In this section we will review the activities for their efficiency. Only those identified in section 3, but nevertheless making up the majority of the expenditure, will be reviewed. In this section we have used the data in the spreadsheets provided by QR in response to the information request shown at Appendix 1. We have been informed[41] that the data represents the situation in approximately mid 2011 and therefore is 2 to 2½ years old at the time of this report.

4.1 Mechanised Resleepering

In section 2.3.1 we confirmed that this activity ostensibly referred to timber resleepering, but that during clarification with QR was also revealed as including other works such as drainage, cutting widening and access road maintenance. These other works were in addition to the other programmed activities that are part of maintenance for the whole length of the railway and which are separately identified.

There appears to be a genuine strategy of making sure that when resleepering is performed the whole of the asset to the width of the corridor is left in a very good state and that the time to perform this other work is during the time of resleepering when the track is under possession and other QR resources are present.

If the work needs to be done then there is sense in combining it with the resleepering activities and making use of some economies of scale. However if the work could be delayed then the asset is being over-serviced. Clearly there is a balance in these two objectives and it is not possible to understand the trade-offs without being "on the ground".

In terms of the forward program however it is possible to indicate some abnormalities. Firstly, in the sections of line where there is dual track, one could have expected these other works to have occurred when the concrete sleepers were inserted on the "Down" line. Secondly, west of Toowoomba, where most of the timber resleepering is to occur, the corridor conditions are less onerous than east of Toowoomba and little extra work should be required.

It is likely that the estimates have been generated using experience of past resleepering in more difficult situations, on the Toowoomba Range or elsewhere, and that they are inflated above that needed. Our estimate is that resleepering is approximately $160 to $200 per sleeper and this compares with QR's estimate of $320 to $350 per sleeper.

We are also aware[42] that the QR estimate includes a "Corporate Charges" factor. We are concerned that some double counting may be evident. In any event our estimate of a like

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[41] Meeting QCA and QR 12th February 2014. QR is moving to a new asset management system and data has not been uploaded since that time.
[42] Meeting with QR 12th February 2014

for like timber resleepering unit cost of $200 is reflective of reasonable overheads and any adjustment for “Corporate Overheads” has been taken into account in our estimate.

In conclusion we believe the sum of $13,702,000 is a reasonable estimate for the resleepering scope proposed.

4.2 Mechanised Resurfacing

In section 2.3.2 we noted that the quantity of resurfacing was equivalent to treatment of every kilometre of the system every year, and also at a very high unit cost rate.

We have previously concluded that the high unit cost rate points to the activity being associated with multiple passes and large lifts of the track which are normally associated with track strengthening.

Ordinarily, the high total and unit cost of maintenance resurfacing shown in QR’s budget would point to severe problems with vertical and horizontal stability, perhaps as shown in black soil country receiving high tonnage. Coupled with the high consumption of ballast our conclusion is that ballast depth increase as well as preventative resurfacing requires multiple machine passes.

This strategy uses maintenance resources applied at an intensive rate and this is necessary because of underlying weaknesses in the formation and earthworks generally. It is an upgrade of the track structure which is not quite at Capex proportions but is designed to strengthen the track structure for the task on a weak sub-structure.

We conclude that QR’s proposed estimate for Mechanised Resurfacing of $18,500,000 over a 4 year period is reasonable but that since the quality of the sleepers and ballast are being improved by way of the capital program as well as timber resleepering, one could expected a large reduction in the next Regulatory Period of approximately half that total.

4.3 Major Earthworks

This activity is associated with non-formation repair and strengthening and is typified by the challenges present on the Liverpool Ranges. It is an outsourced activity and designed to provide a robust foundation for the track as well as provide for access for maintenance purposes.

We have no issue with the need for the work, nor its efficiency given its outsourced delivery, but it is testimony to the parlous state of the formation and drainage and its significant cost is at least a measure of the dilapidated asset which appears not to have been designed and built for the purpose and conditions at hand and projected.

The large budget of 3.27%[43] of the total maintenance cost of the system is reflective of the inability of QR to adopt the current Aurizon strategy for earthworks which is “fix-on-fail” given in its recent April 2013 Submission for UT4[44] because failure of the formation would likely close the track for days and failure under a passenger train is unacceptable.

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[43] Typically less than 1%

[44] UT4 Maintenance Submission 30th April 2013

We conclude that QR's formation, its access roads and drainage are substantially life expired on this railway but that QR's proposed estimate for Major Earthworks of $3,418,000 is reasonable.

4.4 Maintenance Ballast

We have commented in section 2.3.7 that the ballast quantity budget by QR for the Regulatory Period is sufficient to reconstruct one quarter of the full length between Rosewood and Columboola. This is not representative of maintenance ballast but more of reconstruction of large parts of the system. It aligns well with the large resurfacing effort and the resleepering which involves the complete reconstruction of the track.

We conclude that the Maintenance Ballast budget is indicative of the fact that the line is not fully fit for purpose and that further work is required to bring it to a standard where normal maintenance expenditure would stabilise its requirements.

Along with the Mechanised Resurfacing and the Mechanised Resleepering we estimate that approximately 39% of the track structure between Rosewood and Jondaryan is not fit for purpose, given its need to be of heavy duty in nature due to the substantially life expired formation. This will be reflected in the DORC estimate.

We conclude that QR's proposed estimate for Maintenance Ballast of $2,822,000 for this Regulatory Period is reasonable but ballast of these quantities should not be required once the concrete resleepering in the capex program and the timber resleepering are concluded.

4.5 Major Rail Joint Elimination

This activity is designed to bring the configuration of the rail to that suitable for heavy haul operation and reliability. The elimination of joints reduces maintenance and improves safety by eliminating the weakest part of the track structure. This results in an improvement of infrastructure reliability.

As such we conclude it is an improvement activity, where the usual MEERA configuration, even for the low tonnage projections west of Jondaryan, would require fully welded standards. While the existing QR standards permit joints in rail, these standards indicate minimum positions, and not one that relates to the reliability needed for coal traffic of the type on the West Moreton system.

The activity is evidence that the track infrastructure is not at MEERA standard, that it is below the standard required of the traffic and that the DORC should be adjusted to reflect the fact as we have done so in that Chapter of this report. The expenditure is not capex because the effect on reliability or capapcity of welding a relatively small number of joints is so minimal as to be immeasurable. Nevertheless it is good practice and over time will assist in the reliability of the infrastructure.

Since QR has not provided details of joint locations and numbers of joints in their response to our information request and we have no information as to the location of the program of joint elimination we have assumed that a proxy for the need for joint elimination and the configuration of the rail is the amount of 41kg/m rail remaining in the track. We assume the joint elimination is on the 41 kg/m rail because there is no obvious reason why new 50 kg/m rail would be installed with joints especially given the majority of the 50 kg/m rail is located on concrete sleepers which provide more than enough stability[45].

In Table 6 the length of 50 kg/m rail on curves and straights in the system is shown. Between Rosewood and Columboola approximately 43% of all track, concrete sleepers or not, is railed with 50 kg/m rail, 57% is not. The use of 50kg/m rail closely follows that of concrete sleepers, although not universally.

Table 6 Existing Use of 50kg/m Rail

	Curve length Track km	Straights length Track km	Total length Track km	50kg/m rail on curves Track km	50kg/m rail on straights Track km	Total 50kg/m rail Track km
Rosewood to Toowoomba	65.527	92.572	158.099	47.553	33.027	80.58
Toowoomba to Jondaryan	10.869	34.722	45.591	5.739	2.08	7.823
Jondaryan to Columboola			152	0	0	0

If QR needs 50kg/m rail to improve the strength of the track to compensate for the poor strength of the formation then 57% of the rail structure is not fit for purpose. The elimination of joints on the 41kg/m rail is an indication of this shortfall and the presence of a joint elimination program is evidence of the lack of fitness for purpose.

QR's 41kg/m rail is a proxy for this shortcoming and which represents 115 kilometres of track between Rosewood and Jondaryan for which the DORC should be substantially life expired and will be reflected in the estimates for DORC.

We conclude that QR's proposed estimate for Major Joint Elimination of $2,404,000 over the 4 year period is reasonable for maintenance expenditure but that the program is evidence that the DORC will need to reflect the deficiencies of the configuration against the MEERA standard.

4.6 Review of Structures Maintenance

With 109[46] timber bridges to maintain, the workload for the timber inspection and spot maintenance is substantial. During the 4 year Regulatory Period 13 bridges have been targeted for renewal or upgrade of major components (strengthening). Seven Timber and Steel Bridges will be replaced with Reinforced Concrete Box Culverts. This make a

[45] Joints in a railway are normally associated with lightweight sleepers unable to stabilise the track in extreme temperature, hot or cold, where in hot times the track buckles and in cold times the rail "pulls in" on curves. Elastic fasteners on concrete sleepers hold the rail longitudinally to prevent movement which leads to buckling or pulling.

[46] under the maintenance responsibility of QR. Other overbridges are maintained by local authority

total of 20 bridges that will receive major work, essentially to bring them back to as new functionality. At this rate it will be 2037 when the last of the timber bridges is replaced, but it is unlikely that the timber bridge in the best condition today will last that long under the coal traffic. Hence the workload to maintain the bridges will rise and the current rate of replacement is not sustainable.

We note a drop in structures maintenance at the end of the Period and we question why that might be appropriate as although 20 of the 109 bridges would have been renewed a further 89 timber bridges would have received another 60 million gross tonnes[47] with the inherent vibration and movement.

The maintenance budget is approximately $2m per year. This is sufficient funding for 15 to 20 persons with material to inspect and repair the timber bridge inventory. Some expenditure will occur through manufacture of components, the purchase of timbers or components as well as specialist concrete or steel bridge material.

Allocating $2m over 109 timber bridges provides for approximately $2,000 per bridge. A bridge inspection will take 2 persons one half a day (1 man day) at a cost of approximately $1,500 with truck and equipment and engineering interpretation. A simple inspection will be performed each year and more detailed substructure inspection every 5 years. Therefore inspection cost of timber bridges alone is a significant component of the total allocated cost at approximately 50% of the budget.

Steel and concrete inspection and repairs are also undertaken but it would appear that the timber bridges take the bulk of the budget.

We are concerned that the estimates for the bridge maintenance drop during the Regulatory Period and that they appear to be only just sufficient for a short term program of maintenance. We suggest that any “surplus” of resleepering or resurfacing budget as we believe there will become evident, be placed into bridge maintenance to avoid speed restrictions that will be needed as the bridges deteriorate.

We conclude that QR’s proposed estimate for Structures Maintenance of $8,271,000 over the 4 year period is reasonable.

4.7 Review of Trackside Systems Maintenance

The Trackside Systems Maintenance detail in the Maintenance Submission permits a high level of scrutiny in work allocation and activities.

We note that of the $2.2m budget each year, approximately $2m is provided for labour. Maintenance activities for signalling equipment and telecoms equipment in mainly composed of inspection, cleaning and small component replacement which is labour intensive.

The $2m labour expense would account for approximately 15 to 20 persons. There would be regular programmed inspections for each component over the 300km length of

[47] 4 years of 16 MGT approximately

route and there would be callouts after hours to attend incidents and rectify faulty components. In addition there would be attendance at track maintenance activities where an electrical trade's person is required.

A benchmark for comparison is the Newlands System, which while not as long as the West Moreton System has similar levels of traffic and similar total maintenance costs.

Both systems[48] show total costs of approximately $20m, not including resleepering, and Trackside System costs of approximately 10% of the total.

While Newlands does not have the length of the West Moreton System, its concentration of signals equipment is greater, particularly in comparison with the Toowoomba to Columboola section.

Therefore we conclude that the Trackside Systems Maintenance cost estimate provided in QR's submission of $9,109,000 over the 4 year period is reasonable.

4.8 Review of Facilities Maintenance

Facilities maintenance is concerned with the maintenance of QR offices and depots and represents a very small component of total costs.

Whether gang amalgamation and/or relocation of depots would provide efficiencies in facilities operation and maintenance has not been investigated in this review. These would be the avenues to investigate but due to the cost materiality this review has not sought to provide a reorganisation review.

For the estimates suggested only minor repairs are planned on the facilities and therefore we conclude this level of maintenance, estimated by QR of $612,000 over the 4 year period is sustaining maintenance only and is therefore reasonable.

[48] The West Moreton System is longer in length

5 Formation Remaining Life

This chapter is concerned with an evaluation of the maintenance cost submission by QR. However, we have found that much of the maintenance work is associated with compensation for a deteriorated formation.

In this section we briefly review the status with regard to the deterioration of the formation and in a later chapter will look at the treatment with regard to its DORC status.

QR has already paid much attention to the formation of the West Moreton system, which appears to be the most problematic asset, causing the most on-going distress and cause for unreliable train running.

Since 2007 QR has expensed capital monies relating to the formation into:

- Columboola to Port of Brisbane Upgrade including $6,780,000 into “cuttings” and “embankments” amounting to approximately 11kms of formation repair using the unit cost from the AU1 Submission.
- Jondaryan Upgrade including $1,686,507 on “track reconditioning” amounting 2,310m as well as 2,850m of “formation stabilisation”
- Western System Asset Replacement includes 21.865km of “track reconditioning”.

We assume that where “track reconditioning” has occurred, that this has been undertaken on areas that do not need formation repair and that for the most part these areas have been fully restored to their function.

In the AU1 submission the following is planned:

- $8,063,000 on “slope stabilisation”, amounting to approximately 8km (our estimate) of equivalent track formation functional re-establishment
- 20kms of “formation repair” at 5kms per year. The proposal indicates that “*It is forecasted that 5km per year will ensure defect growth is less than repair works”. This work program is expected to continue past 2016/17*.

For these works we assume that “slope stabilisation” will also bring the formation (which includes cutting and embankments) to restored function.

The Rosewood to Columboola Line route is approximately 300kms in length.

The work performed from 2007 to 2012 amounts to 38 kms of track which is, in the context of formation life, new.

The work to be performed 2013 to 2017 amounts to approximately 28kms of line, which is, in the context of formation life, fully life expired.

In addition a further 5kms per year of formation repairs is likely into the foreseeable future. The completion of the program would take 51 years.

If a program of 5kms per year is indicative of the need for formation repair then the average life remaining, using 100 years as the nominal formation life is 34 years taking into account the work already performed and that planned in the next Regulatory Period.

That is, the asset is life expired to 34% of its new value.

6 Maintenance Cost Benchmarking

In order to carry out a benchmarking exercise we have eliminated the reinforcement or refurbishing components of the budgets to compare on a like for like basis other operations in the Australian context that are not undergoing the gradual Capex and maintenance improvement process that is underway on the West Moreton System.

We have concluded that for the 4 year period, $51,183,000 of the $104,517,000 budgeted in the maintenance program is for some type of improvement of the existing infrastructure and therefore one could expect more usual budgets, post major work, in the region of $60m to $70m for the 4 years in long term steady state maintenance. There will always be some heavy maintenance even for the steady state situation.

The system's operating statistics are that the network comprises 356 track kms transporting 2.810 Bgtk[49].

Recent benchmarks will provide some reference points for the QR estimates and these are summarised in Table 7 with previous years' estimates escalated by CPI. The benchmarks are for non-electrified lines with varying tasks.

Table 7 Maintenance Benchmarks (June 2013 $)[50]

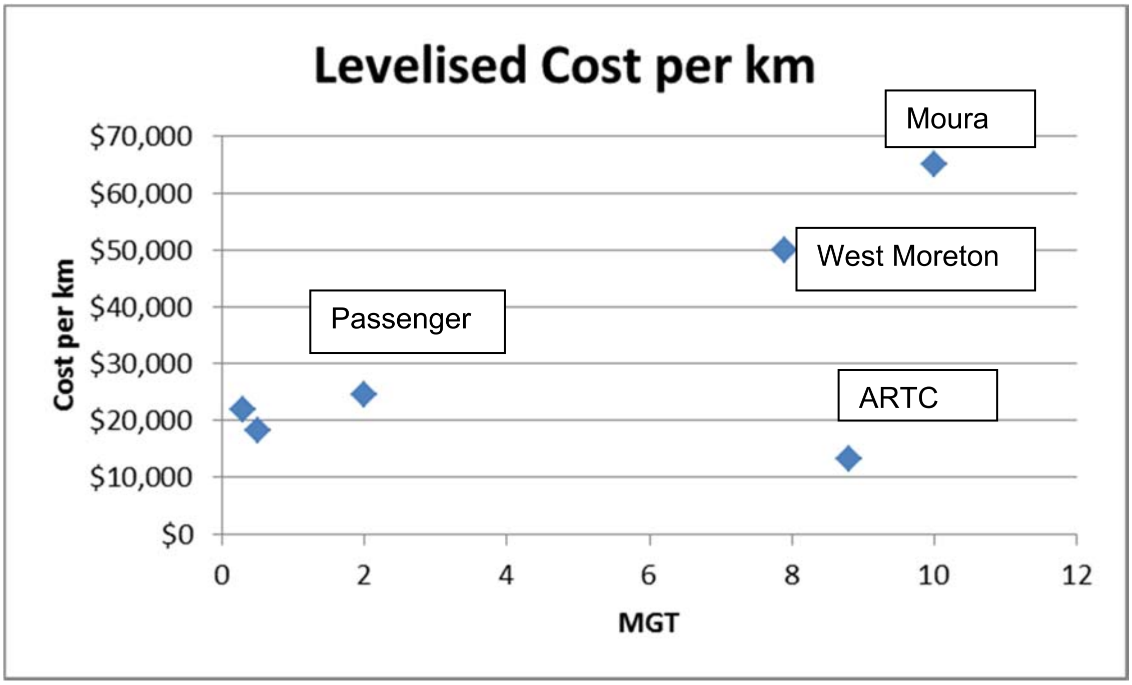
Operation Type	Unit Costs	Maximum Million Net Tonnes	Approx MGT[51]	Unit costs per MGTkm
Passenger 160kph Victoria[52]	$24,471 / track km	2	2	$12,230
Victoria Freight Trunk Routes[53]	$18,085 / track km	1	0.5	$36,170
NSW Grain Lines[54]	$22,000 / track km	1	0.3	$73,333
ARTC Non-Hunter Valley Network[55][56]	$13,300 / track km $1.55 / '000 gtk	10	8.8	$1,551
Moura System UT4 Maintenance Submission[57][58]	$65,000 / track km	12	10	$6,500
QR West Moreton submission and B&H Calculation[59]	$50,000 / track km $5.78 / '000 gtk	8	7.9	$6,329

49 Source: QR's E:\QCA 2013\WM\Actual QR WM Submissions\Question 15 detail\[Q15d Traffic Volumes.xlsx]SUMMARY
50 Escalation at CPI
51 Million Gross Tonne calculated from gtk/km for the system
52 Essential Services Commission (prepared by WorleyParsons) (2006), Maintenance Cost Benchmarking for the Victorian Freight Network
53 Essential Services Commission (prepared by WorleyParsons) (2006), Maintenance Cost Benchmarking for the Victorian Freight Network
54 Maintenance costs for grain branch lines in NSW—FINAL report to IPART, sapere research group
55 http://www.artc.com.au/library/2010-11%20Unit%20Costs%20for%20website.pdf
56 http://www.artc.com.au/library/annual_report_2013.pdf
57 http://www.qca.org.au/files/R-Aurizon-QR2013DAU-ExMatMaint-0513.pdf
58 Cost includes that for the Callemondah yard and all Gladstone precincts but omitted from km

These results are shown graphically in Figure 1 and Figure 2 and show that with the exception of the outlier ARTC there is consistency in the trend of maintenance costs in levelised[60] maintenance cost. ARTC's costs as reported have not included large scale capital upgrading costs performed at the time but nevertheless have shown a consistent trend over the past decade to be Australia's best performer in these measures.

An important concept in this type of presentation is that MGT (Million Gross Tonnes) is not that task at the port or at the maximum task for the system. Rather, it is the task spread evenly over the whole system and which better represents the situation where maintenance cost will be higher in some parts of a system than in others. On higher tonnage sections one could expect higher unit costs than on low tonnage sections. The costs reported are available only for the whole system and therefore the task must be spread across the whole system to arrive at a cost per track kilometre.

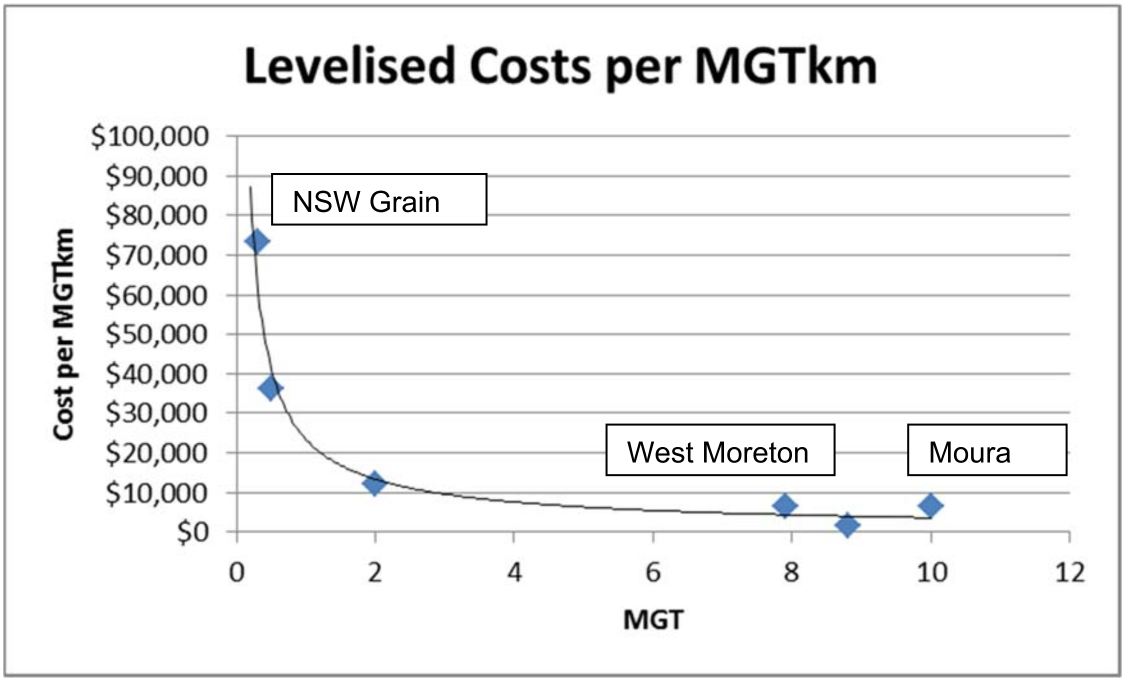
Figure 1 Cost per km for MGT



In Figure 2 the costs per MGT km for Million Gross Tonne Kilometres (MGTkm) is shown and indicates the same consistency. It is unsurprising that cost per MGTkm increases rapidly for low tonnage lines. The West Moreton system lies to the right of the knee in the curve indicating that when the reinforcement of the line stops it is likely to be within the more stable region of the trend provided the tonnages remain and the maintenance tasks are not reactive as they are now.

[59] http://www.qca.org.au/files/R-QRail-Sub-QRailJune13DAU-WesternSysRefTariffsResetMaintenance-0713.pdf, Table 7.6
[60] Spreading the costs that vary from year to year evenly to create a level cost accrual

Figure 2 Costs per km for MGTkm



We conclude that if it not were for the rebuilding tasks being performed as represented by the maintenance budget, the maintenance costs would be comparable to other well documented benchmarks.

7 Maintenance Analysis and Recommendations

7.1 Analysis

The West Moreton system rail infrastructure between Rosewood and Jondaryan is challenged by the fact that the alignment, formation and drainage have not been designed for the traffic projections contained in AU1. The track west of Jondaryan, with its lower tonnage profile has a configuration that more closely matches the fit for purpose standard needed of it.

For the Rosewood to Jondaryan section the formation is in such a poor state that the track structure requires reinforcing to compensate for the lack of strength in the formation.

Consequently, in this section we have assessed that the formation is substantially life expired and the DORC should be adjusted to reflect this.

Also in the Rosewood to Jondaryan section, since it appears the combination of concrete sleepers and 50 kg/m rail is required to compensate in track structure strength, for the lack of strength in the formation, the sections of track that are not of concrete sleeper and 50 kg/m rail configuration are also substantially life expired. This amounts to 39% or 80 kms of the distance for non-concrete sleepers and 57% or 115 kms of non-50 kg/m rail. Further analysis is given in the Chapter on the DORC.

In terms of efficiency, it is not surprising that unit costs and absolute costs of the work program are much higher than could be expected from normal maintenance activities because many activities are concerned with rebuilding or reinforcement of track structure elements which need to be over-designed to compensate for the poor formation conditions.

Structures, trackside systems and facilities maintenance estimates are commensurate with the configuration and traffic levels projected for the line except that the bridge maintenance budget is lower than it should be.

7.2 Recommendations

We conclude that for the 4 year period $51,183,000 of the $104,517,000 budgeted in the maintenance program is for reinforcement of the existing infrastructure and without that burden the West Moreton System would have maintenance costs that were commensurate with other well documented rates. The costs associated with these activities are not clearly of a capital nature but they underpin the view that the underlying formation, bridges and “below track” structure is in a poor state. The resleepering unit rate does however indicate that “other works” designed to improve other aspects of the infrastructure beyond that of resleepering solely and we have suggested an adjustment to this estimate so that if other works are required then a capex or further maintenance requirements are more clearly stated. We have adjusted the QR proposed overall maintenance cost down by $10,006,600 which is composed of adjustments to resleepering solely.

We have identified a number of areas where we conclude that the scope of activities is over-budgeted financially, perhaps as a result of blindly applying previous rates to new work. Our recommendation is that the QCA closely monitor the scope and actual expenditures for consistency and that scopes are not modified to fit the budget. The routine maintenance activities totalling approximately $25m over the Period provide scope for reasonable and adequate day to day maintenance.

Chapter 2 Capital Expenditure

1 Capex Costs

1.1 QR's Approach

The West Moreton System is Queensland's first railway and much of its infrastructure is more than 100 years old. It was built at a time of relatively simplistic construction techniques and with materials that have been surpassed for strength and longevity.

The Capex program of QR's addresses many of these issues as well as issues generated specifically from the increasing coal tonnage on the rail.

The railway remains and will remain for the foreseeable future as a relatively light axle load railway but with substantial tonnages. At 15.75 tonnes axle load the railway is the lowest axle load mainline railway in Australia. Western Australia's lightest grain lines are 16 tonne. Despite the low axle load the grades and curves on the railway and the poor formation conditions require special engineering focus and the Capex program reflects those needs.

1.1.1 The Context of the QR Submission

The context of the approach taken by QR in its Capex proposal is an important factor in considering the relevance of certain projects.

The West Moreton System has only recently seen coal demand of the magnitude it faces over the Regulatory Period, although coal has been a regular traffic since 1982. There is now an established coal export demand and long term contracts have been established. In contrast to earlier coal traffics, all coal is now exported and all coal travels over the problematic ranges between Toowoomba the Port of Brisbane and through the suburban area.

According to verbal advice from QR[61], transit through the metropolitan suburban area of Brisbane is not assured for the long term. In the QR response to QCA's Clarification Questions, at Appendix 1, QR confirmed that the Queensland Government is committed to permit railings through the metropolitan area until (at least) 2024. This is still not a long time for investment in assets with a 50 year life. This uncertainty has led to indecisiveness about the scope of works required and there is a certain reluctance to replace or upgrade anything except the most urgent needs.

While the railway could warrant a very extensive upgrading program, to boost axle load, train length and speed, the Capex proposed addresses the more urgent needs. The total scope of needs has not been espoused by QR and it would certainly assist the review to understand the long term replacement needs as well as the upgrade path. In response the Clarification Questions QR outlined its strategy and these are reviewed in the section in this report dealing with the AU1 capital program.

[61] Site visit August 2013

In relation to its propensity to invest, QR in its Explanatory Statement[62] to its DAU Submission notes:

" ..there is currently no available capacity on the West Moreton system, and any increase in rail capacity would require significant capital expenditure to fund mainline expansions. The reference tariff for the West Moreton system does not support significant expansions to the system, associated with the duplication of certain segments of the system.

Accordingly, where Queensland Rail is not willing to fund a capacity expansion of the system, this would only occur if an access seeker, or group of access seekers, proposed to fund the expansion".

This situation limits QR's scope to plan.

Lastly, being a Queensland Government entity, QR is subject to government budget, industrial relations and other processes, which while not evident in any QR documentation as being a problem, will distract otherwise "commercial" efforts, or at least simply form another boundary condition to the strategy. The policy position stated above to ask an access seeker to fund expansion in an explicit manner by way of cash injection[63] is evidence that purely commercial decisions do not drive QR's Capex needs.

The sequential nature of the Pre AU1 projects is one would prefer to think due to the need to keep the interruptions to rail traffic at manageable levels rather than necessarily any restrictions on the availability of resources. Being a government entity however, may have led management to prioritise to suit other government agendas.

1.2 The QR Capex Cost Estimates

The tables[64] in the Introduction of QR's submission[65] covering the period 2007/08 to 2012/13, shows total cost of various capital projects, and is repeated here in Figure 3.

[62] Explanatory Submission – Queensland Rail's Draft Access Undertaking 1 (February 2013)
[63] All expansion in all railways is ultimately paid by the users
[64] Unnumbered, called Total Maintenance Costs – AU1 reset period ($'000)
[65] AU1 West Moreton Reference Tariff Reset Capital Submission, undated

Figure 3 QR's Pre AU1 Project List

Pre AU1 Project List and Summary (excl. Capitalised Interest)

	Project Name	07/08 ($'000)	08/09 ($'000)	09/10 ($'000)	10/11 ($'000)	11/12 ($'000)	12/13 ($'000)	Total ($'000)
1	Jondaryan Track Upgrade	9	1,685	11,397	198	0	0	13,289
2	Columboola to Fisherman Islands Project	90	2	15,698	16,274	4,434	990	37,488
3	Western System Asset Replacement	3,593	51	0	3,577	6,724	9,636	23,581
	Total Cost	3,692	1,738	27,095	20,049	11,158	10,626	74,358

Pre AU 1 Project List and Summary (incl. Capitalised Interest)

	Project Name	RAB: Rosewood – Macalister							RAB: Macalister – Columboola						
		07/08 ($'000)	08/09 ($'000)	09/10 ($'000)	10/11 ($'000)	11/12 ($'000)	12/13 ($'000)	Total ($'000)	07/08 ($'000)	08/09 ($'000)	09/10 ($'000)	10/11 ($'000)	11/12 ($'000)	12/13 ($'000)	Total ($'000)
1	Jondaryan Track Upgrade	9	1,769	11,965	208	0	0	13,951	0	0	0	0	0	0	0
2	Columboola to Fisherman Islands Project	0	0	0	18,540	2,448	547	21,535	0	0	0	16,719	2,207	492	19,418
3	Western System Asset Replacement	3,772	54	0	3,755	7,059	10,116	24,756	0	0	0	0	0	0	0
	Claimed	3,781	1,822	11,965	22,503	9,507	10,663	60,241	0	0	0	16,719	2,207	492	19,418

We note that the extent of the West Moreton System for coal traffic has increased from Macalister to Columboola (Cameby Downs) since the previous review in 2009, a distance of approximately 86kms. This is an old line now subject to coal traffic and some of this Capex has addressed this need.

The AU1 project list covering the period 2013/14 to 2016/17 is given in the (unnumbered) section of the QR Submission as repeated in Figure 4.

Figure 4 AU1 Project List

AU1 Project List and Estimate Summary (incl. Capitalised Interest)

	Project Name	RAB: Rosewood – Macalister					RAB: Macalister – Columboola				
		13/14 ($'000)	14/15 ($'000)	15/16 ($'000)	16/17 ($'000)	Total ($'000)	13/14 ($'000)	14/15 ($'000)	15/16 ($'000)	16/17 ($'000)	Total ($'000)
1	Slope Stabilisation on Toowoomba Range	1,076	2,238	2,328	2,421	8,063	0	0	0	0	0
2	Formation Repairs	2,798	2,909	3,026	3,147	11,881	430	448	466	484	1,828
3	Timber Bridge Strengthening and Elimination	4,150	3,774	1,164	0	9,088	0	0	0	1,780	1,780
4	Replace Timber and Steel Bridges with Reinforced Concrete Box Culverts	618	654	1,110	0	2,382	0	0	0	228	228
5	Drain Renewals	533	0	0	0	533	0	0	0	0	0
6	Check Rails Curves (6.105km Toowoomba Range & 1.055km Little Liverpool Range)	2,978	3,097	3,220	3,349	12,643	0	0	0	0	0
7	Relay Program (4km Oakey - Jondaryan)	0	0	1,187	3,704	4,891	0	0	0	0	0
8	Rerailing Program (2.5km Rosewood - Helidon & 1.5km Toowoomba - Oakey)	0	0	0	1,937	1,937	0	0	0	0	0
9	Western System Asset Replacement	8,089	3,581	4,432	0	16,102	0	0	0	0	0
10	Level Crossing Compliance Program	0	0	0	1,816	1,816	0	0	698	0	698
11	Siemens AZ S 600 Axle Counter Replacement	205	638	663	690	2,197	0	0	0	0	0
12	ATP Encoder Replacement	0	520	541	563	1,624	0	0	0	0	0
13	Corridor and Asset Protection Strategy	323	783	0	0	1,106	0	0	0	0	0
14	Radiocommunications Strategy	192	441	917	295	1,845	77	175	363	116	730
15	Backbone Strategy	216	0	0	0	216	85	0	0	0	85
	Claimed	21,177	18,636	18,589	17,922	76,324	592	623	1,527	2,607	5,349

In this review we will examine each set of projects.

2 Pre AU1 Capital Costs

The Jondaryan Track Upgrade and the Columboola to Fisherman Islands Project were explicitly funded by the two coal companies involved through an Access Facilitation Deed and were in direct response to increasing tonnage or the opening of a mine.

The Western System Asset Replacement project was the replacement of assets with modern equivalents for more general asset life expiry reasons.

2.1.1 Jondaryan Track Upgrade

A breakdown of the work scope is shown in Figure 5, extracted from the Business Case[66].

Figure 5 Jondaryan Track Upgrade Work Breakdown

COMMERCIAL IN CONFIDENCE

The infrastructure works programmed to be carried out includes:-

Activity Name		Budget
Gatton -Helidon - Resleepering	$	[redacted]
Air Force Straight -Resleepering	$	
Welding Joints	$	
Resleepering	$	
Track Reconditioning	$	
Eliminate Doctors Creek Bridge (Survey, Geotech and Design)	$	
Signal Construction	$	
Formation Stabilisation/ Repairs	$	
Eliminate Timber Bridges	$	
Project Management	$	
Material Escalation	$	
Contingency	$	
Total	$	
Total & Rounded	$	13,500,000

This project was in response to increasing tonnage from the New Acland mine. The work elements reveal more of a maintenance flavour than capital improvement but in fact consist of attempts to improve the infrastructure on a priority basis.

Improvements were necessary to track infrastructure where the foundation was inadequate. Poor formation conditions meant that the usually sufficient steel sleepers and 41kg/m rail were not adequate. But there were some locations where it is clear the formation itself needed treatment.

There also appears to be areas where mere resleepering was not enough either. Track Reconditioning signifies that the ballast as well as the sleepers need to be changed but the condition is not so bad as to need formation rectification or re-establishment of the capping layer.

There appears to be resleepering AND resleepering, some allocated location specific identities and some unallocated. The inference is that the whole of the section between Gatton and Helidon required complete sleeper changeout whereas on other sections there would be spot resleepering.

There are bold titles such as “Eliminate Timber Bridges” when clearly, as the evidence is today; there are plenty of timber bridges yet to be eliminated.

Some aspects are more maintenance than capital works such as (spot) Resleepering and Welding Joints. Clearly, this is a package of work designed to accommodate the increased tonnages by improving the reliability and maintainability of the infrastructure. This is not said in the Business Case[66] but it appears to be the case.

The options presented were simple. Do nothing or do the work. The business case has no discussion on other technology options but being an internal document and a summary, perhaps QR believed there was no need to offer the full consultation and options development documentation.

Significantly, there were severe boundary conditions in the construction of the Business Case. A “Key Issue” indicated in the Business Case was “Political Pressures”, “Queensland Transport has agreed to QR Network to contract these addition train paths and undertaking the infrastructure works on the network. QT has restricted the contract period for the additional train paths to 5 years (from the completion of the mainline infrastructure works)”.

Thus this work is short term urgent and prioritised work, devoid of the freedom to explore economies of scale, and to use alternate technologies such as ballast cleaning, shoulder cleaning, retention of steel sleepers or selective resleepering.

The commercial conditions imposed by others and the sum total probably dictated rather than needs based has constrained this work from being optimal and this is shown in the business case where no mention is made of any strategic future for the line; rather a 5 year horizon placed on it. There is also evidence in the UT1 submission that shows this job was sub-optimal because maintenance resources and new rounds of resleepering and formation rectification are once again being proposed.

A strategic future for the line would most likely provide more optimum and efficient expenditure.

2.1.2 Columboola to Fisherman Islands Project

This project is in specific response to a new mine opening west of Macalister, where the coal traffic formerly stopped.

Consequently it contain elements of greenfields spur and loading loop and further improvement to make the existing track more reliable.

The expenditure on the Columboola to Fisherman Islands section has been kept to a minimum because there is clear expectation that the coal will travel to Wiggins Island rather Brisbane Port in the future. Figure 6 indicates the work breakdown for the project[67].

[66] Jondaryan Coal Track Upgrade Project, Business Case, 18 September 2008

[67] Columboola (Cameby Downs) to Port of Brisbane, Business Case, 18 September 2008

Figure 6 Columboola to Fisherman Islands Project Work Breakdown

COMMERCIAL IN CONFIDENCE

The infrastructure works to be carried out include:-

Infrastructure Works (including contingencies)	Infrastructure Estimate [redacted]
Columboola Spur and Balloon Loop	[redacted]
Columboola to Macalister Mainline	
Macalister to Rosewood	
Rosewood – Fisherman Islands (Brisbane Metropolitan Section)	
Project Management QR Services indicative margin on costs Price Escalation Contingency Project Contingency	
Total	
Total (including contingency & rounded)	

For more detail please refer to appendix for scope of works.

Similar to the Jondaryan project, an Issue relates to QR's role where boundary conditions relating to the length of the train path agreements would have played a significant role in work scope.

Once again, similar to the Jondaryan project, the track between Macalister and Rosewood requires work to improve its reliability under the existing and new tonnage. This project is a good opportunity to revisit sections of track and to fill in those areas that were not as urgent when the Jondaryan works were undertaken.

Both the Jondaryan and Columboola Projects provide an opportunity for remedial works that must have been obvious for some time and are being addressed on a priority basis as funding from external sources becomes available.

The Columboola Project will like the Jondaryan Project be sub-optimal in the larger strategic scheme, but as there is no strategic view about the line, little can be concluded about the efficiency with which the works were performed. In an ideal world the sum total of all needs would be placed in a strategic framework and economies of scale and priorities would determine the work program. This has only occurred opportunistically in this case. No alternatives for the work were presented in the Business Case.

2.1.3 Western System Asset Replacement (WSAR) Project

The business case[68] for this project is dated September 2010 and occurs after "initial investment of $5.5m was approved and spent over the period 2005/06 – 2009/2010".

This is an asset replacement project and does not relate to a specific increase of traffic. The substance of the FIAR is that with the increase in tonnage the track is deteriorating to such a degree that it has caused an upswing in derailments and concerns about safety. These and speed restrictions in turn create unreliability in the system. QR have claimed the measures are need to create a "fit for purpose" infrastructure so as to service the client and show QR is a reliable supplier.

The FIAR indicates that the investment is aligned to the business strategy. The business strategy as an identifiable document is not apparent but as this project is a result of

[68] Western System Asset Replacement Project; Submission No: 1, Feasibility Investment Approval Request (FIAR)

response to problems, a sub-set of the business strategy is most likely the provision of business continuity.

The work breakdown shown in Figure 7 reveals that the work was entirely of two types, turnout replacement and track reconditioning. QR provided clarifying data in the process of providing a reply to the Clarification Questions in Appendix 1 regarding the scope of this project in the number of turnouts and extent of reconditioning.

Figure 7 WSAR Project Milestones

[redacted]

Track Reconditioning

The term "Track Reconditioning" refers to the replacement of the super-structure of the railway, namely the ballast, sleepers and rail. In that respect it is all-encompassing, and where situations are encountered when the track is "opened-up" there can be some surprises in scope involving partial replacement of formation and drainage. Using the estimates provided in the submission, the total costs look higher than the simple calculation of replacement of those components and future prudency reviews could look to investigate other secondary costs that become material in complex procedures such as track reconditioning.

Our site inspection[69] noted that there were various locations where the formation was sub-standard and that the ballast sleepers and rail were required to be in good condition to compensate for the formation's inadequacy.

Our inspection[70] noted that track reconditioning included the use of 50 kg/m rail on concrete sleepers to replace 41 kg/m rail on steel sleeper/timber mix[71]. The use of the heavier rail and concrete sleepers would provide a more stable track structure and

[69] Site visit August 2013
[70] Site visit August 2013
[71] Generally in a 1 steel in 2 or 1 in 4 pattern

increase the reliability of the line and the choice to provide an upgraded structure is a measure of the degradation of the formation since a lighter track structure of 41kg/m rail and steel sleepers[72] could perform the task under better formation conditions.

Evidently, the works are in response to problems on a priority basis rather than being preventative. However we note that the FIAR indicates this is an "Optional Investment". In the context of the task it does not appear to "optional".

We note work did not start in earnest until the Columboola to Fisherman Islands Project was nearing completion which in turn did not start until the Jondaryan Track Upgrade was nearly complete. This strategy could have been prudent timing to avoid excessive disruption to traffic or been managed to coincide with other external requirements such as government policy.

Considering the formation conditions observed on our site visit the use of 50kg/m rail on concrete sleepers is justified.

Turnouts

Our advice[73] was that a QR National-wide policy decision prompted all turnouts to be replaced with 60kg/m swing nose concrete bearer turnouts on coal routes. The Western System was a small part of the total scope as the Central Queensland Coal Network is the largest entity in this category.

The new turnouts replaced 41kg/m timber bearer turnouts and no doubt the tonnage on the line made the maintenance of this type of turnout infeasible.

The Business Case states that "Yes", "Have the critical viable alternatives been thoroughly considered and the optimal design selected".

Other designs were available at that time for this traffic axle load, frequency and tonnage and while track engineers would be very pleased with the chosen policy design, other types were being used around Australia. For example, on ARTC heaviest 25 tonne axle load 20 million tonne route, a Rail Bound Manganese (RBM) design is proving satisfactory as it had done for many years in NSW and Western Australia.

50kg/m rail turnouts are common throughout Australia and can easily accommodate the 15.75 tonne axle load on this line.

Timber bearers are becoming difficult to source and the quality of the timber is noticeably lower but timber bearered turnouts are still being installed.

In view of the tonnage and axle load requirements on this line the use of 60kg/m swing nose concrete bearered turnouts is excessive. Other contract period limitations as observed in the Jondaryan and Columboola Business Cases along with the uncertainty about access to the Brisbane Suburban network adds to the excessiveness of the decisions to use large and expensive turnouts. The turnouts also add to the cost of signalling maintenance because the swing nose of the frog[74] needs to be detected[75]. The swing nose has also been known in the general railway field to add to unreliability because of the existence of moving parts compared to RBM frogs and there is always a

[72] Table 7.1, Queensland Rail Standard, CETS 7
[73] Site visit August 2013
[74] The intersection of the diverging and main line
[75] The signalling system needs to be sure that the nose is oriented for the correct direction

trade-off to be made between lower geometry maintenance requirements of the swing nose and small reductions in reliability.

Perhaps the only mitigating factor is that these turnouts can be used elsewhere but if not provide a very low maintenance solution. In addition, given the need to replace turnouts, the purchase price difference between 60kg/m rail and 50kg/m rail and concrete and steel bearers is not great; approximately $200,000 and $150,000 respectively. The cost of insertion, approximately $50,000, is very similar. Therefore the actual difference between an optimal cost and the incurred cost is approximately 29*$50,000, $1.45m in a project cost of $6.9m for the turnouts only.

2.2 Clarification Questions

During the course of the review the QCA asked QR to provide extra data and clarify some aspects of the submission and those questions are shown in Appendix 1.

QR provided open and transparent answers and the scope of projects were clarified to our satisfaction.

The most disturbing aspect of the data however was that where a project involved improving reliability or safety as an objective, while providing information to that effect, the information showed indiscernible improvement or in some cases degradation of the parameter. Invariably QR has answered in the vein of the WSAR project that "*The improvement or reduction in speed restrictions over the timeframe cannot be linked solely to the WSAR project*" or that "*WSAR results in no direct increase in capacity; however it does increase the robustness of the West Moreton System by creating a stronger track structure that increases reliability, safety and utilisation of the system*."

While these statements are true to a certain degree, the lack of improvement is not the main concern. The main concern is that given an objective for a project investment there appears to be no measurable outcome. How do investors know whether they have received value?

In fact, QR's statistics do show that little if any degradation of performance has occurred since the works and that during that time tonnages have increased. A measure showing the parameter against traffic flow may have been more favourable.

2.2.1 Conclusion

The Pre AU1 Projects were carried out in response to demands or problems and within the constraints of the operation of QR working as a government instrumentality.

At the time of the projects there appeared to be no strategy for the line except to provide service and to retain confidence in the organisation as a reliable supplier. This is the extent of the information shown in the Business Plans.

In operating purely in a responsive matter, sometimes after the event in "clean-up" mode, QR has carried out minimum scopes of work in order to survive.

This mode of working is not conducive to optimal expenditure and in one case, turnout replacement, has been shown to be sub-optimal. The fact that successive projects come back to carry out the same work in different tranches and chasing the problems does not promote a continuity of methodology, machinery utilisation or skills.

A strategic plan for the line would benefit the efficiency of the capital projects. In the AU1 Submission and Clarifying Questions, QR has responded with the elements of a longer term plan. Given the circumstances QR's past capex appears to be reasonable but considerable improvements could be achievable when considered more strategically.

3 AU1 Proposed Capex

QR's Submission provides a good strategic view of the conditions under which the capital program has been constructed, stating assumptions on tonnages and strategy to ensure the line is fit for purpose.

Assumptions stated in the submission that would have the effect of limiting capital expenditure, if in fact more or less was needed, include:

a) 15 million gross tonnes maximum per year for the 4 years;

This assumption has two effects. Firstly, it provides a task level for the period of the Undertaking only. While forecasted volumes during the period could understandably drive most maintenance tasks, capital investment should be driven by much longer periods. Secondly, the statistics has no practical application in terms of need for the investment, the financial viability of the investment or of the ability to perform work without undue disturbance to train running.

b) 1 x 48hr closure per month;

2 x 12hr closures per month (Sunday & Monday), Jondaryan - Rosewood possessions;

1 x 12hr closure per month (Sunday), Jondaryan - Rosewood possessions;

Presumably these are measures of the ability to perform work without undue disturbance to train running. But they ought to be measures determined after the determination of needs for investment because the need for investment will be negotiated with the users and an appropriate level of disturbance will then be worked out

c) 15.75 tonne axle load;

Speed of 60km/hr down road (loaded train to Fisherman Islands) and speed of 80km/hr up road (unloaded train to mine).

A reference train comprised of 2 x 90 tonne locomotives plus 41 coal wagons;

These are legitimate operating requirements, not so much "assumed" but determined by the need of the client and expressed in the Operations Plan (if there is one)

d) Staffing levels constant until the capital program delivers less maintenance intensive infrastructure.

This assumption appears to be a signal to stakeholders, including QR's owners that the capital program and its effectiveness are dependent on constant staffing levels or are tied to constant staffing levels as if other factors might influence the staffing levels within QR. The "strategy" bears no relation however to the need for capital investment and meeting the client's needs, but it is an obvious signal that QR does not operate commercially.

With these assumptions, which are restrictions on commercial behaviour, the review by WorleyParsons is only one reviewing the pre-determined scope of activity as distinct from a review of the needs for capital investment and the context of the investment taking into account the line's future.

Given the state of the infrastructure there is no doubt a long list of needs for investment in the context of long term traffic forecasts. In view of the subjective nature of determination of scope, the extent and depth of work on a priority basis, it is amazing that WorleyParsons would agree with every aspect of the capital program. In fact it was not asked to look at the program but rather the justification for pre-determined fixed scopes of work.

Only persons with an in-depth knowledge of the behaviour of the infrastructure under various conditions of weather and traffic intensity would be able to make judgements about priority of needs within the constraints given in the assumptions. Therefore our review here will not be to review the extent of scope but to suggest areas where alternative methods to address the problems and reduce costs could be implemented.

3.1 QR's Capital Investment Strategy

In response to QCA's Information Request given in Appendix 1, QR provided a comprehensive answers and to the question of strategy which included their System Strategy stated:

"*The long-term capital strategy of system is to:*

> *1. Install concrete sleepers with 50kg/m rail on the heaviest usage section (being between Rosewood and Jondaryan).*
>
> *2. Eliminate and/or strengthen existing timber bridges.*
>
> *3. Maintain a safe and reliable network.*
>
> *4. Increase or maintain system robustness at key priority locations*."

It is further explained that the projects nominated in the capital program fall within these 4 "objectives[76]. Other objectives, not stated in the proposal, but subsequently elicited through Clarification Questions[77] are also relevant to the strategy and restated below.

It has become clear over the duration of the review that QR is edging the infrastructure to an upgraded position with the replacement of assets to a better standard than at present. The other objectives are:

- Full depth concrete sleepers with a 26.5 tonne capacity[78],
- Low profile sleepers for use in the tunnels with 20 tonne capacity but at the same costs as the 26.5 tonne sleepers,
- 50 kg/m rail on concrete sleepers with a 20 tonne axle load capacity[79] up from 41kg/m rail on steel sleepers with a 16 tonne axle load capacity,
- 60 kg/m rail turnouts with a 26.5 tonne capacity, up from 41kg/m rail with a 16 tonne capacity
- Bridges to 30 tonne axle load capacity, up from timber bridges with 15.75 tonne capacity

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[76] The words "strategy" and "objectives" are used interchangeably
[77] In Appendix 1
[78] Presumably these are chosen because they are available from the supplier to CQCN
[79] Although all other Australian jurisdictions allow higher axle loads

- Ballast depth 200mm under concrete sleepers, not recognised in the standard CETS 4 but satisfactory for steel sleepers and >16 & ≤20 tonne axle load

On this basis it is not clear to us whether a coherent policy exists about the future standards of the line.

A serious boundary condition was indicated in QR's response to the Clarification Questions as follows:

"*Given the current State Government approval of railings of coal from Toowoomba through to the port of Brisbane is committed until 2024; any proposed investment needs to be carefully considered as the risk of stranded assets is possible*". We interpret the words as meaning "until only 2024" and that QR itself is unwilling to take risk on assets that could become stranded.

This is surely code for "we will only do what is absolutely necessary" and therefore the investment we see in the capital proposal is unlikely to be optimal. Investment is by its very nature speculative to a degree and mechanism exist to reduce the risk are available.

For example the WACC on assets that are subject to the highly likely pressure of stranding will be different to that of enduring operation. More temporary style of asset replacement may be appropriate. Or, since the future of the line in 10 years' time, approximately 20% of the asset's lives will be entirely dependent on agricultural products and passenger services; then coal's share of those capital costs might be mitigated. These alternative treatments may provide scope for other capital investment decisions.

Overall we find that QR's strategy is one of survival, given short decision timeframes, poor infrastructure condition, rising tonnage and opportunistic engineering standards.

3.2 QR's Approach to Project Scoping

QR's task of determining the priority for a sub-standard line nearly 300kms in length and with the legacies of an indeterminate future and historical past is indeed a difficult one.

Of the 115 timber bridges[80] QR has identified 13 locations where work is required in this Regulatory Period due to the operation of coal trains. The bridges would need to be replaced eventually anyway but the coal train operation has advanced that need. This same principle applies to many of the capital items.

All of the items in the capital proposal are replacement items, none are to increase the capacity of either the axle load, speed or train length. Replacement of the items will increase reliability which in itself helps to improve the capacity available for train running.

3.3 Constraints and Boundary Conditions

In recognising only 13 bridges in the four year program, and similarly for other items, a small proportion of the total asset, QR would not hope to completely eliminate all problem areas within a timeframe that would ever make this line an efficient coal carrying asset. Its efficiency, at 15.75 tonnes axle load and slow average transit time is approximately three quarters as efficient[81] as the Central Queensland Coal Network measured on an ntk/gtk ratio and a transit speed basis. The capital program for the Regulatory Period does not address these issues, but merely to repair and replace to standards that will improve the reliability of the infrastructure.

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[80] Answers to Clarification Questions

[81] gtk/ntk of 2.1 compared to 1.55, transit speed of 35kmph compared to 50kmph.

The bridges that are being replaced will provide for a 30 tonne axle load and the rerailing and concrete sleeper installation will provide for a 20 tonne axle load. While it is true that a 30 tonne axle load bridge capacity cost is not much more than a 20 tonne axle load capacity[82], the extent of the mismatch with the track capacity is surprising and the documentation has not provided information as to the economies of either option. Ultimately the strength of the formation will dictate the axle load capacity of the track, even if much larger capacity rail and full depth concrete sleepers[83] are used and currently the Queensland Rail Standard CETS7 only[84] permits 20 tonne axle load on 50 kg/m rail.

On some limited height sections such as in tunnels the low profile concrete sleeper is used. These are used for the passage of container trains and passenger trains. Coal trains do not need the same height clearance.

A particularly worrying boundary condition is one relating to "constant staffing levels". QR should have the freedom to employ contractors and/or staff depending on the expenditure need. It should also be testing the market for contractor efficiency between contractors and between contractors and its own staff. The staff are not being tested as such, but rather the work techniques, construction equipment and management.

Consequently, the whole capital proposal is bound by these assumed constraints and boundary conditions, effectively preventing efficient practice in the transport of coal. We refer to "assumed" because no documentation supporting these constraints has been provided to QCA.

Unfortunately, there is no doubt some of these constraints were locked in at a time when coal tonnages were low and commercial considerations suggest a minimum cost trajectory. However, now that larger tonnages require transport, the efficiency of the system becomes more compelling and if there is any future in the line then these constraints need to be revisited.

3.4 Capital Expenditure Benefits

In QR's Overall Submission the treatment of capital is "*not seeking to add a share of Transport Service Contract projects (i.e. those attracting Government support)*" but that "*a 100.0% coal train path allocation percentage is being sought in relation to projects that solely facilitate coal traffic (including those funded by end-users)".*

Many of the projects claim "*The works that comprise this project will be undertaken specifically to benefit coal carrying customers on the West Moreton System*". Our view is that it is not possible to only benefit coal carrying services because all trains do some level of damage. However we do recognise that due to the presence of coal trains the damage is accelerated and that the project is required before it might otherwise need to occur. We also recognise that the coal traffic causes damage at a level where if it were not for the coal traffic the existing maintenance methods and assets may be adequate for long term sustainable and levelised operation and that new technology is needed to cope with that level of damage either for technical reasons (failure) or for economic reasons (capex and maintenance trade off).

[82] Estimated as 10%, since the substructure is very similar and the installation cost is the same for the superstructure. Only the beams will be demonstrably greater cost.
[83] These are the same sleepers used in the CQCN with 26.5 tonnes axle load
[84] All other jurisdictions in Australia permit up to 23 tonne axle load on 50 kg/m rail

In making the above claim QR has not provided its rationale for these distinctions. We have provided our estimate of the type of Capital Expenditure Benefit (CEB) as follows:

> **CEB 1.** Creation of damage by coal trains that requires a new type or more robust type of asset if it were not for the coal traffic and is fully caused by the coal traffic.
>
> **CEB 2.** Creation of damage by coal trains that accelerates the need for replacement or repair to a period within the Regulatory Period whereas otherwise it would be beyond the Regulatory Period and where the damage occurs on the basis of tonnage.
>
> **CEB 3.** Fully time based or environment related damage and where share of the cost by train paths (capacity usage) is appropriate.
>
> **CEB 4.** Mixture of time and load/tonnage damage, where train paths and tonnage are equally apportioned on a 50/50 basis.

We have offered our view in the each project's commentary.

3.5 Individual Project Comment

In this section our comments will be restricted to the evaluation of the project in the overall context of the future of the line.

Program Project	Comment and Categorisation
Slope Stabilisation on Toowoomba Range Formation Repairs	The proposals for both "Slope Stabilisation" and "Formation Repairs" discusses overlapping issues involving Mud Holes and other manifestations of formation failure. We have combined comments in this section. Our site inspection confirmed that a great deal of stabilisation needs to occur in the Toowoomba Ranges. Whether more or less stabilisation should occur can only be determined by detailed geological interpretation. We were not able to confirm the quantity or cost estimates which will be specific to the type of problem and location. The QR RIMS[85] database identifies 13.8kms of formation along the full West Moreton route where attention is required within the next 4 years, with an average of 5kms per year addressed. The criterion for intervention is not stated and we have not been able to confirm quantity. As to the unit cost of formation repair of $600,000 per km, we agree this is a reasonable estimate. The damage requiring attention is caused by a combination of time/environment and tonnage as thus our classification of benefit is CEB4.
Timber Bridge Strengthening and Elimination	The proposal for "Timber Bridge Strengthening and Elimination" and "Replace Timber and Steel Bridges with Reinforced Concrete Box Culverts" identifies similar activities

[85] Acronym unknown

Program Project	Comment and Categorisation
Replace Timber and Steel Bridges with Reinforced Concrete Box Culverts	and it is not clear what the distinction may be. While the costs are at the higher end of an industry average, QR has built the bridges to a higher specification than that necessary to accommodate current coal train services, though the rationale for this is unclear. It is probable that there are standard designs already available from work on other parts of the total Queensland rail network. Standard designs can offer economies of scale and the incremental costs for the higher standard are not significant. Therefore, while anomalous, the costs are reasonable. A total of 13 bridge sites are being addressed over the 4 years. A total of 115 timber bridges will eventually need to be addressed to prevent line closure or if the 20 tonne axle objective for the line is to be met. At the current rate of replacement the last timber bridge replacement will occur in 2049, well after the 2024 horizon of access through the metropolitan area. CEB4.
Drain Renewals	This project comprises culvert replacement where the concrete has deteriorated which is a common occurrence. CEB3
Check Rails Curves (6.105km Toowoomba Range & 1.055km Little Liverpool Range)	Our site inspection confirmed the poor performance of the previous system of check rails for the accelerated damage caused by the higher average axle load of the coal trains and the benefits of the new system. To date, experimentation with a new design has driven cost estimates. As more experience is gained with the installation of further curves the cost base is expected to change. The prudency review at the conclusion of the Period should look at any improvements or overruns in cost as the experience is gained. Costs are likely to be location specific. CEB1
Relay Program (4km Oakey - Jondaryan) Rerailing Program (2.5km Rosewood - Helidon & 1.5km Toowoomba - Oakey)	These programs address the same damage concerns, that is, the need to use higher strength rail and sleeper combination in areas of poor formation to compensate for the poor quality of the formation. The damage occurs to levels on the existing 41kg/m rail with the axle at the limit of the rail's capacity where if a stronger formation was present the deflection of the rail and the accompanying stresses would prolong the life of the rail. CEB1

Program Project	Comment and Categorisation
Western System Asset Replacement	This is a far reaching program with some track reconstruction and turnout work. Deterioration of these components have been accelerated and it is clear from the length of the program that this is a long term requirement in which some of it has fallen into this Regulatory Period. Given the high cost of this project a detailed prudency will be required. CEB2
Level Crossing Compliance Program	This program has been influenced by external factors, where Standards have been improved, not because of usage but because of the application of more modern community expectations. The program has been caused by the effects of time on standards of living. CEB3
Siemens AZ S 600 Axle Counter Replacement	These axle counters have been technologically superseded with the elapse of time. CEB3
ATP Encoder Replacement	If it were not for the passenger trains using this corridor, the use of ATP would not be required, although any system of improving safety is desirable. This project is unrelated to coal traffic.
Corridor and Asset Protection Strategy	This project introduces a step change in technology and safeguards brought to the corridor by the massive increase in coal traffic. CEB1
Radio communications Strategy	This project has been brought about by the obsolescence of the technology. CEB3
Backbone Strategy	This project has been brought about by the obsolescence of the technology. CEB3

3.6 Further Asset Investment

We have observed in this list of projects that while they have targeted solutions that would provide relatively short term benefits they have not included scopes that would provide long term maintenance benefits on the particular assets that give the most reliability and maintenance intensive problems. We suggest that the following methods may give longer term benefits, some with higher and some with lower costs.

i. Bridge elimination using alternative large culvert jacking systems. In this method, the bridge is replaced by providing large diameter culverts jacked under the formation adjacent to the existing bridge which can then be replaced with pipe or box culverts. The replacement at the bridge has less waterway area but with the addition of culverts adjacent to the bridge the waterway area is restored.

ii. Black soil solutions. The most effective solution to prevent future black soil problems is to isolate the formation from the egress and ingress of water. This is accomplished by waterproofing the formation by applying a bitumen layer under the track at the time of track reconditioning or formation repair and a waterproof membrane on the batters and drain areas at the foot of the formation embankment.

iii. Rather than continue to rely on QR owned and operated communications system, Telstra's 3G/4G technology is available to perform the tasks required. The 4G technology is already being planned for roll-out in Europe where it will replace current GSM-R technology. A migration to 4G will also permit the introduction of moving block control in the coming decades.

iv. The use of replacement 41 kg/m rail will be feasible where the formation is of sufficient quality, as will be the use of 100% steel sleepers when appropriately placed and compacted.

v. We note the use of specially designed check rails for the check rail program. We understand these are imported specially. We suggest the use of off the shelf checkrail technology as used in turnouts.

vi. In order to improve the prospects that coal traffic will continue to operate after 2024 it is understood many issues need to be addressed including coal dust, noise and train path use. In relation to noise, in addition to the current methods a system of rail vibration damping and wheel vibration damping using damping blocks has proved effective elsewhere. In relation to coal dust, while roofing the fleet is the most effective, veneering the coal at regular intervals has proved effective. In relation to train pathing, longer or closely fleeted trains may permit greater tonnages.

In this section we have provided scenarios for further evaluation.

4 Summary of Analysis and Recommendations

Our view is that QR's Capital Proposal in its UT1 Submission is probably sub-optimal because it is constrained by the absence of long term strategies which are consistent with one another.

For example there is an approach in the projects which is a short term minimum cost approach where future Regulatory Periods may be left a legacy that once again will require minimum capital but high maintenance cost approaches. A definitive future is required for the corridor even if that involves limited life strategies.

We have noted differing standards being applied across different assets for no explained reason.

Consequently the overall capital program does not hang together as an integrated plan.

We also believe that the projects have been constructed for one reason or another to smooth out the work. If one reason is to continue to utilise in-house staff on a consistent basis, we are concerned that that driver may sub-optimise project timing and we recommend that QR investigate contract resources to provide greater flexibility and innovation into delivering the program.

We have made comment about each of the Pre AU1 and the AU1 forward program on a project by project basis and we have made suggestions to improve the effectiveness of the works or the efficiency of delivery.

We do not accept that all components of the forward capital expenditure program are reasonable because there has been little if any evaluation of alternatives for many of the projects. Our main areas of concern are the use of grossly over-designed concrete sleepers, continuation of in-house telecommunications, and specially imported checkrail units. However, these elements in themselves do not constitute reason enough for a material change to QR's estimates and therefore the total estimate of $78,938,000 is considered reasonable in this context. It is noted that the DAU provides for a detailed review of prudency to be subsequently undertaken.

Chapter 3 BELOW RAIL OPERATING COSTS

1 Operating Costs

1.1 The Context of the QR Submission

The operation of Train Control on the West Moreton system involves the management of trains of various types, an interface with the suburban system and an infrastructure that is prone to disruption because of its difficult configuration of steep grades and multiple access points.

These factors also contribute to high above rail management workloads where trains need to be rescheduled and crews relieved or suchlike.

The physical Train Control working space would no doubt be populated with both above and below rail personnel, with overlapping duties but with different responsibilities.

1.2 QR's Approach

The Overall Submission devotes a relatively small section addressing "Other Operating Costs" in which are contained a number of costs and cost categories derived from QR's reported[86] expenditure for 2011/12. We note that QR is using its reported expenditure partially because certain costs in the 2009 determination contained cost elements associated with the pre-Aurizon split.

QR then uses those reported costs with an escalation index to uplift from the reported 2011/2012 to 2013/2014 period.

A working capital allowance of 0.3% of revenue has then been proposed.

Finally, QR has proposed that it will embark on a "strong program of reform" that will reduce operating costs on a "glide path to efficiency of 80.0% (2013/14), 76.5% (2014/15), 73.0% (2015/16) and 70.0% (2016/17)".

The quantum of escalation and the WACC are to be resolved when the draft decision and other timing is finalised.

1.3 Benchmarking QR's Costs

In Table 8 we have repeated QR's submission and provided benchmark information to make a comparison. Two years of data are shown. The 2011/12 data is required for the basis of the QCA decision while 2012/13 provide more recent data for comparison.

Data that is material to the benchmarking and to the context of the QR forecasts are as follows:

- Revenue $60m[87], $83.9m[88],
- Coal only Train Kilometres[89] 1,484,400, all Train Kilometres 2,309,602[90],
- Volume Forecast[91] 3,776,111 '000 gtk

These parameters are used variously in the benchmarking of Table 8.

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[86] Reported to the QCA as the 2011/12 Below Rail Financial Statements

[87] Reported working capital is $180,000 for 2011/12(section 4.7 of "Overall Submission" which is 0.3% of revenue implying $60m)

[88] 3,776,111 forecast gtk, section 4.4 at $22.22 per '000 gtk, section 5.1"Overall Submission"

[89] Jondaryan 3,700 one way paths – 148kms, Macalister 2,400 one way paths – 213 kms, Columboola 1,400 one way paths – 304 kms, section 4.4 "Overall Submission"

[90] QR's Overall Submission, coal paths 72.6% Rosewood to Macalister and 50% Macalister to Columboola

[91] Section 4.4 QR's "Overall Submission"

Table 8 QR's Reported Operating Costs '$000

Item	Sub-element	2011/12 Cost	Benchmark for 2011/12	2012/13 Cost	Comment 2012/13
Operating Expenses		**Reported**		**Reported**	
Train Operations Management:				**Rounded**	
	Train Control	3,070	1. QCA reported benchmark of 1 train controller per 200,000 train kilometres[92]. Parameter suggests 11 to 12 train controllers (2,309,602/200,000). If each train controller costs $150,000 with on costs, train control should be approximately $1.6m to $1.8m 2. Bottom up derivation requires 24/7/365 operation with 2 controllers for each shift requiring 11 controllers (200 shifts per year) plus training, say 14 controllers, costs approx $2.1m 3. ARTC 2010-11 Unit Cost Calculation $0.74 per train km, QR situation translation is $1.2m 4. QR's Overall Submission seeks $22.22 per '000 gtk[93] implying revenue of $83.9m. Train control represents 3.7% which is larger than the CQCN benchmark of 2.5%[92] 5. The Economic Regulation Authority of WA Final Determination for WestNet Rail's Floor and Ceiling Costs (June 2009) included benchmarking done by Price Waterhouse which showed: • Train Control and access management costs per '000 train km of $198 giving QR equivalent costs of $0.33m. • Operating and Overheads per Track Km of $15,090 giving QR[94] equivalent costs of $5.4m, • Operating & Overheads per '000 GTK[95] of $1.28 giving QR equivalent costs of $3.6m. • Operating & Overheads per '000 train km of $546 giving QR equivalent costs of $0.9m	2,805	Train control costs remain higher than expected. The stakeholder comment from New Hope is well directed but secondary issues associated with training, interfacing with other networks, particularly suburban, training, leave allowances as well as specialised equipment, increases the overall costs. Train control activities relating to maintenance activities also increase the coordinating effort. New Hope's[96] comment about Train Control highlights workload from train operation only. Other workload occurs such as for resolution of incidents, maintenance of the corridor and assets, and public safety issues.

[92] Chapter 12 Stand Alone Costs Draft Decision 2000, QCA
[93] QR's "Overall Submission", P3
[94] QR's network is 356 track kms
[95] QR is forecasting 2.81Bgtk
[96] Queensland Rail's proposed Reference Tariff Reset New Hope Corporation submission, 31st October 2013

Item	Sub-element	2011/12 Cost	Benchmark for 2011/12	2012/13 Cost	Comment 2012/13
	Corridor Management	381	1. WestNet's rail costs included corridor management 2. QR's costs imply 2.3 persons	87	In some railways this item is included in train control so the reduction is welcome
	Planning & Systems (Allocated)	289	1. WestNet's rail costs included planning & systems 2. QR's costs imply 1.9 persons	325	In some railways this item is included in train control
	SUB-TOTAL	**3,740**	1. QR's Train Control costs appear to be outside a comparable range 2. When considering QR's costs in the context of the other costs presented including Corporate Overheads, these costs appear high. 3. Our suggested Train Control (only) cost is $2m.	**3,219**	Train control costs fall outside comparable/efficient range and adjustments are required.
Other Expenses:					
	QCA Fees	0	It is unclear why no QCA fees are suggested	0	
	Regional Costs (i.e. Council Rates & Power)	163	These will be specific to QR	216	Within expectations
	Engineering Services (Allocated)	697	1. QR's costs imply approx. 3 persons 2. Infrastructure Management (which would include Engineering Services & Group Management) as benchmarked by QCA in the 2000 Draft Decision indicate 2% of total costs. Proxy total costs as revenue, QR's costs imply $1.68m	102	Although these allocated costs are reasonable in total there is some concern that there is a degree of "yearly accounting" that could distort particular workloads and "steady state" activity levels.
	Business Management (Allocated)	391	1. QR's costs imply approx. 3 persons 2. Business Management as benchmarked by QCA in the 2000 Draft Decision indicate 0.5% of total costs. Proxy total costs as revenue, QR's costs imply $0.4m	446	
	Group Management (Allocated)	878	See Engineering Services	505	
	Operational Telecommunications	194	Not benchmarked (Allocated)	189	
	Business Telecommunications	133	Not benchmarked (Allocated)	0	Notional telecoms backbone charge for below rail business comms was not put through in 2012/13 - i.e. costs are present but remained in their original categories.
	Other (Allocated)	71	Not benchmarked	33	As expected
	SUB-TOTAL	2,528	These costs appear to be within a reasonable range	1,490	These remain reasonable

Item	Sub-element	2011/12 Cost	Benchmark for 2011/12	2012/13 Cost	Comment 2012/13
Corporate Overhead		2,921	1. This cost represents 3.5% of total costs (revenue) 2. With reference to the benchmarks shown against "Train Control" in this table, when read in conjunction with "Train Control" costs the combined costs appear to be out of range 3. Corporate Overheads as benchmarked by QCA in the 2000 Draft Decision indicate 4% of total costs.	1,568	This cost now represents 1.9% of total revenue and is within applicable benchmarks for the full business undertaken by QR on this corridor, taking into account maintenance costs and train management. New Hope's comments about Corporate Overhead have focussed on Train Control only.
Total Operating Expenses (Corporate Overhead plus Other Expenses plus Train Operations Management)		9,189	1. When considered in the light of the benchmarks shown in "Train Control" in this table, the overall expenses appear to be outside the benchmarked range. 2. Train Control costs are disproportionately high and tend to distort the comparison	6,277	
Return on Buildings, Plant, Software & Inventory					
	Buildings (Subset of Property)	3,076	QR Specific costs	3,298	
	Plant	6,807	QR Specific costs	7,375	
	Software	1,294	QR Specific costs	1,902	
	Current Inventory	1,624	QR Specific costs	2,151	
	Non-Current Inventory	376	QR Specific costs	515	
	SUB-TOTAL	13,177	QR Specific costs	15,241	
WACC Estimate		6.93%		6.93%	
Total Return on Buildings, Plant, Software & Inv		913	QR Specific costs	1,056	
GRAND TOTAL (2011/12)		**10,102**	Further comment follows	**7,334**	

In Table 8 only Train Control costs appeared to lie outside comparable benchmarks. The changes in the 2012/13 reported costs compared to the 2011/12 costs were extraordinary in a number of areas and the overall result satisfies, in one year, a cost reduction program previously planned for three years of the four year program. Some "allocation" costs show large variations while a more modest improvement is shown for Train Control.

2 Operating Cost Approach Implications

The use of reported costs is a practical method in the first instance of establishing a broad budget.

The weakness of the approach lies in the accuracy of the recorded costs and we suggest that in this instance some above rail “train control” has been included in the recorded and reported costs.

The “glide path to efficiency” is a laudable strategy and provided on-site management with real targets for efficiency.

With a 70% target for 2016/2017, Train Control costs will be approximately $2.1m and be more comparable with the benchmarks provided in Table 8 and our suggest budget.

Having said that we would be cautious about choosing a glide path which has not taken account of the economies of scale that may have been present in the larger pre-split QR, but at the same time mindful of the need for a settling in period under the new regime.

We suggest these targets could be expressed in a Regulatory Submission in terms of workload and resources required where a bottom up budget is presented.

The fact that QR has readily identified the inefficiency of its operations and is making steps to rectify the inefficiencies will be applauded by the industry.

We note that the 2012/13 reported costs fall within the 2015/2016 target but that Train Control still remains outside of a reasonable range.

3 Summary of Analysis and Recommendations

QR has presented a methodology and budget that begins a process of efficient operations over a 4 year period.

For the most part the costs presented are commensurate with benchmarks except for the relatively large component of Train Control.

QR appears to have recognised their inefficiency and the target improvements will, over a 4 year period, be comparable with other industry benchmarks for Train Control.

Therefore the only issue left outstanding is how the QCA and Stakeholders may wish to consider the efficacy and funding of the transition.

A detailed bottom up budget process will underpin future reviews and a robust reporting function where above rail and below rail costs with a stabilised operation can be appropriately identified will add to the rigour of the costing process.

There already appears to be considerable variability in the glide path to efficiency since most of the costs have already reached their four year target as shown in the recently reported 2012/13 report. At one level this is concerning that they could change so dramatically in one year, but in an overall sense, welcomed. There may be issues of cost categorisation that will need to be addressed. For example Train Control may be burdened with higher "administration" costs which in turn have shown extraordinary reductions.

Chapter 4 REVIEW OF DORC

1 DORC Background

On 25 February 2013, Queensland Rail submitted a voluntary draft access undertaking for its West Moreton System (the 2013 DAU) to the Authority for its approval. The Authority has commenced its investigation into the 2013 DAU, which includes reference tariffs for coal-carrying train services operating on the West Moreton System.

Queensland Rail has proposed operating and maintenance (O&M) as well as capital expenditure (Capex) forecasts relating to the West Moreton System reference tariffs and the Authority must assess these in order to consider the efficiency of Queensland Rail's proposed reference tariffs. Other Chapters of this report address those issues.

The Authority's consideration of the appropriateness of Queensland Rail's proposed reference tariffs will be based on the review of the costs related to the below-rail operations underlying its proposal.

Consequently, the Authority engaged B&H Strategic Services Pty Ltd to assess the reasonableness of the O&M costs, Capex costs and DORC in order to consider the proposed West Moreton reference tariffs.

The West Moreton System runs west from the edge of the Brisbane suburban network, across the ranges to Toowoomba and to Columboola, servicing the recently expanded coal province as well as general traffic such as grain and general freight plus a passenger service.

QR has submitted various documents[97]. This review by B&H will consider these reports. In addition, B&H, together with officers of QCA and QR undertook a track inspection of the infrastructure in August 2013 and the observations of that inspection will also be taken into consideration.

Finally, B&H and QCA formulated clarification questions addressing items in the Maintenance Cost Submission to which QR responded with configuration details. Requests for condition data were not responded. A further meeting was arranged to discuss the timber sleeper strategy in detail.

We have derived the condition of the assets in order to estimate deterioration by referring to the maintenance and Capex programs, both past, present and future. The maintenance and Capex programs reveal a deteriorated formation, structures and track asset. This Chapter details those deteriorations and estimates. A summary of the depreciated metrics for each asset element is shown in Table 9.

In this analysis we have interpreted the Optimised Replacement Cost (ORC) to be that associated with the Modern Engineering Equivalent Replacement Asset (MEERA) identified by Connell Hatch and adjusted by Everything Infrastructure and subsequently published by QCA in 2009.

[97] "WMRTR Maintenance Submission Final (Public)" (Maintenance Cost Submission) to QCA in support of their Reference Tariff submission and they have also submitted a review of the CAPEX and OPEX work programs over the Regulatory Period by their consultants WorleyParsons in "Queensland Rail - Attachment 4_Worley Report_Confidential(629497_1)" (the WorleyParsons report).

In that draft determination, for example, all sleepers in the network were concrete sleepers with a 50 year life. In this analysis, if a timber sleeper with half its life remaining, that is 10 years, we have determined that this is sleeper has a remaining life of 10 years in 50 years. That is, it is 80% life expired against the benchmark of the concrete sleeper. This principle has been applied to all assets.

Table 9 Summary of asset life assessment

Asset Element	Remaining Life	Life expired as a % of ORC
Formation	34 years (of 100)	66%
Top 600	34 years (of 100)	66%
Rail	30.63 years (of 58.82)	47.9%
Sleepers	25.65 years (of 50)	48.7%
Ballast	10 years (of 20)	50%
Tunnels	50 years (of 100)	50%
Bridges	26.34 years (of 100)	73.66%
Culverts	25 years (of 50)	50%
Turnouts	23.85 years (of 50)	52.3%
Signals	10 (of 20)	50%
Telecom	10 (of 20)	50%

The reason that rail attracts a life of 59 years is because it is over-specified in the ORC and we have reflected the actual life it will achieve. It has been over-specified to compensate for the poor state of the formation and we assume for strategically preparing the corridor for higher axle loads, although this cannot happen until bridges are substantially upgraded.

For ORC elements we recommend 100 years life for bridges, 20 years for signals and telecoms.

2 Asset Elements

In this section we assess each element of the asset to conclude with the estimated remaining value of the ORC, reflecting both the nature of the assets, and their condition.

2.1 Formation

In this section we detail the status with regard to the deterioration of the formation.

QR has paid much attention to the formation of the West Moreton system, which appears to be the most problematic asset, causing the most on-going distress and cause for unreliable train running.

Since 2007 QR has expensed capital monies relating to the formation into:

- Columboola to Port of Brisbane Upgrade including $6,780,000 into "cuttings" and "embankments" amounting to approximately 11kms of formation repair using the unit cost from the AU1 Submission.
- Jondaryan Upgrade including $1,686,507 on "track reconditioning" amounting 2,310m as well as 2,850m of "formation stabilisation"
- Western System Asset Replacement includes 21.865km of "track reconditioning".

We assume that where "track reconditioning" has occurred, that this has been undertaken on areas that do not need formation repair and that for the most part these areas have been fully restored to their function.

In the AU1 submission the following is planned:

- $8,063,000 on "slope stabilisation", amounting to approximately 8km (our estimate) of equivalent track formation functional re-establishment
- 20kms of "formation repair" at 5kms per year. The proposal indicates[98] that "*It is forecasted that 5km per year will ensure defect growth is less than repair works. This work program is expected to continue past 2016/17"*.

For these works we assume that "slope stabilisation" will also bring the formation (which includes cutting and embankments) to restored function.

The Rosewood to Columboola Line route is approximately 300kms in length.

The work performed from 2007 to 2012 amounts to 38 kms of track which is, in the context of formation life, near new.

The work to be performed 2013 to 2017 amounts to approximately 28kms of line, which is, in the context of formation life, near fully life expired.

In addition a further 5kms per year of formation repairs is likely into the foreseeable future. The completion of the program would take 51 years.

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[98] AU1 West Moreton Reference Tariff Reset Capital Submission, Item 2, AU1 Civil Projects

If a program of 5kms per year is indicative of the need for formation repair then the average life remaining, using 100 years as the nominal formation life, is 34 years taking into account the work already performed and that planned in the next Regulatory Period.

An outline of the calculation is shown in Table 10.

Table 10 Formation Life

Year of Repair	Kms Repaired	Remaining Life in 2013
2007-2013	38 kms	99 to 94 years
2014-2017	28 kms	0 to 4 years
2018-2064	5 kms per year	5 to 51 years
Weighted Average		34 years

That is, the formation asset is life expired to 34% of its new (ORC) value.

2.2 Top 600[99]

There is ample evidence to suggest that the West Moreton System was built with no Top 600 as we know it today.

The Top 600 that does exist has been added at a later time and therefore we need to rely on the historical records to indicate when the asset was added.

The historical records consist of those accessed for the formation.

We consider that the indicators of the need to replace or upgrade the formation are the same as those for the Top 600 and therefore we conclude that, while the Top 600 may not actually exist, its function is being performed by whatever material is present.

Our conclusion is the same as for the formation asset in section 2.1. That is, the Top 600 asset is life expired to 34% of its new (ORC) value.

2.3 Rail

2.3.1 Background

In its response to the QCA's Clarification Question on Maintenance, QR provided details of the curves and straights of the route and the rail size and details in each section[100].

[99] The top 600 is the earthworks structure at the top of the formation and under the ballast, typically in Queensland of depth 600mm but not always, the depth depending on geology and weather

From these details we know the current (2011) use of 50kg/m rail[101] and 41kg/m rail[102]and whether used on curves or straights, curve radius as well as whether the rail is on the loaded, empty or single track.

Some 50kg/m rail has been placed on timber sleepers, some on steel sleepers[103] and some 60kg/m rail has been placed on concrete sleepers. Similarly 41kg/m rail is placed on timber, steel or concrete sleepers.

There are relatively very few curves between Jondaryan and Columboola, and those are generally relatively flat with radius greater than 1000m.

Between Rosewood and Jondaryan there is 204kms of track, 121 kms of which is 41kg/m rail track and 83kms of 50kg/m rail track. Some of this track is main single line, some crossing loop, some main loaded ("Down") track and some empty coal train ("Up") track. This section of line is projected to carry[104] approximately 16 MGT[105] per annum (8 MNT[106]). Between Jondaryan and Macalister there is 66kms track of 41kg/m rail type which is projected to carry approximately 9 MGT per annum. Between Macalister and Columboola there is 86kms track of 41kg/m rail type which is projected to carry approximately 6 MGT per annum.

This is a total of approximately 273kms of track with 41kg/m rail. Some of this rail will be replaced in the capital program proposed for the Regulatory Period.

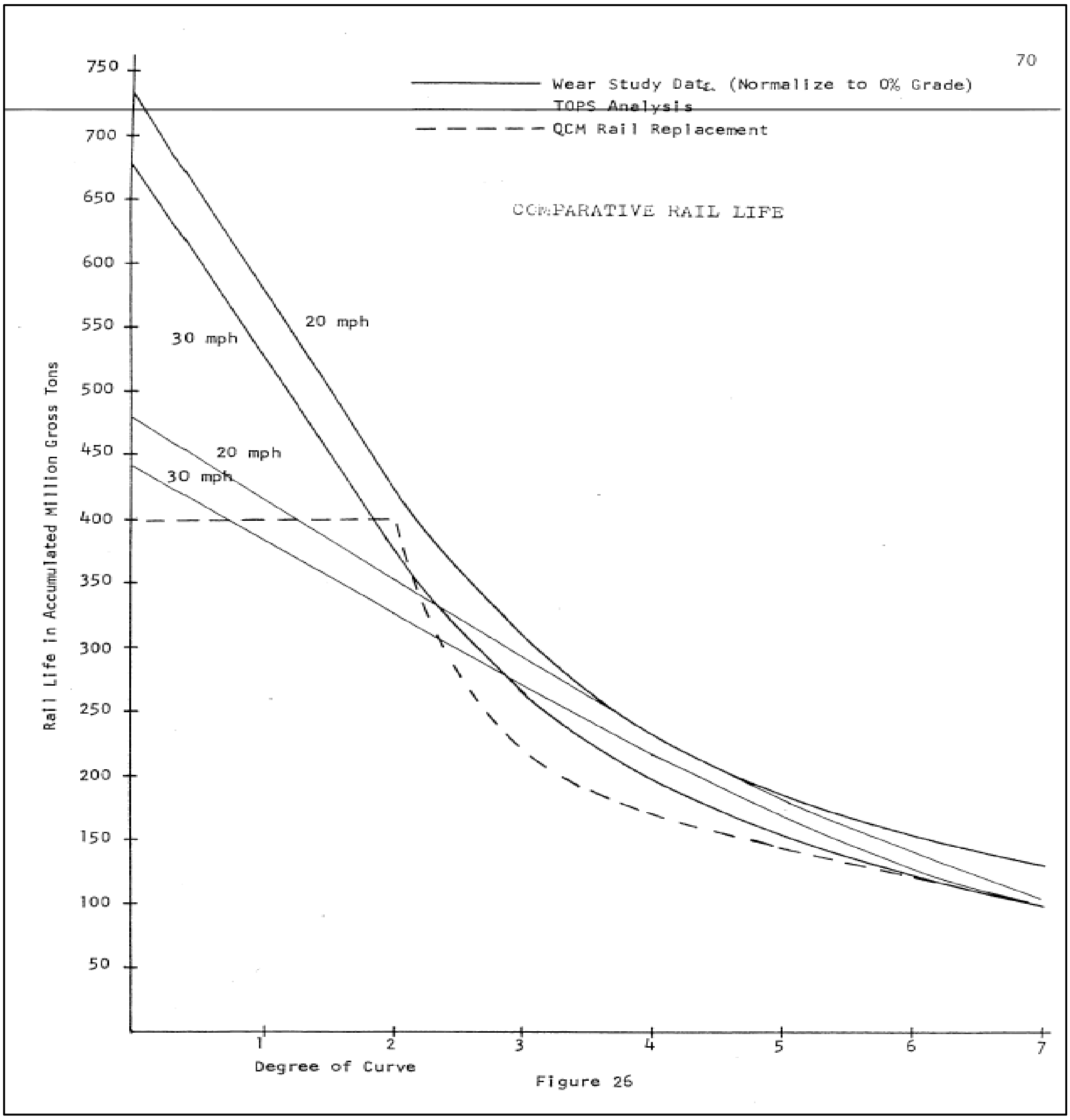
2.3.2 Rail Life

In order to estimate the remaining life in the rail we have referenced the Civil Engineering Studies, Transportation Series No. 12, "*Report of Rail Life Analysis*", Supervised by W.W. Hay and with Project Investigator Paul T. Bakas. This is a seminal piece of work frequently referred as a basis for estimates of this kind. Figure 8 shows this original work.

We have derived similar curves for each rail type using the benchmarks

Figure 8 Relative Curve Wear Rail Life

[100] QR has indicated that the data provided is approximately 2 years old since no data has been input since mid-2011. QR plan to introduce a new asset management system. The quantity of rerailing performed in the last 2 years is immaterial.
[101] A very minor length is 60kg/m rail which we have subsumed into 50kg/m head hardened calculations and a minor length is 53kg/m rail which we have subsumed into 50kg/m calculations
[102] Some very minor lengths of 60kg/m rail and 60lb/yd rail do occur
[103] At the site visit Aug 2013 we were told 50kg/m rail was not physically compatible with steel sleepers, but this is true only of the older style sleeper
[104] Overall Submission Section 4.4 Volume Forecasts, QR
[105] Rounded to approximately 2 times net tonnes since GTK/NTK is approximately 2.
[106] Rounded to include other traffics in addition to the 7.545 coal, similarly other estimates in this section



Note that Seven degrees of curvature is the same as 250m radius. Nineteen degrees of curvature is 92m radius, the sharpest mainline curve on the West Moreton System. This set of data indicates a rail life relationship of MGT Life = 173.37 * ln(Curve Radius in metres) - 785.89

Since 1979 when this paper was written, significant improvement in rail life has occurred because of the advances in rail grinding, lubrication and rail steel composition. But the relative lives of curve and tangent[107] rail has remained similar. Today, it could be expected that straight rail (tangent) with 50kg/m rail (not head hardened) and 15.75 tonne axle load could achieve 1,000 million gross tonnes life and this life is on the basis of grinding wear reduction rather than fatigue. On tangent rail the life expected of 41kg/m rail is 500 MGT and this life is the result of fatigue failures rather than wear. On the sharpest of the curves on the West Moreton System with 50kg/m head hardened rail, we

[107] Straight track

estimate a life of 400 MGT. On the sharpest of the curves with 41kg/m rail[108] we estimate a life of 100 MGT. We therefore estimate that the relationship for rail life is:

- for 50kg/m head hardened rail is MGT Life = 369.15 * ln(curve radius in m) - 1400,
- for 50kg/m rail standard carbon (non head hardened) is MGT Life = 173.72 * ln(curve radius in m) – 600.00, and
- for 41kg/m rail[109] is MGT Life = 86.859 * ln(curve radius in m) – 300, where the operator "ln" is the natural logarithm.

We have deduced these lives using the Reference data in Figure 8 as well as more recent data from other sources referenced below.

- At the Heavy Haul Conference India 2013, reports of rail lives of more than 2,000 MGT were made using alloy steel with sophisticated rail grinding and other husbandry[110].
- In 2006, ARTC commissioned Booz Allen Hamilton for their DORC[111], and estimated an "overall average" life, including curves, of 750 MGT for 53kg/m rail and interstate container traffic.
- The Indian Railways guideline[112] for life of 52kg/m rail is 525 MGT (including curves and straights).

In the West Moreton System the "equation" predicting the remaining rail life consists of an evaluation of all the different circumstances for all the different locations on the system and with all the different rail types.

2.3.3 Rail Optimisation

The reduced rail life for 41kg/m rail over 50kg/m rail is indicative of the adjustment that must be made to the ORC on account of the configuration of 41kg/m rail compared to 50kg/m rail which has been chosen for the ORC.

In choosing 50kg/m rail for the ORC, Connell Hatch was in fact saying that 41kg/m rail is sub-optimal despite the fact that 41kg/m rail on concrete sleepers and modern engineering formation and structures is quite adequate for 15.75 tonne axle load. That's because in designing a railway today for 8 million tonnes of coal, one would not design for 15.75 tonnes axle load, but rather 21 tonne or 23 tonne axle load.

Similarly the use of Head Hardened 50kg/m rail could also be deduced as sub-optimal since it is not mentioned in Connell Hatch ORC estimates. However, we have assumed that on a case by case basis the use of Head Hardened rail is justified and provides a

[108] This is a hypothetical construct because all the sharp curves have been rerailed in 50kg/m, but it provides a reference point.
[109] 41kg/m rail is not manufactured in head hardened steel, only standard carbon
[110] Sroba P. "Preventive Grinding on Estrada de Ferro Carajás, Brazil", 10th International Heavy Haul Conference February 4 to 6, 2013, New Delhi, India
[111] ARTC Standard Gauge Rail Network DORC Australian Rail Track Corporation Ltd Sydney January 2007
[112] Indian Railways FAQ Permanent Way.htm

better economic result. Of the 43 track kms of 50 kg/m rail between Rosewood and Toowoomba on curves, only 13 tracks kms of Head Hardened rail is used.

2.3.4 Rail Situation

There are many different curve situations from very sharp to tangent track. The sharpest curve on the mainline track is 92m radius which is very sharp for conventional railway locomotives of the CoCo type and for coal wagons. These curves will wear out very rapidly.

Generally[113], rail that wears quickly will not be degraded by fatigue failure.

We have referred to the QR database of curvature and tonnage on this System and summed all the curves, their respective locations and the tonnage over each curve since they were laid.

We have made assumptions about how much tonnage has already been over the existing track. The assumptions are based on past capital programs, future capital intentions and submissions from QR as to the maintenance effort required on existing rail.

2.3.5 41kg/m Rail

For nominal tangent track we have used a radius of 10,000m to calculate the expected total life of 500MGT. We have then adjusted the expected life for all curve and tangent situations on a curve radius weighted basis.

Between Rosewood and Jondaryan, there is 28.56kms of 41kg/m rail track on the loaded (Down) track that will receive approximately 48 MGT[114], there is 44.64kms on the empty (Up) track that will receive 16 MGT[115] and there is 4.48kms on the single line section of 41kg/m rail that will receive approximately 64 MGT[116] over the Regulatory Period. Over the previous Regulatory Period it received a similar amount.

The Rosewood to Jondaryan section has received a long history of mixed freight traffic and coal traffic. We estimate that it has received between 200 MGT and 300 MGT from coal and a further 50 MGT from freight and passenger traffic over an extended period.

Therefore we estimate that the remaining 41kg/m rail in the Rosewood to Jondaryan section, a track length for the 41kg/m rail of 121.35kms, will exhibit a remaining life of no more than 25% of an initial life of 450 MGT[117], or 13 years[118], with much of it needing replacement in AU1 or AU2 as has been programmed.

Between Jondaryan and Macalister, the accumulated tonnage from coal is in the vicinity of 100MGT and our estimate is that the rail is at half life or approximately 240 MGT of

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113 Not always true, but the wear removes any initiator cracks. Will also depend on the cleanliness (impurity content) of the steel.
114 8 million tonnes load plus 4 million tonnes tare for the loaded train times 4 years
115 4 million tonnes of the empty train tare times 4
116 4 times 16 MGT. The ratio of Gross tonnes to Net tonnes is approximately 2
117 Nominally 500MGT on tangent and then adjusted for curves on a radius weighted average basis, equivalent to 58 years life at new for a weighted annual tonnage of 7.6MGT
118 On an empty/loaded/single track weighted basis for remaining 100MGT life

480MGT[119], where the track is mainly tangent. This track length, all with 41kg/m rail, is 66kms.

Between Macalister and Columboola, the accumulated tonnage from coal is small but historically, like the other sections has carried freight and passenger traffic from which we estimate it is at one third life or approximately 150 MGT of 450MGT. This track distance, all with 41kg/m rail, is 86kms.

2.3.6 50kg/m Rail

On the West Moreton system, the relaying of 50kg/m standard carbon and 50kg/m Head Hardened rail is a relatively new practice and coincides with a program to renew or reinstate the formation, ballast and concrete sleepers.

The situational occurrence of 50kg/m rail is different to that of 41kg/m rail because 50kg/m rail has generally[120] been utilised to rerail in locations where maximum tonnage combine with the tightest radius of curvature. Consequently, 50kg/m rail only occurs in the Rosewood to Jondaryan section.

The activity of rerailing in heavier 50kg/m[121] rail started in 2000 and has continued through to the end of the last Regulatory Period. Approximately 88kms of the total length is now 50kg/m rail and using the 2009 Access Undertaking Submission and the data obtained during the valuation[122], the rate of replacement has been relatively consistent but with higher rates of replacement toward the latter half of the last decade.

Of the curves with 50kg/m rail[123], the percentage life already used is estimated as 9 years on an age/length/radius weighted basis. That is 9 years of a new life of 32 years. Of the straights/tangent with 50kg/m rail, the percentage life used is estimated as 15% already consumed leaving 85% remaining life of the 51 year new life.

The differences in configuration and of rail size and hardness make individual differences and detailed in Table 11.

2.3.7 Summary

Rail life will vary depending on rail weight, rail chemical and hardness composition, curvature and tonnage. In this analysis we have used data supplied by QR in response to the Clarification Questions as well as valuation data obtained during the 2009 Access Undertaking process and calculated the remaining life for the various combinations of rail configuration in the West Moreton System and summarised in Table 11.

In Table 11 the initial life of the remaining rail will vary because the configuration of the remaining rail will be different from section to section. For 41kg/m rail, most of the rail in

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[119] Notionally 500MGT for tangents and then adjusted for curves on a radius weighted average basis

[120] Not in every case and the use of 50kg/m rail has also been used on straights with concrete sleepers to provide extra support in areas of poor formation strength

[121] Some is 60kg/m rail for which we have assumed the same life profile and head hardened 50kg/m rail since its ultimate life is determined by wear and where there is greater wear scope

[122] Final Estimate Report Western System – Depreciated Optimised Replacement Cost (DORC) Assessment Queensland Rail 6 August 2008 Connell Hatch

[123] A minor number of curves have 60kg/m and 53kg/m and some have head hardened 50kg/m but the majority is 50kg/m standard carbon

the Rosewood to Jondaryan section will be tangent and on the empty track where there is double track, and most of the curves have been rerailed in 50kg/m rail whereas in the Jondaryan to Macalister section, curves still remain but the tonnage is lower. In the Macalister to Columboola section, the number of curves is very small.

Table 11 Remaining Life of Rail on the West Moreton System

Rail Weight	Length of Track[124]	Life at New	Remaining Life in 2013
41kg/m Rosewood to Jondaryan	121 kms	58 years	13 years
41kg/m Jondaryan to Macalister	75 kms	53 years	26 years
41kg/m Macalister to Columboola	89 kms	80 years	53 years
50kg/m on curves	39 kms	32 years	23 years
50kg/m HH on curves	17 kms	58 years	50 years
50kg/m rail on straights	37 kms	51 years	43 years

Notes: The 41kg/m between Rosewood and Jondaryan exhibits a higher "life at new" because it remains in lightly used track, empty/up direction and loops.

The distance weighted life at new is 58.82 years and the distance weighted remaining life is 30.63 years indicating that the rail has expired from ORC by 47.9% and that the remaining life is 52.1% of ORC.

[124] The length of rail in a kilometre of track is 2 kilometres. For double track areas, the length of the formation is only one half of the length of the track

2.4 Sleepers

2.4.1 Background

The West Moreton System contains a number of different configurations of sleepers including different materials and different designs from the same material. In this report each configuration or sleeper type will be dealt with separately.

The remaining life of sleepers may have little to do with the deterioration of the sleeper. QR has clarified[125] their strategy to install concrete sleepers and 50kg/m rail on sections of heaviest tonnage, tight curvature and poor formation locations to improve the reliability of the infrastructure. Therefore timber sleepers and steel sleepers may be changed for concrete sleepers earlier than their nominal life expiry. There is evidence of this at the side of the track[126] where steel sleepers are stacked, presumably for future use on other lines.

The determination of DORC will need to consider the salvage or disposal value of these surplus assets. QR has not indicated a salvage value for the sleepers in their maintenance or capital submissions or resulting from the work they have done in recent years.

The number of various sleeper types between Rosewood and Columboola used in tracks including in loops[127] is shown in Table 12[128]. In this table the Track Km has been calculated as the equivalent length[129], but for timber and steel sleepers these have been used in conjunction with one another or solely and therefore do not represent a contiguous length. Concrete sleepers are only used contiguously. Each sleeper type will be reviewed separately.

Two sleeper spacings are used by QR depending on the sleeper type, tonnage, speed and line status. The ORC, based on concrete sleepers and 50kg/m rail used a spacing of 685mm or 1,460 per km. According to QR Drawing 10435, Track Types, timber and steel sleepers for use with 41kg/m rail also have a spacing of 685mm.

Table 12 Sleeper Types Used

	Rosewood-Toowoomba		Toowoomba-Columboola		Total	
Type	Sleepers	Track Km	Sleepers	Track Km	Sleepers	Track Km
Steel	42,218	29	139,291	95	181,508	124
Timber	46,182	32	143,578	98	189,761	130
Concrete	142,460	98	38,464	26	180,924	124
Total	230,860	158	321,333	220	552,193	378

125 Response to Clarification Questions
126 Site visit August 2013
127 Some smaller sidings have been included but are not material and are part of the amalgam of data available from QR
128 Data sourced from the spreadsheet replies provide in response to the Clarification questions sought by QCA in 2013. QR advised on 12 Feb 2014 that the data was approximately 2 ½ years old and therefore some of the concrete sleepers will not be included in the data
129 Number of sleepers equivalent to a number of kilometres, but steel sleepers and timber sleepers are mostly not contiguous

2.4.2 Concrete Sleepers

QR strategy to move toward a fully concrete sleepered track with 50kg/m rail is based around the proposition that the railway will be required to transport existing levels or higher levels of coal into the longer term[130]. The majority of the concrete sleepers to be used under this approach will be the full depth concrete sleeper purchased from the Rockhampton factory of Austrak and which are suitable for the 26.5 tonne axle loads of the CQCN and which are designed for 28[131] tonne axle load. The other concrete sleeper type used is the "low profile" sleeper suitable for restricted headroom locations such as for tunnels. This sleeper is suitable for 20 tonne axle load. Both sleepers have been considered together in this report as the cost of both is similar[132].

The full depth concrete sleeper used in the 15.75 tonne axle load environment of the West Moreton System, are highly over designed. Nevertheless their use has been based on the ease with which they can be purchased under the existing sleeper supply contract now managed by Aurizon. No evidence that alternative sources were investigated for the lower axle load application is apparent. But given the universality of their application, both in the CQCN and suburban Brisbane and the absence of similar demand in the geographic vicinity of Queensland it is unlikely a cheaper price for concrete sleepers of this type could have been obtained.

Evidence for the use of full depth concrete sleepers to 2012/2013 comes from the DORC Valuation 2009, Appendix B, Connell Hatch; the spreadsheets of curves and straights supplied as part of "Clarification Questions to QR 2013", and the WSAR, Columboola and Jondaryan upgrade projects submitted as part of QR's capital submission for the 2013 AU1.

Despite Connell Hatch asserting in its "Response to EI Questions on CH DORC 2-Mar-09.pdf" document that "*The QR Standard for coal railways specifies concrete sleepers*", and is a justification for the ORC concrete sleeper standard, we do not agree that this is a coal railway as it is not being evaluated on a Stand-Alone basis since it is mixed use and with a relatively low annual tonnage and very low axle load (15.75t) it has very little similarity with the coal railways of CQCN. With an ORC standard formation there is no reason why, at least west of Jondaryan and on the empty train parts of the line to the east of Jondaryan, a steel sleeper track structure would not be adequate.

Data for concrete sleeper installation is detailed in **Table 13** and based on that data the remaining life for the concrete sleepers is summarised in **Table 14.**

130 The current QR Submission for the next Regulatory Period only makes reference to "existing contract" levels.
131 QR West Moreton Capex Information Request QCA_Final_PW.pdf, page 5
132 QR West Moreton Capex Information Request QCA_Final_PW.pdf, page 5

Table 13 Concrete Sleeper Installation on the West Moreton System

Installation Date	Number Installed	Remaining Life[133]	Source
1999	1,868	36 years	Appendix B, DORC Valuation, Hatch 2009
2000	9,296	37 years	
2002	27,012	39 years	
2004	90,641	41 years	
2005	13,292	42 years	
2006	18,483	43 years	
2011-2013	21,534	48-50 years	WorleyParsons[134] concluded average cost was $339 per sleeper "*Concrete Sleepers on a face Toowoomba to Jondaryan WL*" $7,300,000 assume 21,534
2011-2013	6,556	48-50 years	
2008	2,868	45 years	Assume half 3.5km in each year 2008 & 2009 2011: 3.419km at 1,639 per km 2012: 5.589km 2013: 7.607km QR West Moreton Capital Information Request_QCA_Final_PW.pdf ref WSAR clarification
2009	2,868	46 years	
2010	0	NA	
2011	5,604	48 years	
2012	9,160	49 years	
2013	12,468	50 years	
2011	14,085	48 years	"Gatton-Helidon Resleepering" $4,774,666 assume 14,085 sleepers at $339 02 Business Case - Jondaryan Track Upgrade_pw.pdf
2011	2,955	48 years	"*Air Force Straight Resleepering*" $1,001,642 assume 2,955 sleepers
2011	4,667	48 years	"*Resleepering*" $1,582,087 assume 4,667
2011	1,658	48 years	"*Track Reconditioning*" $1,686,507 assume third cost is sleepers, 1,658

Table 14 Summary Concrete Sleeper Remaining Lives

Remaining Life (yrs)	Number of Concrete Sleepers	Remaining Life (yrs)	Number of Concrete Sleepers	Remaining Life (yrs)	Number of Concrete Sleepers
36	1,868	41	90,641	46	2,868
37	9,296	42	13,292	47	0
38	0	43	18,483	48	38,332
39	27,012	44	0	49	16,338
40	0	45	2,868	50	19,646

[133] Assume 50 years life for concrete sleepers, life is time dependent not tonnage dependent, and is commensurate with the Everything Infrastructure Report, Assessment of Western System Asset Valuation, November 2009. The full depth sleepers in use are suitable for nearly twice the axle load applied on the West Moreton System

[134] Queensland Rail - Attachment 4_Worley Report_Confidential(629497_1).pdf, QR Maintenance Submission

Table 14 indicates that the average remaining life for concrete sleepers is 43.29 years. Thus the concrete sleepers are life expired by 6.71 years or 13.42% of the ORC leaving 86.58% for the DORC.

Concrete sleepers make up 32.76% of the total number of sleepers.

2.4.3 Steel Sleepers

Steel sleepers have been used in two ways. They have been used in association with timber sleepers on a 1 in 2, 1 in 3, or 1 in 4 pattern approach and they have also been used "on a face"[135] so that every sleeper is steel. QR has a long history of the use of steel sleepers on secondary lines as they are compatible with timber sleepers when mixed, and therefore are able to be used without full replacement of all the sleepers in the section of track[136].

In total 181,508 steel sleepers are in place[137] on the West Moreton System representing the equivalent of 124 kms of track.

2.4.3.1 Historical Background

In view of the absence of direct historical information on the installation dates for steel sleepers we have relied on historical data on manufacture and installation trends in the following paragraphs to estimate the time if installation.

The steel sleepers in use on the West Moreton System are of various ages and designs, although all were Australian produced by BHP/Traklok in Whyalla South Australia. The Traklok designs include the Traklok I style where the spring clip is inserted directly into a hole in the sleeper and pressed up shoulders retain the foot of the rail. These sleepers are only suitable for 41kg/m rail. These sleepers were available between approximately 1984 and 1987.

These sleepers were superseded by the Traklok II design where a hook-in shoulder retains a spring clip and the shoulder can be positioned for either or both the 41 kg/m rail or the 50 kg/m rail. These sleepers were available after 1987.

BHP's first Australian steel sleepers with a researched design were released in 1983 for the Pilbara railways and shortly thereafter for other railway systems. Testing and research had been conducted by a BHP Research organisation, now Institute of Railway Technology at Monash University for wide application during the late 1970's to early 1980's.

Queensland Rail started their steel sleeper insertion using them on a face (contiguous) but testing of interspersed steel sleepers were successful and this practice started in the mid 1980's with a major review undertaken by T Griffin in 1991[138]. The practice of interspersed steel sleepers became cost effective since less steel sleepers were needed when spaced between or among timber sleepers that still had a useful life.

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[135] Contiguously over a length of track

[136] Low profile concrete sleepers have been used in this way around Australia to varying degrees of success but QR is only using concrete sleepers contiguously

[137] Latest detailed data is to mid 2011

[138] Griffin T, The Effects of Interspersing Steel Sleepers into Existing Timber Sleepered Track, October 1991

Three interspersed patterns are observed. The 1 in 2 pattern is one that has developed from an initial 1 in 4 pattern. This can be observed in Figure 36 – Typical track section in the WorleyParsons report[139]. The Traklok I sleepers are interspersed at 1 in 4 and the Traklok II sleepers are interspersed at 1 in 4, making an overall 1 in 2 pattern. The Traklok II sleepers are the “second wave”.

The remaining 1 in 4 pattern represent the first wave of steel resleepering and there are very few remaining in that pattern, approximately 2000 sleepers only.

The 1 in 3 steel sleeper pattern represents are quandary for QR as they are not easily “upgraded” with further steel sleepers without a total replacement of the 2 intermediate timber sleepers. This pattern was part of the “first wave” and represent a relatively small number of approximately 25,000 sleepers or about 10% of the total population.

2.4.3.2 Installation Estimates for DORC Remaining Life

Using the foregoing history, in this analysis we have assumed installation dates for the steel sleepers as follows:

- Steel sleepers on a face: Installation between 1984 and 1990
- Steel sleepers on a 1 in 4 pattern: Installation between 1987 and 1992
- Steel sleepers on a 1 in 3 pattern: Installation between 1987 and 1992
- Steel sleepers on a 1 in 2 pattern: Installation between 1987 and 1992 for the first tranche of 1 in 4 and between 1995 and 2005 for the intermediate 1 in 4 (to result in 1 in 2)

The range of dates is reflective on the incremental installation, performed most probably with maintenance/opex funds over a long period of time over different sections. We have inferred these estimates. We will further assume that the steel sleepers in the track were installed evenly year to year.

In the WorleyParsons report it is reported that “Figure 37 - Steel sleepers were generally in fair condition although some signs of corrosion and aging generally evident”.

One could expect from this statement that noticeable life had expired from the sleepers.

2.4.3.3 Remaining Life

For the purposes of this DORC review a life of 50 years for the steel sleepers has been assumed on the basis of the relatively light axle load and non corrosive[140] ballast conditions. Most steel sleepers are already at least half life.

The order of steel sleeper installation, derived from the data provided for straights and curves in QR’s response to the QCA Clarification Questions and using the assumptions

[139] AU1 West Moreton Reference Tariff Submission Review, WorleyParsons, September 2013

[140] At least as to not cause undue corrosion. Some ballast has been noted as being inoperative for drainage but by far the majority is in good condition and reflects attention to resurfacing and large quantities of ballast used in the previous years, possibly to compensate for poor formation conditions.

outlined are shown in Table 15 and the remaining life for steel sleepers shown in Table 16.

Table 15 Steel Sleeper Installation

Steel Sleeper Installation			
Current Configuration	# Steel	Dates Installed	Av # Installed per Year
Face	28,309	1984-1990	4,044
1 in 4	2,153	1987-1992	359
1 in 3	14,616	1987-1992	2,436
1 in 2	136,429	1987-1992	8,025
		1995-2005	8,025
Total	181,508	1984-2005	8,250

Table 16 Steel Sleeper Remaining Lives

Steel Sleeper Remaining Lives (2013)		
Installed	Years Life Remaining	# Steel Sleepers
1984	20	4,044
1985	21	4,044
1986	22	4,044
1987	23	14,864
1988	24	14,864
1989	25	14,864
1990	26	14,864
1991	27	10,820
1992	28	10,820
1993	29	0
1994	30	0
1995	31	8,025
1996	32	8,025
1997	33	8,025
1998	34	8,025
1999	35	8,025
2000	36	8,025
2001	37	8,025
2002	38	8,025
2003	39	8,025
2004	40	8,025
2005	41	8,025
Total		181,508

Table 16 indicates that the average life remaining in the steel sleepers is 30.22 years. Thus the sleepers are life expired by 39.6% of the ORC, leaving 60.4% for the DORC.

Steel sleepers make up 32.87% of the total.

2.4.4 Timber Sleepers

In Table 12 we noted that 189,761 timber sleepers remain in track. Only 46,182 timber sleepers remain in the higher tonnage and sharper curved section of Rosewood to Toowoomba. Between Toowoomba and Jondaryan 11,720 timber sleepers remain.

QR has set out a timber replacement program in its Capital Submission for the Regulatory Period as:

- In the Rosewood to Toowoomba section QR has indicated in its Capital Submission that it will replace 8.949 kms of timber sleepered check rails in its Capital Program for this Regulatory period. This length[141] represents

[141] At 1460 per km

approximately 13,066 timber sleepers which are assumed to be life expired now[142].

- In the Toowoomba to Jondaryan section QR has indicated in its Capital Submission that 4kms of relay[143] will occur. We assume this will occur in a section of 1 in 2 steel[144]. This will replace 2,920 timber sleepers which are assumed for the DORC to be life expired now.

QR has set out a timber replacement program in its Maintenance Submission for the Regulatory Period as:

In the 2015/16 period

- *9,000 timber sleepers on the track section between Rosewood to Toowoomba;*
- *7,231 timber sleepers between Jondaryan to Dalby; and*
- *26,512 timber sleepers between Macalister to Miles.*

For a total of 42,743 timber sleepers

The 2016/17 program will replace approximately:

- *6,000 timber sleepers on the track section between Rosewood to Toowoomba;*
- *4,500 timber sleepers on the Willowburn loop;*
- *4,877 timber sleepers on the Toowoomba to Jondaryan section; and*
- *11,252 timber sleepers on the Jondaryan to Dalby section.*

For a total of 26,629 timber sleepers

The total number of sleepers that will be replaced during the Regulatory Period is 85,358 and we assume that these represent sleepers in the final one quarter[145] of their life.

2.4.4.1 Remaining Lives for Timber Sleepers

QR and WorleyParsons have stated that the expected life of a timber sleeper is 20 years[146] which is 40% of the expected life of a concrete sleeper. In the first stage of calculation of the value in relation to the ORC, timber sleepers are reduced in value by 60%.

In order to calculate the remaining second stage condition based remaining life of the 40% of a new timber sleeper we have assumed that the life of the total population is of normal distribution characteristics.

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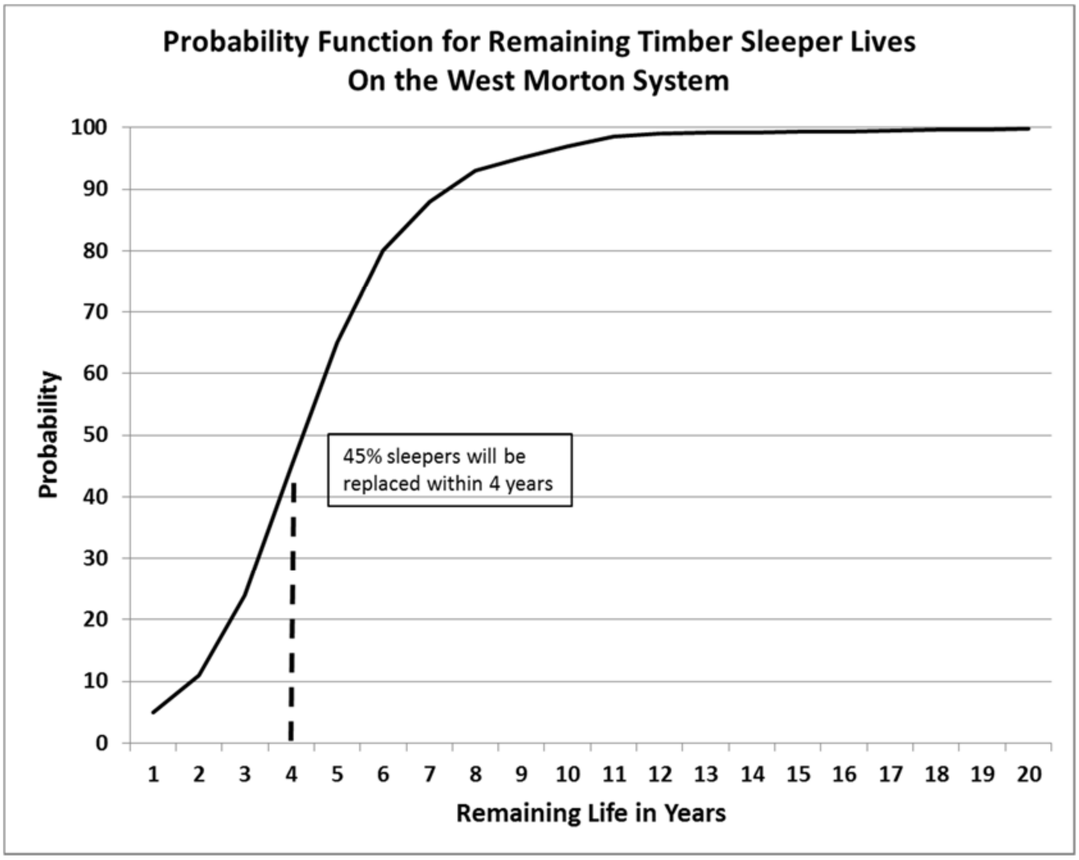
[142] The check rail configuration is life expired which has caused the timber sleepers to be life expired. Once removed it is unlikely the sleepers will be reused because the fastening configuration for check rails is different to that for plain track.
[143] Rerailing with resleepering at the same time
[144] We note some smaller sections of face steel in this section and will not be affected by the program
[145] QR have indicated in clarification answers that resleepering could be expected to occur "on a 5 to 6 year cycle", or one quarter of 20 years.
[146] The use of timber sleepers with steel is likely to increase the life of the timber sleeper, previously footnoted with reference in the Chapter on Maintenance

The number of sleepers replaced during the Regulatory period will be 85,358 which is 45% of the population. This indicates a large deficit in timber sleeper condition notwithstanding the special circumstances of the replacement of checkrails and the strategy to concrete sleeper weak areas of formation. The timber sleepers in these instances are life expired, not by way of condition, but by technical obsolescence.

If 45% of the population have remaining lives of 4 years or less, and the maximum life of a sleeper is 20 years, and the mean of the normal distribution is 10 years then there is a large skewness shown in Figure 9. The figure shows the skewed normal distribution using the ERF function.

Figure 9 Timber Sleeper Probability Function



This figure shows that most sleepers are less than the expected mean.

The average remaining life of the timber sleepers in the West Moreton System, that is where the probability is 50%, is 4.5 years or 22.5% of the 20 year life. Thus the life remaining in the timber sleepers as a percentage of the ORC is 22.5% of 40% or 9%. This is the same as 4.5 years in 50 years.

The expiry of the timber sleepers in the West Moreton System for the purposes of the DORC is 100%-9% or 91% leaving 9% of the ORC as DORC.

Timber sleepers make up 34.36% of the total.

2.4.5 Summary Sleeper Remaining Life

Table 17 summarises the contribution to life expiry of each sleeper type.

The remaining ORC is 51.64% indicating the total sleeper population has expired from a 50 year life by 48.36%.

Table 17 Summary Sleeper Remaining Life

	Concrete	Timber	Steel	Total
% of all sleepers	32.76%	34.36%	32.87%	100.0%
Remaining ORC	86.58%	9%	60.40%	
Contribution	28.37%	3.09%	19.85%	51.31%

2.5 Ballast

2.5.1 Background

We note in the Connell Hatch Report[147] Appendix B, that the depth of ballast specified for the ORC is 400mm for a volume per km of 1600 cubic metres (m^3). While this depth may be appropriate for a situation of severely degraded Top 600 and formation, such as the actual situation on the Western System, it does not reflect the standard that should be used for an ORC where the formation has been constructed as MEERA. The current QR standard[148] for 15.75 t axle load is a depth of 200mm. The appropriate volume would then be approximately 1100 m^3.

2.5.2 Ballast Use

We have noted in the Maintenance Chapter that QR plan to use a large amount of ballast during the Regulatory Period, equivalent to reconstruction of one fifth of the track of the System for an ORC design. One could conclude therefore that the full profile of ballast will be replaced over a 20 year period and this is commensurate with QCA's previous considerations where ballast is ascribed an asset life of 20 years. This represents a task of approximately 320 MGT, a relatively low life of ballast compared even with the CQCN where ballast coal contamination has a much greater impact.

2.5.3 Summary

QR appears to be replacing or upgrading ballast at a rate commensurate with the expected new life of the ballast to maintain its functionality. While it appears that the ORC is 31% (500/1600) greater than it should be, the replacement strategy is consistent with a view that the ballast is 50% life expired.

2.6 Tunnels

2.6.1 Background

The West Moreton System tunnels were constructed by 1867 when the line was opened to Toowoomba. The tunnels are already 146 years old.

2.6.2 Maintenance and Other Works

We note that according to the (2013) Maintenance Submission Queensland Rail have no maintenance plans for the 2013/2017 Regulatory Period but that Major Tunnel Repairs[149] were planned for 2009/10 and 2010/11. It is also our understanding that the tunnels will have work performed on them for the purposes of clearance improvement for certain loads in the near future but for which Queensland Rail is not submitting those costs for this evaluation.

2.6.3 Asset Life

In the QCA's Draft Decision 2009 the ascribed asset life for the tunnels is 100 years and as Queensland Rail have not flagged any particular maintenance problem with them

[147] Final Estimate Report Western System – Depreciated Optimised Replacement Cost (DORC) Assessment Queensland Rail 6 August 2008
[148] QR Track Types, Drawing Number 10435
[149] QR Network's Access Undertaking (2009) Western System Coal Maintenance Costs

there is no reason to suggest that the tunnels will not remain operative for at least as long as the "default[150]" life expiry would suggest, that is 50 years.

Therefore we conclude that the life expired is 50%.

2.7 Bridges

2.7.1 Bridge Inventory

At the beginning of this Regulatory Period a total of 109 timber bridges remain in the System. There are also 14 pre-stressed concrete bridges, under the responsibility of QR. A further 12 bridges are steel and (reinforced) concrete under the responsibility of QR.

During the 4 year Regulatory Period 13 timber bridges have been targeted for renewal or upgrade of major components (strengthening). Seven(7) Timber and Steel Bridges will be replaced with Reinforced Concrete Box Culverts. This make a total of 20 bridges that will receive major work, essentially to bring them back to as new functionality. At this rate it will be 2035 when the last of the timber bridges is replaced. That is, six Regulatory periods will be required to upgrade the bridges.

2.7.2 Life Expiry Approach

The ORC configuration relates to a pre-stressed concrete bridge with a 50 year life[151]. This previously determined new asset life, QCA's Draft Decision 2009, is inconsistent with their own determination for CQCN and also inconsistent with the Australian Standard AS5100.1 where a design life of 100 years is required[152].

Unlike timber sleepers, timber bridges have been shown to exhibit a 50 to 100 year life and this is achieved by replacing components when required. Thus the evaluation of the applicable remaining life for bridges will rely solely on their condition.

Direct evidence of the bridge condition was not available from QR at the time of this review but QR is in the process of obtaining a consultant's report.

Where the date of bridge construction or renewal, this may form a guide as to the remaining life but its condition is the definitive method of assessing its remaining life.

The condition of the asset is best indicated by its planned replacement date.

Where the replacement date is unknown or cannot be deduced or the installation date is unknown then an average remaining life of 50% has been applied.

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[150] When no data exists or when a value greater than 50 years indicates risk of stranding due to technical obsolescence, alternative route or resource depletion, a value of 50 years is adopted

[151] We note that in the Connell Hatch evaluation of asset lives, it was assumed the life of a new bridge was 100 years and that the remaining life for most bridges was 50 years after a depreciation factor of 50%. This evaluation is not in accord with QCA's Draft Decision of December 2009. In this review we will assume the concrete, steel and timber asset life from new is 50 years

[152] Apart from the ability of modern materials to sustain a 100 year life, the bridges also need to be designed for flood levels and loading that could reasonably occur in a 100 year life

2.7.3 Timber Bridges

We note the reference in QR's Maintenance Submission of the onerous task of maintaining the timber bridges. We deduce that replacement of those bridges will occur as soon as they can, both practically by meeting possession and line disruption criteria, and financially through capital fund allocation.

We assume that the current planned rate of bridge replacement or upgrade will continue to occur, that the current plans are indicative of the need to replace the bridges and that all remaining timber bridges will be replaced in 22 years' time, at the rate of 20 every 4 years, or 5 per year.

According to the Connell Hatch bridge inventory and Queensland Rail's stated number of timber bridges remaining, timber bridges make up 74% of the total replacement cost taking into account the number of spans and their length, with steel and concrete the remainder.

Assuming that the timber bridges will be all replaced by 2035, in 22 years' time, at the rate of 5 per year, the average remaining life of the timber bridges is 11 years. That is, the timber bridges are life expired by 78% ((50-11)/50) and that DORC is 22% of ORC.

2.7.4 Concrete and Steel Bridges

According to the Connell Hatch bridge inventory[153], the average life expiry applicable to the concrete and steel bridges is 40.001% on the basis of a 50 year life at new; that is, 30 years remaining. This generally reflects the replacements of timber bridges that have occurred as well as some upgrades over the last decade. The steel and concrete bridges make up 26% of the value of the total bridge inventory.

2.7.5 Summary Remaining Life for Bridges

On a replacement value weighted basis the average life expiry across all bridge types on the West Moreton System is 74% of 78% plus 26% of 40%, total 68.1%. That is, on average, the bridges on the West Moreton System are life expired by 68.1% of the ORC leaving 31.9% of the ORC as DORC on the basis of a 50 year life at new.

Our recommendation is that on the basis of 100 year life at new the average life expiry would be 74% of 89% plus 26% of 30%. That is, life expiry of 73.66% leaving 26.34% of the ORC as DORC.

2.8 Culverts

2.8.1 Background

The line was constructed nearly 150 years ago and at that time culvert material of construction was timber. It is most likely all timber culverts have been replaced with concrete or steel boxes, pipes, or arches since that time.

[153] DORC Valuation 080715 Appendix B – Excel.xls

2.8.2 Asset Life

In the QCA's Draft Decision, a new life for culverts adopted was 50 years. For an ORC evaluation it would be consistent to adopt a life at new as the same as for bridges because the material is similar. Fifty years however is not consistent with the QCA's own determination for the CQCN where 100 years is adopted. It is also not consistent with the bridge Australian Standard AS5100.1 where a design life of 100 years is specified.

2.8.3 Remaining Life

While asset life at new may not currently be consistent across all documentation, without specific inspection data and evaluation it is not possible to know the actual remaining life in the structures. Given that neither this Regulatory Period's Maintenance Submission, the 2009/13 Period Maintenance Submission or any of the Capital Expenditure programs make any reference to culvert maintenance or replacement, it is reasonable to assume that no less than half of the new life remains in the culverts. If more than half remains then the new life at new should be greater than 50 years and the net result of the life expiry will be the same.

Therefore we conclude that adopting half-life expiry for the culverts is reasonable.

2.9 Turnouts

2.9.1 Background

Various capital programs over the last 5 years have placed emphasis on turnout replacement. As turnouts are often the weakest link in track structure due to their mechanical nature this program has been a key part of Queensland Rail's attempts to improve reliability for the growing coal task. The capital programs have been:

- Columboola to Fisherman's Island Project 2010/13
  - Unspecified number
- Western System Asset Replacement 2007/2013
  - 15 turnouts replaced

In addition capital works are planned:

- Western System Asset Replacement 2013/2016
  - 16 turnouts to be replaced

These turnouts are concerned with the mainline and on lines with loaded coal trains. We estimate that 68 turnouts operate with loaded trains running on them.

In total there are 119 turnouts on the West Moreton System (common network) from Rosewood to Miles, including siding turnouts, "Y" turning roads and multiple loops at Willowburn.

2.9.2 Turnout Asset Configuration

There is no single turnout configuration that is MEERA for the range of tonnages experienced on the line. East of Jondaryan a robust turnout is justified and the MEERA turnout would consist of a minimum 50kg/m rail and concrete bearers. However west of

Jondaryan where tonnages are lower and steel bearer 41kg/m turnout would be adequate.

2.9.3 Asset Life

As the MEERA turnout is constructed with concrete bearers, the life at new for a MEERA turnout should be 50 years. Generally the decision to renew a turnout is based on the combined deterioration of the bearers (sleepers) and the rail in association with the degree of difficulty to maintain the turnout to a reasonable reliability. Turnouts with low tonnages such as in sidings and empty train loops will exhibit a very long life with timber bearers and small rail sections being replaced during the normal course of maintenance.

For concrete bearered turnouts various elements of the rail sections will need to be replaced but on an operating cost basis. The decision to replace a concrete bearered turnout will be one made on the same basis as of the life of concrete sleepers.

The capital programs observed address the heavy use turnouts and represent a total of approximately 39 turnouts in a population of 68. Of the remainder many lie to the west of Jondaryan or are siding turnouts on empty train dual track.

2.9.4 Estimate of Remaining Life

From 2007 to 2013 approximately 20 to 25[154] turnouts were replaced and the remaining life will average 47 years.

The Capex proposed 16 turnouts will have a remaining life average of 2 years.

The remaining turnouts, most of which will experience light axle loads, light tonnages and be of timber construction will be at half life or 25 years remaining.

Notwithstanding the various MEERA construction standards applicable, the turnout population on a number weighted basis exhibit a life expiry of 26.15 years, or 52.3%, leaving 47.7% of the ORC for the DORC.

2.10 Signals

The 2009 QCA Draft Determination indicated an asset life at new for signalling assets of 20 years on the recommendation of Everything Infrastructure. The 2000 QCA Draft Decision for the CQCN indicates an asset life for field signalling equipment of 10 to 35 years and QRNetwork submitted a life of 30 years.

In view of the rapidly changing telecommunications and electronics industry it is not unreasonable to err on the side of the risk of technical obsolescence including that of radio based signalling/safeworking.

Therefore we agree that 20 years is more appropriate as the life of signalling assets at new and that the remaining life is only 10 years and the depreciation is therefore 50% due to the likelihood of technical obsolescence.

[154] It is not possible to be precise from the information provided by QR, but estimate 23.

2.11 Telecoms

The 2009 QCA Draft Determination indicated an asset life at new for telecoms assets of 20 years on the recommendation of Everything Infrastructure. QRNetwork submitted a life of 30 years.

In view of the rapidly changing telecommunications and electronics industry it is not unreasonable to err on the side of the risk of technical obsolescence including that of radio based signalling/safeworking.

Therefore we agree that 20 years is more appropriate as the life of telecoms assets at new.

As this asset is continually being replaced on a component by component basis effectively maintaining it functionality at new condition, the appropriate life expiry is 50% because its replacement will occur as a result of technical obsolescence rather than condition.

Appendix 1 – Maintenance Clarification Questions & Answers

Information Request - Clarification Questions for QR's West Moreton AU1 Maintenance Submission

1. What assets are being maintained? Please include details of the type of asset, the number and their location. For example. For timber sleepers, please indicate the "to and from" kilometrages and the number of sleepers. For timber bridges, please include the number of spans and the type of construction (beam, truss etc.). For level crossings, the location and type of crossing (active, passive with bitumen road, passive with dirt road)

2. What condition are the assets? This information could be detailed by recent inspection reports or by reports indicating the remaining life in a certain total life.

3. What work has been performed in recent years (3-5 years) apart from capital or damage rectification? That is, what volume of work in each of the normal maintenance categories has been performed and represents the type of work being suggested in the works in AU1? The volume of work should be expressed, for example, as the number of timber sleepers replaced with concrete, the length of ballast undercutting performed as part of sustainable maintenance (not damage rectification), the quantity of structural timber replaced, the length of tamping/resurfacing performed as part of a sustainable program (not damage rectification).

4. How is the term "capacity constrained" calculated? (a) Could an updated calculation sheet now be supplied please indicating the longest section running time, the number of minutes per week theoretically available for train services taking into account the "curfew" in Brisbane metro area and any other boundary conditions, the number of minutes or hours per week allowed for maintenance effort and the make-up of the different train types using the infrastructure. (b) What allowance in the calculation has been made for unplanned above rail incidents?

5. For what reason is there not a "condition of carriage" that the wagon should be free of contamination, such as coal residue after dumping.

6. What are the performance targets (KPI's) in addition to OTCI and TTD for the delivery of below rail services on this network? (a) For example, what reliability and availability are targeted, usually expressed as "number of services run versus number of services possible/planned, and number of services arriving within 15 minutes of the planned time? (b) How is maintenance effort and cost related to the reliability and availability on this network? (c) What special or extra maintenance effort is being applied in UT1 that has not been provided in the past and is related to the achievement of performance targets?

7. (a) What are the targets for OTCI and TTD and how has the maintenance effort been targeted to improve these performance measures? (b) What are the metrics for these KPI's?

8. (a) What plans or past results are in place to make sure that the services currently supplied by in-house teams are competitive? (b) Are there any special reasons why these services have not been outsourced?

9. In Table 5.1 please give examples of how the last two columns are applied? For example, will the network need 4 weeks of ballast cleaning per year? Will the network need 4 weeks of resurfacing per year? Will the grinder be expected to respond in less than 24 hours to a defect but the plan is not to do any rail grinding? An explanatory note would be useful.

10. In Table 6.9, in view of the need to "Maintain appropriate rail profile and remove small surface fatigue cracks" (your Table 6.8) why does Macalister to Miles not receive any rail grinding and Toowoomba to Macalister only 6.590 kms per year?

11. In Table 6.13, what does the maintenance effort represent in return period for those activities? Thus 4 Major and 3 Minor crossings in a population of how many?

12. Is there any "catch up maintenance" included in the estimates of work load? That is, does a maintenance deficit exist?

13. On an activity by activity basis, such as the detail already provided in Table 7.1, please provide similar detail for all other activities, together with their scope or volumes (such as you have provided for ultrasonic inspection), perhaps in spreadsheet format?

END

QCA West Moreton System

Information Request

(AU1 Maintenance)

Background

The Queensland Competition Authority (QCA) is currently assessing Queensland Rail's Draft Access Undertaking 1 (AU1). As part of this assessment, on 23 July 2013 the QCA requested that Queensland Rail provide information in relation to its proposed West Moreton System maintenance program.

The information is to assist the QCA to assess Queensland Rail's proposed reference tariff. This document provides a response to the QCA's request for information.

Queensland Rail has included each of the QCA's questions in this document in bolded italics and provided its responses directly after the question to which the response applies.

1. *QCA Maintenance Clarifications*

The Authority has advised that it "*needs to form a view on whether the maintenance program is suitable to serve the forecast traffic, for the infrastructure in place. The Authority therefore requires more detailed information on all three of those considerations, particularly the maintenance and infrastructure*."

Questions

2. ***What assets are being maintained? The main issue is how many timber and steel sleepers there are, and where they are located. Please include details of the types of assets, their number and their location.***

   For example, for timber sleepers, please indicate the "to and from" kilometrages and the number of sleepers. For timber bridges, please include the number of spans and the type of construction (beam, truss etc.).

   For level crossings, the location and type of crossing (active, passive with bitumen road, passive with dirt road).

   It may be useful to look at the Network Management Plan provided to the Authority by QR Network on 10 March 2009. However, the information needs to be more detailed, so that the Authority can identify what is to be maintained, and where.

Queensland Rail notes that the Authority is seeking considerable detail in relation to this question. To facilitate this, Queensland Rail has provided detailed spreadsheets with the relevant information it. The response to the above questions is contained in the attached Zip folder called "*Question 1_Maintenance Info Request*" The spreadsheets provided in the zipped file are:

- Curves ML WM System.
- Curves WL WM System.
- Drains ML WM System.
- Drains WL WM System.
- Loops ML WM System.

- Loops WL WM System.
- PC Bridges ML West Moreton.
- PC Bridges WL West Moreton.
- S & C Bridges ML West Moreton.
- S & C Bridges WL West Moreton.
- Sidings ML WM System.
- Sidings WL WM System.
- Straights ML WM System.
- Straights WL WM System.
- Timber Bridges ML West Moreton.
- Timber Bridges WL West Moreton.
- Tunnels ML WM System.
- Turnouts ML WM System.
- Turnouts WL WM System.
- WM TSS Assets.

3. ***What condition are the assets in? This information could be detailed by recent inspection reports or by reports indicating the remaining life in a certain total life.***

The Overall Track Condition Index (OTCI) is the measure used by Queensland Rail as the measure of track condition. The West Moreton OTCI Trends Graph is attached in the following zip file: *Question2_Maintenance Info Request.zip*. This document gives an overview of the West Moreton system over approximately a decade.

Assets are maintained according to the Civil Engineering Track Standard (CETS) and the Civil Engineering Structures Standard (CESS) (MD-10-575 and MD-10-586). These Standards are also included in the above mentioned zip file. These standards are used to ensure the safe, reliable passage of trains.

Queensland Rail is currently implementing an Enterprise Asset Management System (EAMS), which will incorporate an information system which provides up to date asset condition.

The assets are fit-for-purpose for the West Moreton System traffics.

4. ***What work has been performed in recent years (3-5 years) apart from capital investment or damage rectification? That is, what volume of work in each of the normal maintenance categories has been performed and represents the type of work being suggested in the works in AU1?***

   The volume of work should be expressed, for example, as

   - ***the number of timber sleepers replaced with concrete,***

No timber sleepers were replaced with concrete sleepers from the operating budget during the period in question.

- ***the length of ballast undercutting performed as part of sustainable maintenance (not damage rectification),***

No ballast undercutting was performed during the period.

- ***the* quantity *of structural timber replaced,***

For information relating to this question please refer to the following zip file: *Question3_Maintenance Info Request.zip* [PDF Document – *Question 3_Timber Bridge Repairs Response*].

- ***the length of tamping/resurfacing performed as part of a sustainable program (not damage rectification).***

Past years expense for the maintenance activities by product is attached in the following zip file: *Question3_Maintenance Info Request.zip* .[Excel spreadsheet *13 08 - Data for West Moreton (2011 - 13).xls*]. Included in this document, but as separate tabs ((worksheets) is the data relating to the resurfacing and grinding that was undertaken during the period in question.

In other words, is the work program provided indicative of the longer-term work program?

Future years Network Maintenance Plans by product are attached in the following zip file: *Question3_Maintenance Info Request.zip* in the following: spreadsheet: (West_Moreton_Opex_Summary_n_Product_breakdown_130503.xls).

5. *How have you calculated that the network is "capacity constrained"?*

a. Could an updated calculation sheet be supplied that indicates the:

i. longest section running time for the network;

ii. number of minutes per week theoretically available for train services taking into account the "curfew" in Brisbane metro area and any other boundary conditions;

iii. number of minutes or hours per week allowed for maintenance effort; and

iv. make-up of the different train types using the infrastructure?

b. What allowance has been made in the calculation for unplanned above-rail incidents?

Capacity Calculations for Toowoomba Range

Longest Section: Rangeview to Spring Bluff	
Down Sectional Running Time	24
Up Sectional Running Time	22
Average Sectional Running Time	23
Start Allowance	3
Adjusted Average Sectional Running Time	26
Hours per Week for Maintenance	19
Total Minutes per Week	10,080
Minutes per Week for Maintenance	1,140
Available Minutes per Week for Operations	8,940
Reduction Factor[1]	65%
Available Minutes per Week for Operations after Reduction Factor Applied	5,811
One-way Paths per Week	224
Return Paths per Week	112

[1]A number of influences affect the daily operation of a rail network. These include

- the prevailing weather conditions;
- temporary speed restrictions;
- minor signal and trackside equipment faults;
- reduced locomotive and rollingstock performance;
- individual train dynamics and driving techniques; and
- unplanned above rail incidents.

Unplanned above-rail incidents are one of the things accounted for in the reduction factor. Additionally annual volumes are based on railing 50 weeks of the year.

For the West Moreton System, the reduction factor also allows for inefficiencies of theoretical path utilisation due to the variety of traffic and origins. These influences have the potential to reduce train running speeds and increase sectional run times and impact on efficient utilisation of available paths which will negatively impact on network capacity.

The make up of the different train types using the infrastructure is summarised in item 15 (d).

While capacity calculations result in 112 return paths per week, 106 paths were contracted (77 coal, 27 non-coal freight and 2 passenger). Government have not indicated a willingness to contract additional coal services and in relation to non-coal freight, above rail operators have not shown a willingness to contract additional services.

6. ***Please also detail the expected impact on capacity of the two new passing loops announced 16 May 2013. Important questions include:***

i. How many extra paths will be created?

Up to 20 return paths per week.

ii. How many of those paths will be used by grain traffics?

All capacity created by these loops will be reserved for future additional contracted agricultural products. These paths cannot be contracted to coal services.

iii. What will happen at times of the year when there is no grain to ship?

Paths will be available for other services on an ad hoc (day of operations) basis.

iv. When will the infrastructure be built?

The project is expected to be complete mid 2015.

v. What standard will it be built to?

The loops will be built to a standard to accommodate all traffics that use the line. In practical terms, the rail infrastructure will be to a standard capable of 20 tal, although the remainder of the line will continue to be limited 15.75 tal.

vi. What is the proposed treatment of the common user infrastructure?

These passing loops are fully funded by the State Government of Queensland as part of their Agricultural Freight Strategy with the additional paths to Fisherman Islands created from the construction of these passing loops being reserved for agricultural traffic. The capital expenditure associated with it will not be included in the RAB making the New Range Crossing passing loops excluded from the *AU1 West Moreton Reference Tariff Reset Capital Submission*.

vii. Will there be any associated upgrades other than the passing loops to cope with the extra traffic?

The project team are currently investigating the feasibility of tunnel floor lowering to allow 9'6" shipping containers to be transported by rail on the line (currently the height of shipping containers is limited to 8'6" due to tunnel clearances). A decision regarding whether to include this element of the project scope in the works will be made on completion of this feasibility analysis. No other works have been identified.

7. *For what reason is there not a "condition of carriage" that the wagon should be free of contamination, such as coal residue after dumping.*

Queensland Rail considers this to be an above rail issue as the operator has the obligation for the safe operation of its rolling stock on the network including loading, unloading and ensuring that the wagon contents remains secured while in transit. The operator is also required to adhere to all relevant legislation including legislation relating to the environment.

8. *What are the performance targets i.e. key performance indicators (KPIs) in addition to the overall track condition index (OTCI) and total train delays (TTD) for the delivery of below-rail services on this network? (See various references in section 6 of Queensland Rail's maintenance submission).*

Queensland Rail has a set of KPIs for the West Moreton System and has attached these in the following zip file: *Question7_Maintenance Info Request.zip*.

a. For example, what reliability and availability are targeted, usually expressed as "number of services run versus number of services possible/planned, and number of services arriving within 15 minutes of the planned time"?

Services Run vs Planned

Queensland Rail does not have a specific KPI with benchmarks in relation to services run and services planned. Queensland Rail does have the following information, although it is not KPI:

1. MTP vs actual train services; and
2. 112 paths v actual.

These can be provided to the QCA upon request. However, these are not a good indication of below rail performance as above rail events such as cancellations will skew the results.

Number of services arriving within 15 minutes

The measure of *"number of services arriving within 15 minutes"* is not, in itself, a KPI. However, this data is contained in Queensland Rail's database in relation to this type of statistic and is regularly reported. The below table contains the number of West Moreton train services that arrive at Fisherman Islands within 15 minutes:

Arrival Location	Measure	2011	2012	2013
Fisherman Islands	Percentage of train services that exit with 15 minutes of scheduled time	**66.26%**	**72.57%**	**71.44%**

Note: All train services that go to Fisherman Islands have been included in the above table.

b. How is maintenance effort and cost related to the reliability and availability on this network?

The Network Maintenance Plan has been built upon meeting the key performance indicators and past experience including the performance of the network. The maintenance activity also assumes that the capital identified in the submission will be delivered. Maintenance activities are undertaken according to the standards (provided with question 2 in this document). Major asset renewals are funded through capital works and are more aligned to improving reliability.

c. What special or extra maintenance effort is being applied in AU1 that has not been provided in the past and is related to the achievement of performance targets?

Queensland Rail's AU1 maintenance program is consistent with the approach and maintenance effort that has occurred over the past years.

Improvement in asset reliability is typically achieved through the asset renewals in the capital works program, e.g. the AU1 programs for check rail curves, replacing timber sleepers with concrete, and the Slope Stabilisation on the Toowoomba Range. These initiatives will reduce the risk of major outages on the Toowoomba Range caused by heavy rainfall.

8. *OTCI and TTD:*

a. What are the targets for OTCI and TTD, and how has the maintenance effort been targeted to improve these performance measures?

Queensland Rail has provided its key performance indicators for the West Moreton System in the attached zip file: *Question8_Maintenance Info Request.zip*. These KPIs are a guide in determining the maintenance and capital effort.

b. What are the metrics for these KPIs?

OTCI is as per the standard calculations for the condition index. Transit Time Delays are measured in minutes (delay per 100km).

9. *In-house sourcing:*

a. What plans or past results are in place to make sure that the services currently supplied by in-house teams are competitive?

Worley Parson's have undertaken a review of Queensland Rail's AU1 submissions indicating that maintenance activities are within normal industry bounds for reasonable costs. They further identified that the program will maintain a fit-for-purpose network. Worley Parsons' stated:

> *In summary it is considered that the strategies and maintenance programs being put forward by Queensland Rail demonstrate a clear understanding of railway engineering best practice (in terms of the existing asset type, age, condition and environmental and operational constraints) required to maintain the asset fit for purpose in terms of safety and operational objectives.*[155]

b. Are there any special reasons why these services have not been outsourced?

155 WorleyParsons AU1 West Moreton Reference Tariff Submission Review, Sept 13, p. 45

Queensland Rail is presently undertaking benchmarking activities to determine how present delivery mechanisms compare against the market place. Outcomes of this project will ensure that Queensland Rail delivers its activities at defendable rates. Queensland Rail currently outsources part or all of each of the following activities:

- Rail Grinding
- Earthworks
- Vegetation Management
- Bridge Painting
- Surveying
- Fencing
- Material supply and delivery
- Ultrasonic testing
- Major bridge/culvert construction

Queensland Rail is currently exploring options for outsourcing part or all of each of the following activities:

- Plant maintenance
- Resurfacing
- Themit Welding
- Labour Hire (for some products)
- Protection Officers

However, Queensland Rail notes that WorleyParsons have identified that the maintenance activities are within normal industry bounds for reasonable costs (refer to question 9(a)).

10. ***In Table 5.1 please give examples of how the last two columns are applied. For example, will the network need 4 weeks of ballast cleaning per year? Will the network need 4 weeks of resurfacing per year? Will the grinder be expected to respond in less than 24 hours to a defect but the plan is not to do any rail grinding? An explanatory note to support Table 5.1 would be useful.***

Table 5.1 was inadvertently included as it was in a sample template. The information does not relate to the West Moreton System and should be disregarded.

11. ***In Table 6.9, in view of the need to "Maintain appropriate rail profile and remove small surface fatigue cracks" (Table 6.8) why does Macalister to Miles not receive any rail grinding and Toowoomba to Macalister receive only 6.590 kms per year?***

The curvature and tonnages Rosewood to Toowoomba warrants significantly more attention as there is a much larger number of curves along this section. The 6.59km represent the length of curves between Toowoomba and Macalister where the combination of speed and curve radii requires annual grinding. Due to significantly lower traffic, the tighter radius curves West of Macalister are not ground, however they are monitored for rolling contact fatigue. (*refer to attached document: Question 11_ Maintenance Info Request.zip*).

12. ***Basis of maintenance effort forecasts:***

a. In Table 6.13, what does the maintenance effort represent in return period for those activities? Thus 4 Major and 3 Minor crossings in a population of how many?

There are 138 level crossings in the West Moreton System which can be classified as a major crossing (i.e. public level, pedestrian crossing) and a minor crossing (i.e. occupation, Queensland Rail crossing).

Level Crossing Type	No. of Level Crossings
Major: • Public level crossing • Pedestrian crossing	97
Minor: • Occupation crossing • Queensland Rail	41
TOTAL	**138**

b. What is the approach to determining the frequency and intensity of maintenance? Is it set on a 'levelised' basis, divided equally over the life of the asset, or based on an assessment of the state of the asset at a particular point in time?

The current strategy is to revisit/review all level crossings on average ever 10 years, hence all level crossings will be reconditioned.

13. ***Is there any "catch up maintenance" included in the estimates of work load? That is, does a maintenance deficit exist?***

There is no "catch up maintenance" within the current program. Any improvement in the asset is undertaken through the capital program and these projects have been identified previously. Assets that do not undergo any capital improvement will be in the same or similar condition at the finish of the AU1 as the start. There is no maintenance deficit of the asset. It should be noted that Traffic has significantly increased over the previous undertaking period and that the maintenance effort reflects the additional wear and tear or increased usage of the asset.

14. ***On an activity by activity basis, such as the detail already provided in Table 7.1, please provide similar detail for all other activities, together with their scope or volumes (such as you have provided for ultrasonic inspection), perhaps in spreadsheet format?***

The current table 7.6 includes numbers for 'track' without sufficient underlying detail in other tables, or associated spreadsheets, to explain about $12 million in proposed annual spending.

See, for example, the level of detail provided in the table in section 6.1 of the UT3 western system maintenance costs proposal (p.22-3), although we would

want the information provided this time to include scope as well as cost of proposed maintenance.

Queensland Rail has provided the breakdown in the attached zip file: *Question14_Maintenance Info Request.zip*.

15. *Please provide actual figures for the UT3 period, including:*

a. Maintenance costs for all the categories used (see again the table in section 6.1 of the UT3 maintenance proposal).

For the maintenance costs for relevant categories for UT3 please refer to the following zip file: *Question15a_Maintenance Info Request.zip.*

b. *Amount of maintenance achieved, compared with targets, and reasons for the difference.*

Unfortunately, Queensland Rail did not develop the UT3 maintenance submission. Rather, this was done by QR Network Ltd. Queensland Rail does not currently have the information to compare the scope of the UT3 maintenance submission against actuals.

c. Capital expenditure, comparing actual with forecast outcomes, including reasons for the difference. Please also include changes in scope of any of the projects included in the UT3 proposal.

For the capital expenditure comparison for UT3 please refer to the following zip file: *Question15c_Maintenance Info Request.zip.*

d. Actual volumes, by category of traffic, with coal broken down by origin and destination, consistent with the forecasts provided for UT3.

Further information regarding actual volumes, by category of traffic, broken down by origin and destination for UT3 can be found in the following zip file: *Question15d_Maintenance Info Request.zip.*

16. *Please explain the impact on maintenance and capex of the floods in 2011, including:*

a. How much maintenance was brought forward while the track was shut for repairs to the range crossing?

Where possible maintenance activities and capital activities were brought forward during the closure of the network from the inclement weather.

However, in an effort to assist the mining companies to recoup lost revenue maintenance/ capital possessions were handed back to traffics to run additional coal trains once the network was re-opened. Hence, while additional maintenance was undertaken during the closure, planned maintenance was cancelled after the track reopened to allow for the catch up of coal tonnages. As a result, the actual maintenance works performed during the year was of the floods was close to that planned over the whole period. .

b. How much capex was done during that time?

Approximately $40M was spent for the flood restoration. This was not added to the RAB or capitalised in Queensland Rail's accounts. Government and Queensland Rail funded $34M of this and industry funded approximately $6M.

c. What aspects of the proposal for AU1 are driven by lessons learned from the flood damage and repairs?

The AU1 Slope Stabilisation project on Toowoomba Range is a significant capital works project that is in direct response to the experience from the floods. These works will reduce the possibility of such network outages occurring in the future.

Appendix 2 – Capex Clarification Questions

QR West Moreton System

Capex Clarifications

1. Jondaryan Track Upgrade

a) How did the various works increase the capacity of the system to permit "additional traffic to be hauled safely and efficiently"? Was the capacity increased by either or combination of:

- Axle load increase
- Speed increase
- Longer trains
- Closer train spacing
- Improved reliability with regard infrastructure failures and consequent delays
- Improved asset requiring less maintenance downtime
- Some other method

b) What axle load capacity are the low profile sleepers? What axle load capacity were the full section concrete sleepers?

c) What is the rail size where the welding took place and what axle load is applicable to the welded rail?

d) What axle load/loading configuration was the bridge and culverts that were replaced designed? How does that axle load compare with the nominal axle load capacity of the line?

e) How did other traffics benefit even if the works were solely to facilitate increased coal transport?

2. Columboola to Fisherman Islands Project

a) How does the removal of the grain passing loop at Columboola benefit coal traffic?

b) Why was it necessary to relocate and upgrade the pedestrian crossing at Chinchilla?

c) How did other traffics benefit even if the works were solely to facilitate increased coal transport?

3. Western System Asset Replacement

a) The project scope states “23.925km of track to 50kg rail on concrete sleepers” but the total appears to be 20.25kms plus 15 turnouts. Is the reconciliation of 3.675km to 15 turnouts an equivalent amount of 245m for each turnout?

b) Was the scope of the works only those of rail, sleeper and ballast replacement or were there other works such as level crossing replacement, undercutting, formation strengthening or other works?

c) What was the estimated improvement in the reliability of track through a reduction in track under speed restriction and below rail delays (from and to kms under speed restriction and from and to below rail delays)? What increase in capacity did those improvements create?

d) How has the probability of broken rail derailments changed?

e) What reductions were estimated or have occurred to service defects which require shutdowns to remove defective rail (from to)?

f) What was the old and what is the new inspection frequency

g) What were the old and what is the new resurfacing and grinding frequencies?

h) What is the axle load allowable over these sections of track after the upgrading and how does that compare with the remainder of the system?

4. AU1 Proposed Capex (2013/14 to 2016/17)

a) After the program of capital works indicated in the plan has been complete what will be the allowable axle load across the total or within sections of the system? What will be the limiting factors for axle load?

b) What gauge widening strategy is being used on the tight curves when sleepers are being replaced or checkrails added?

c) What are the history of derailments and the causes of derailments on the Toowoomba and Little Liverpool Ranges measured in derailments per year or per MGT and what improvements in derailments per year or per MGT is expected?

d) After the program of capital works indicated in the plan is complete what further work is envisaged to upgrade the system, not for replacement, for the next period beyond 2016/17 assuming no other increase in traffic is forthcoming? That is, what is the full program of upgrades envisaged?

e) In item 10. Level Crossing Compliance Program, what proportion of benefits and costs are attributable to the coal traffic?

f) In item 11. Siemens AZ S 600 Axle Counter Replacement, what proportion of benefits and costs are attributable to the coal traffic?

END

QCA West Moreton System

Information Request

(AU1 Capital Works)

QueenslandRail

Background

The Queensland Competition Authority (QCA) is currently assessing Queensland Rail's Draft Access Undertaking 1 (AU1). As part of this assessment, on 12 August 2013 the QCA requested that Queensland Rail provide information in relation to its proposed West Moreton System capital program.

The information is to assist the QCA to assess Queensland Rail's proposed reference tariff. This document provides a response to the QCA's request for information.

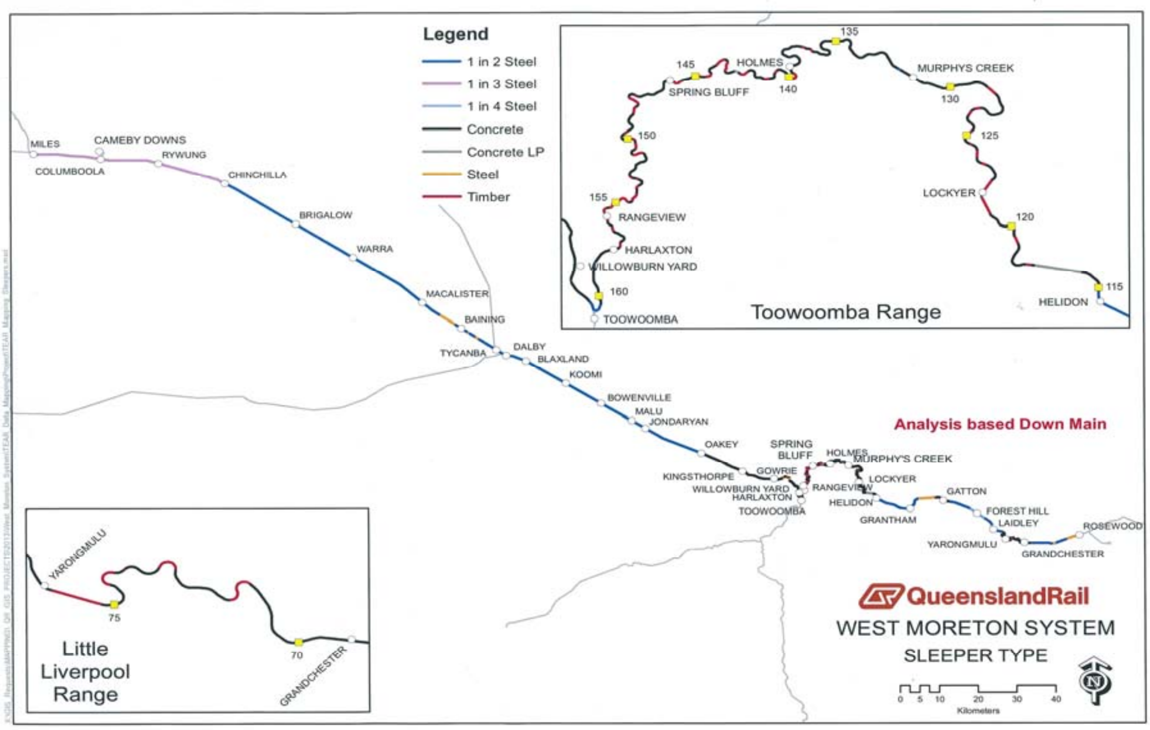
Queensland Rail has included each of the QCA's questions in this document in italics and provided its responses directly after the question to which the response applies.

System Strategy

The West Moreton System is supported as an effective fit-for-purpose coal traffic system. The long-term capital strategy of system is to:

1. Install concrete sleepers with 50kg/m rail on the heaviest usage section (being between Rosewood and Jondaryan).
2. Eliminate and/or strengthen existing timber bridges.
3. Maintain a safe and reliable network.
4. Increase or maintain system robustness at key priority locations.

Queensland Rail's Draft Access Undertaking 1 (AU1) capital program has been designed having regard to these objectives. A brief summary of the links between AU1's capital program and the overarching strategy is outlined below.



Objective 1: Concrete Sleepers with 50kg/m Rail

Western System Asset Replacement (WASR) Project

- At the completion of the WASR project in 2015/16 concrete sleepers will be in place (with the exception of the check rail curves on the ranges) on all single line and the down roads between Rosewood and Oakey.

Relay Program (4km Oakey - Jondaryan)

- The AU1 relay program begins in 2015/16 (after the completion of WASR). It continues concrete sleepering westward. Under this program 4km from Oakey to Jondaryan (at priority locations) will be relayed using 50kg rail on full depth concrete sleepers and 200mm of fresh ballast.
- Queensland Rail intends to continue the relay program after AU1 expires thorough the following undertaking (e.g. through AU2), with the aim of the section from Toowoomba to Jondaryan being fully concrete sleepered.
- The current intention is to maintain one in two steel sleepers west of Jondaryan, unless the coal traffic task on that section significantly increases.

Rerailing Program

- Targets 2.5km between Rosewood and Helidon & 1.5km between Toowoomba and Oakey and replaces 41kg rail with new 50kg rail on existing concrete sleepers (consistent with the upgrade rail to 50kg rail on concrete sleepers in priority locations strategy– this is targeting the heaviest use sections).

Objective 2: Eliminate and/or strengthen existing timber bridges

Replace Timber and Steel Bridges with Reinforced Concrete Box Culverts + Timber Bridge Strengthen and Elimination Project

- Targets the highest priority timber bridges for replacement. This will result in elimination and strengthening of the 13 most problematic timber bridges and flood openings.

Objective 3: Maintain a safe and reliable network

Signalling Project

- Three projects target safety as well as system robustness by undertaking the following:
  - Three high priority level crossings that do not comply with ALCAM assessment reports will be upgraded from passive protection to flashing lights and boom gates.
  - Axle Counter replacement of obsolete technology; and
  - ATP encoder replacement between Rosewood and Toowoomba.

Corridor and Asset Protection Project

- Includes equipment intended to detect failures, faults or overloading that could result in damage to the infrastructure.

Telecommunications Program

- Two projects provide more efficient communication.

Objective 4: Increase or maintain system robustness at key priority locations

Drain Renewals Project

- This project replaces one old cast-in-situ drain that has exposed reinforcement in the roof of 5 of the 6 barrels, and a sagging and broken floor. This drain is located at the 55.270km point on the Jondaryan to Dalby section on the Western Line. This will reduce the risk of culvert failure which would result in transit time delays.

Formation Repairs Project

- Targets key sections between Rosewood and Columboola.

Slope Stabilisation on Toowoomba Range Project

- This project adds to the robustness of the system by addressing the potential for slippages and face movements as have been seen in the past during inclement weather events.

Check Rail Curves Project

- 6.105km on the Toowoomba Range & 1.055km on the Little Liverpool Range of check rail are being upgraded to concrete sleepers with profiled checkrails during the term of the AU1. This is necessary because these curves are currently experiencing a large number of faults under current construction (timbers sleepers with bolted check rails). These new concrete check rail curves have significantly reduced the incidence of faults.

WorleyParsons Review

In June 2013 Queensland Rail commissioned engineering consultants WorleyParsons to undertake a peer review of Queensland Rail's proposed West Moreton System capital and maintenance expenditure for 2013/14 to 2016/17. Queensland Rail's proposals were found to be prudent in standard and scope as well as being within an acceptable cost range[1].

[1] WorleyParsons AU1 West Moreton Reference Tariff Submission Review, Sept 13, p. 14

QCA Capex Clarifications

”Please where possible provide internal documents, approved by the board, minister or senior executives, which include the justification for the project. However, the Authority is also interested in the rationale for the capital expenditure projects, both individually and for as part of an overall strategy, where the existing internal documents do not cover this.”

Jondaryan Track Upgrade

a) *How did the various works increase the capacity of the system to permit “additional traffic to be hauled safely and efficiently”? Was the capacity increased by either or combination of:*

- *Axle load increase*
- *Speed increase*
- *Longer trains*
- *Closer train spacing*
- ***Improved reliability with regard infrastructure failures and consequent delays***
- ***Improved asset requiring less maintenance downtime***
- *Some other method*

This project facilitates additional contracted tonnages from the New Acland mine by improving the reliability of below rail infrastructure. Better reliability reduces infrastructure failures, consequent delays, as well as improving the asset and reducing maintenance downtime.

The project however does not address the other objectives listed above. Please refer to the project scope in the AU1 West Moreton Reference Tariff Reset Capital Submission (AU1 WMRTRCS) for details of the resleepering, rail welding, track reconditioning, formation repairs and timber bridge elimination that comprise the relevant parts of this project. The original business case is enclosed as Attachment 1.

b) *What axle load capacity are the low profile sleepers? What axle load capacity were the full section concrete sleepers?*

Queensland Rail historically sources mainline concrete sleepers from Austrak in Parkhurst (near Rockhampton). These sleepers are a full depth concrete sleeper with a 28 tonne axle loading (28 TAL).

During the early 2000’s Austrak developed a Low Profile Concrete (LPC) sleeper with a 20 tonne axle loading (20 TAL). This low profile sleeper is 100mm shallower than the full depth sleeper and is designed for locations where height limitations restrict the ability to use full depth sleepers, such as in tunnels.

The LPC sleeper is most common in the Brisbane Metropolitan area where height restrictions occur due to the electrified overhead. These height restrictions make it difficult to combine a full depth sleeper with a full depth ballast profile.

Notably, the price of each LPC sleeper is approximately the same as a full depth sleeper as LPC sleepers use substantially less concrete than the full depth sleeper. However the LPC sleeper requires additional pre-stressed steel wires.

c) *What is the rail size where the welding took place and what axle load is applicable to the welded rail?*

The rail size was 41kg (kg per metre). The welding that was undertaken in the Jondaryn Track Upgrade project was intended to eliminate rail joints on the sections of track where new concrete sleepers are installed, as well as welding rail into Long Welded Rail (LWR) on the "one in two" steel sleepered track. This is consistent with the aim of increased reliability.

The maximum axle load on the West Moreton System is 15.75 TAL as per the Civil Engineering Track Standard (CETS). 15.75 TAL is 'fit for purpose' for the system.

d) *What axle load/loading configuration was the bridge and culverts that were replaced designed? How does that axle load compare with the nominal axle load capacity of the line?*

The timber bridge elimination at Doctor's Creek (Replacement with Concrete Rail Bridge at 41.740km) is designed for 300A loading (or 30TAL).

Timber Rail Bridge Elimination (replacement of timber bridges with concrete pipe culverts) occurred at the following locations at a 30TAL axle loading configuration:

Description	Km Point	Details
Air Force Straight	117.230km	12m Length / 1500mm Diameter / 1 Barrel
Western Line	20.840km	8m Length / 900mm Diameter / 1 Barrel
Western Line	26.890km	8m Length / 900mm Diameter / 1 Barrel
Western Line	28.410km	8m Length / 900mm Diameter / 1 Barrel
Western Line	39.590km	8m Length / 900mm Diameter / 1 Barrel

e) *How did other traffics benefit even if the works were solely to facilitate increased coal transport?*

Benefits to other traffic include an increase in net asset reliability. It is important to reiterate that these works are solely to facilitate additional contracted coal tonnages from the New Acland mine. Without this increase in capacity, the need to undertake this project would not arise. This was a coal specific project.

Columboola to Fisherman Islands Project

a) *How does the removal of the grain passing loop at Columboola benefit coal traffic?*

This turnout is not in suitable condition to receive regular coal traffic. Therefore, retaining the passing loop in the face of regular coal traffic requires upgrading or increasing the maintenance task of the turnout on the eastern end of the loop.

Furthermore, the introduction of coal traffic on this section of track reduces the sighting distance for the level crossing (which is a school crossing). This reduced sighting distance due to coal traffic has resulted in a requirement to upgrade the level crossing.

The removal of the loop eliminates the two track level crossing and therefore eliminates the requirement to upgrade the crossing. Due to these reasons the removal of the loop is deemed the most cost effective solution.

b) Why was it necessary to relocate and upgrade the pedestrian crossing at Chinchilla?

The pedestrian crossing at Chinchilla traverses single track. The lengthening of the passing loop for coal trains means that this crossing would be over two tracks. This situation increases the risk to pedestrians to the point that an upgrade to active protection is required. The most effective solution in terms of safety benefits and cost of delivery is to relocate the pedestrian crossing to a new position over one track.

c) How did other traffics benefit even if the works were solely to facilitate increased coal transport?

This project provides no material benefit to non-coal traffic.

Western System Asset Replacement

a) The project scope states "23.925km of track to 50kg rail on concrete sleepers" but the total appears to be 20.25kms plus 15 turnouts. Is the reconciliation of 3.675km to 15 turnouts an equivalent amount of 245m for each turnout? Or does the 3.675 kilometres reflect work in 2006-07, which is not included in the table?

As per the Queensland Rail submission to the QCA on 18 September 2013, advice arising from the Worley Parsons review of the AU1 West Moreton Reference Tariff Reset Capital Submission (AU1 WMRTRCS) results in the three amendments to Queensland Rail's AU1 WMRTRCS. Page 9 is replaced to reflect the correct number of turnout upgrades (19) and track relay (22.715km) that is planned. The submission page is shown below.

Pre AU1 Asset Renewal Projects

3. Western System Asset Replacement

Project Cost ($'000): $23,581 (excl. Capitalised Interest)

This project commenced in 2006/07 and will continue until 2015/16. The total project cost is estimated to be $40,976,000 – note that $1,832,000 of this amount was spent in 2006/07 and will not be claimed in this submission as it is already included in the opening asset value.

Timelines:

Construction: 2006/07 to 2015/16

Corridor	2007/08 ($'000)	2008/09 ($'000)	2009/10 ($'000)	2010/11 ($'000)	2011/12 ($'000)	2012/13 ($'000)	Total ($'000)
Track Reconditioning	3.500km		0.000km	3.419km	5.589km	7.607km	20.115km
Turnout Replacements	8		0	4	5	2	19
Rosewood - Macalister	3,593	51	0	3,577	6,724	9,636	23,581

RAB	2007/08 ($'000)	2008/09 ($'000)	2009/10 ($'000)	2010/11 ($'000)	2011/12 ($'000)	2012/13 ($'000)	Total ($'000)
Rosewood - Macalister	3,593	51	0	3,577	6,724	9,636	23,581
Capitalised Interest	179	3	0	178	335	480	1,175
Claimed	**3,772**	**54**	**0**	**3,755**	**7,059**	**10,116**	**24,756**

Description of Project and Benefits:

Project Scope:
The objective of this project is to improve reliability and increase the longevity of the West Moreton System. This involves the upgrade of 22.715km of track to 50kg rail on concrete sleepers (including 2.600km of track carried out in 2006/07 not shown in the table above) and the replacement of 19 turnouts, upgrading them to 60kg steel on concrete sleepers.

Project Benefits:
- Improve the reliability of track through a reduction in track under speed restriction and below rail delays
- Reduces the likelihood of broken rail derailments, thereby improving safety
- Reduces exposure to service defects which require shutdowns to remove defective rail and expensive welding in, and match grinding of, the inserted closure rails
- Reduces maintenance requirements of inspections, resurfacing and grinding

All Traffics / Coal Specific:
The works that comprised this project were undertaken specifically to benefit coal carrying customers on the West Moreton System.

Delivery Provider:
All works undertaken have been delivered by internal Queensland Rail resources.

Contact Officer:
Project Manager.

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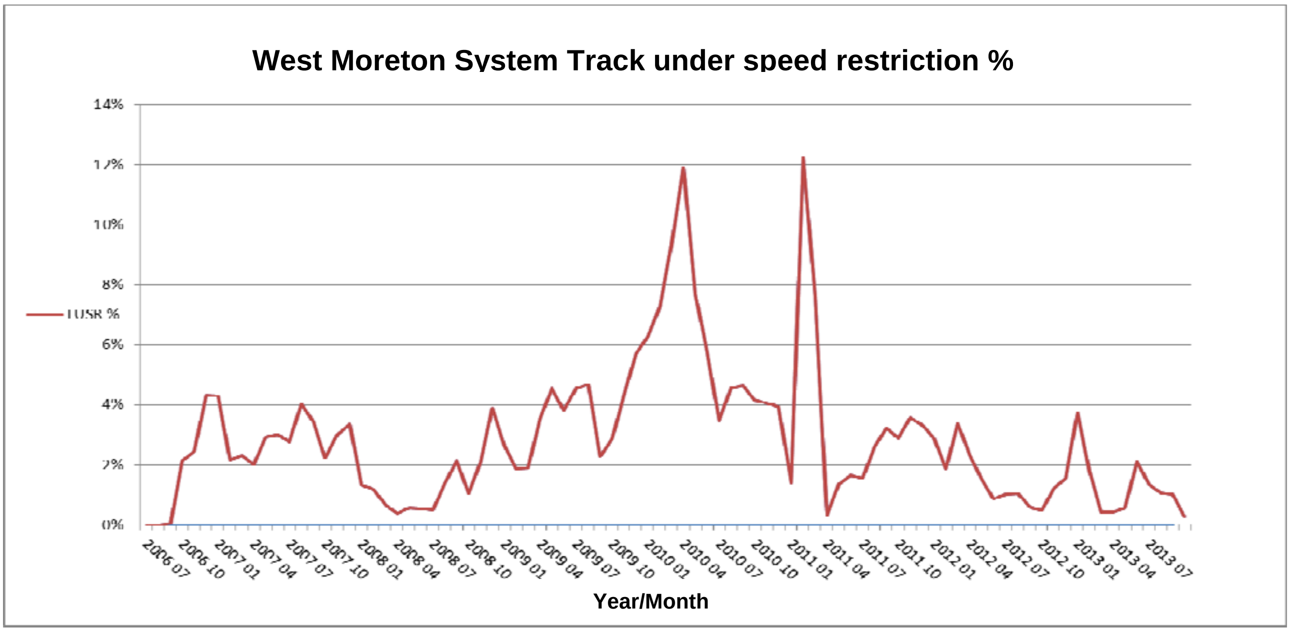
b) Was the scope of the works only those of rail, sleeper and ballast replacement or were there other works such as level crossing replacement, undercutting, formation strengthening or other works?

The scope of works for WSAR is for the replacement and upgrade of selected sections of the West Moreton System track to 50kg rail on concrete sleepers with 200mm of ballast and the upgrade of selected turnouts to 60kg turnouts on concrete bearers with angles ranging from 1:8.25 to 1:12.

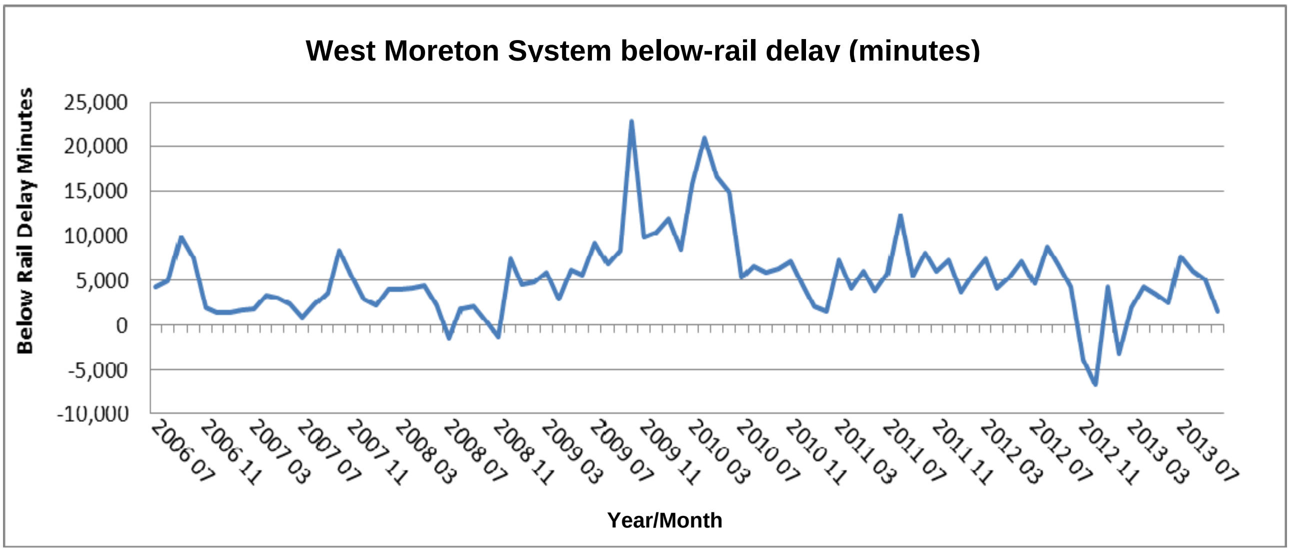
Completing the stated program scope as per the AU1 WMRTRCS requires a small number of ancillary activities, such as earthworks and formation rehabilitation, capitalised as track assets.

c) What was the estimated improvement in the reliability of track through a reduction in track under speed restriction and below rail delays (from and to kms under speed restriction and from and to below rail delays)? What increase in capacity did those improvements create?

The measurement of speed restriction percentage (%) on the West Moreton System is shown in the image below. It is important to note that track under speed restriction can be caused by a number of factors external to Queensland Rail particularly variations in climate (such as changes in temperature) and rainfall. The improvement or reduction in speed restrictions over the timeframe cannot be linked solely to the WSAR project.



The measurement of below rail delays *minutes* on the West Moreton System is shown in the image below.



WSAR results in no direct increase in capacity; however it does increase the robustness of the West Moreton System by creating a stronger track structure that increases reliability, safety and utilisation of the system.

d) How has the probability of broken rail derailments changed?

It is very difficult to quantify / measure the probability of broken rail derailments. However, 50kg/m rail that replaces 41kg/m rail reduces the risk of broken rail derailments as it is a heavier gauge (and is correspondingly stronger) and has better metallurgic properties. Furthermore, “welding out” (or removal) of 41kg/m rail to 220m lengths also reduces the risk of derailments through joint elimination.

e) What reductions were estimated or have occurred to surface defects which require shutdowns to remove defective rail (e.g. from x defects per time period before the work to y defects per time period after the work)?

Ultrasonic testing of the rail within the West Moreton System occurs annually. An increase in internal rail defects (predominately in the 41kg/m rail) has been observed with annual defects (mostly small defects) with a quantity of approximately one defect every 7km annually.

f) What was the old and what is the new inspection frequency

Queensland Rail has an inspection frequency as defined by the Civil Engineering Track Standard (CETS). The standard provides a template by which managers can allocate priority actions within the confines of the resources at their disposal. Inspections may be one of the following types:

- Scheduled Patrol
- Scheduled General Inspection
- Scheduled Detailed Inspection
- Unscheduled Patrol
- Unscheduled General Inspection
- Unscheduled Detailed Inspection

The maximum intervals between scheduled inspections for various elements of the track are defined in Appendix CETS 1.B. The adopted period must take into consideration the track condition, deterioration rates, age, functional capacity, operating conditions and other environmental or local conditions. Conformance to the standards as defined by CETS ultimately means that inspection times remain constant regardless of the capital spending program undertaken. An example of the monitoring can be seen in CETS through the timber sleeper inspection program:

> *1.10.4 Inspection of timber sleepers*
> *The condition of timber sleepers must be closely monitored by the rail infrastructure manager in accordance with Module CETS 3 – Sleepers and Fasteners to ensure track safety and to achieve maximum sleeper life. Testing of sleepers involves the inspection and testing of both the sleepers and the rail to sleeper fastenings. Inspection of rail joints may be carried out at the same time, if desired, or undertaken during separate detailed inspections. The total number of sleepers in the tested section and the number of ineffective sleepers in the tested section must be counted and recorded. Spikes, including sleeper plate spikes, must be tested as necessary. Every timber sleeper must be tested within a five year nominal period. The testing must be programmed by the rail infrastructure manager to meet the following requirements: undertaken not less than*

six months ahead of resleepering gang if the testing is to be used in conjunction with marking out for renewals so that, even under the most adverse conditions, the period between testing any particular sleeper does not exceed six years.

(Queensland Rail Standard – Civil Engineering Track Standard Module 1 – Track Monitoring MD-10-575 (Version 2.0) QUEENSLAND RAIL OFFICIAL Page 63 of 365.)

Queensland Rail will provide the QCA with a copy of CETS upon request.

g) *What were the old and what is the new resurfacing and grinding frequencies?*

Frequencies for resurfacing are determined by on-going track assessments and known degradation rates on the track structure. Actual resurfacing requirements for individual sections may be subject to variation given weather, extreme temperatures, tonnages or Rollingstock condition. In particular, the West Moreton System has experienced severe weather events in 2011 and 2013. Actual and proposed resurfacing 2010/11 to 2016/17 is given below:

	Year	Resurfacing (KM)
Actual	2010/11	270
	2011/12	335
	2012/13	249
Proposed	2013/14	290
	2014/15	305
	2015/16	310
	2016/17	320

Rail grinding is generally a function of gross tonnage levels and development of rail surface defects. For detailed information regarding rail grinding and railgrinding cycles please refer to section 6.1.2 in Queensland Rail's "*AU1 West Moreton Reference Tariff Reset Maintenance Submission",* where rail grinding is discussed in detail including in relation to rail grinding cycles. Rail Grinding is purely a function of MGT's it is not dependant on rail size, sleeper type or ballast condition.

h) *What is the axle load allowable over these sections of track after the upgrading and how does that compare with the remainder of the system?*

The WSAR project results in sections of the West Moreton System being able to accommodate axle loads of 20 TAL; however given the limitations of the 115 timber bridges and 1900's formation material the overall system remains at a maximum 15.75 TAL standard.

AU1 Proposed Capex (2013/14 to 2016/17)

a) *After the program of capital works indicated in the plan has been complete what will be the allowable axle load across the total or within sections of the system? What will be the limiting factors for axle load?*

Post execution of projects that comprise the Capex component of Queensland Rail's proposed AU1 WMRTRCS the maximum allowable axle load across the West Moreton system will remain at 15.75TAL. The process to upgrade the below rail infrastructure on the West Moreton System to accommodate an increase in axle load to 20 TAL is as follows:

- Timber bridge elimination (115 in place)
- Formation engineering (significant sections of the system)
- Upgrade of rail to 50kg rail on concrete sleepers in priority locations.

Currently, industry is not in a position to fund an infrastructure upgrade for the entire system to 20 TAL. There are also additional issues such as the ability to make significant improvements to heritage listed tunnels. However, by progressively upgrading the system, the benefits are greater system reliability and a progressive strategy towards a 20 TAL system.

b) *What gauge widening strategy is being used on the tight curves when sleepers are being replaced or checkrails added?*

As per existing CETS standard which states curves < 300m radius and greater than 160m radius 6mm wide gauge (or 1073mm) and curves less than 160m radius 12mm wide gauge (or 1079mm). Once a curve radius is less than 120m, checkrails are required. As such, AU1 contains a capital program for check rails on the Little Liverpool and Toowoomba ranges.

c) *What is the history of derailments and the causes of derailments on the Toowoomba and Little Liverpool Ranges measured in derailments per year or per MGT and what improvements in derailments per year or per MGT is expected?*

Post separation of Queensland Rail and Aurizon, nine derailments by third-party operated services have occurred on the West Moreton System. A summary of these incidents and causes is presented in the following table with derailments on the Toowoomba and Little Liverpool Ranges shaded grey. In terms of expected derailments, Queensland Rail operates a zero harm safety policy and targets zero derailments.

Event date	Event Type	Reporting Group	Location	Contributing factor
20/05/2013	Derailment	QRN-OP-BULK	Holmes	[redacted]
27/04/2013	Derailment	QRN-OP-COAL	Jondaryn Coal Siding	

5/12/2012	Derailment	QRN-OP-COAL	Jondaryn Coal Siding	[redacted]
27/07/2012	Derailment	QRN-OP-COAL	Holmes	[redacted]
6/06/2012	Derailment	QRN-OP-COAL	Jondaryn Coal Siding	[redacted]
9/05/2012	Derailment	QRN-OP-COAL	Toowoomba Yard	[redacted]
22/08/2011	Derailment	QRN-OP-COAL	Rangeview	[redacted]
16/12/2010	Derailment	QRN-OP-COAL	Bowenville	[redacted]
25/07/2010	Derailment	QRN-OP-COAL	Rangeview	[redacted]

d) *After the program of capital works indicated in the plan is complete what further work is envisaged to upgrade the system, not for replacement, for the next period beyond 2016/17 assuming no other increase in traffic is forthcoming? That is, what is the full program of upgrades envisaged?*

Queensland Rail's plans to continue implementing its strategy for the West Moreton System:

1. Provide concrete sleepers with 50kg/m rail on the heaviest usage section from Rosewood and Jondaryan.
2. Eliminate and/or strengthen timber bridges.
3. Maintain a safe and reliable network.
4. Increase or maintain system robustness at key priority locations.

QR Network's Access Undertaking (2008) June 2010 (2008AU) as well as the AU1 WMRTRCS both outline the projects that will contribute to this plan.

However, implementation of specific programs will be subject to the asset condition and performance of the day. Given the current State Government approval of railings of coal from Toowoomba through to the port of Brisbane is committed until 2024; any proposed investment needs to be carefully considered as the risk of stranded assets is possible.

e) *In item 10. Level Crossing Compliance Program, what proportion of benefits and costs are attributable to the coal traffic?*

As per section 3.4.1 (page 8) and 3.4.4 (page 10) of the AU1 WMRTRCS, Queensland Rail proposes to apply a train path allocation percentage (TPA%) when determining the proportion of capital costs that are charged to coal traffic. In this case, as the level crossing compliance program benefits all users of the West Moreton System 72.6% of proposed capital cost of this project will be added to the Regulated Asset Base (RAB) and passed onto coal traffic.

f) In item 11. Siemens AZ S 600 Axle Counter Replacement, what proportion of benefits and costs are attributable to the coal traffic?

Similar to the previous question, as this project benefits all users of the West Moreton system a TPA% will apply, reducing the proportion of capital costs charged to coal traffic by decreasing the value of this project added to the Regulated Asset Base (RAB) to 72.6%.

New Range Crossing Loops

a) Where are the passing loops to be built, and is there any other associated infrastructure as part of the project?

The range crossing passing loops are proposed to be built at:

- Ballard (151.085km to 152.283km); and
- Harlaxton (157.452 to 158.782).

Additional associated infrastructure with this project includes 11 tunnel floors being lowered to accommodate 9'6 shipping container traffic.

b) What standard will the loops be built to? Will they be able to carry coal traffic?

The crossing loops will be built to accommodate a minimum of 20 TAL and therefore capable of accommodating coal traffic. Initial design indicates the track structure will be 50kg rail on concrete sleepers.

c) If the passing loops are not to be used by coal trains, how will the scheduling be managed?

On day of operations all traffic will use all loops and associated below rail infrastructure as required by train operations. The additional capacity created by the loops will not able to be contracted to coal services.

d) When will the passing loops be completed?

The passing loops will be complete by April 2015.

These passing loops are fully funded by the State Government of Queensland as part of their Agricultural Freight Strategy with the additional paths to Fisherman Islands created from the construction of these passing loops being reserved for agricultural traffic. These passing loops are not being created for coal and cannot be contracted to coal. As a result, the capital expenditure associated with these passing loops will not be included in the RAB making the New Range Crossing Loops excluded from the AU1 WMRTRCS.

Appendix 3 – The Brisbane Peak "Black-out" Period – Impact on Western System Coal Services

A number of methodologies have been put forward for calculating the impact of the "black-out" period of the suburban area, which prevents train paths for coal trains being planned as part of the Master Train Plan for coal train services from the Western System to the Port of Brisbane resulting from suburban system priorities.

These methodologies have been put forward by QR in at least 3 documents as well as from New Hope in their submission.

The essential features of the issue are:

- The Western System west of Rosewood has the capability of providing a finite number of train services
- The Western System trains are timetabled, unlike the CQCN. This applies to all trains.
- The Western System services interface with a suburban system in which train frequencies are different between the two
- The suburban system and other passenger trains have absolute priority in planning as well as in operation
- Periods of the day (so called "peak periods") exist in the suburban system where the train density is such as to mostly exclude any other service including coal traffic
- The peak periods are transitioned from the off-peak periods where train densities gradually increase or decrease, so called "shoulder" periods

Current Calculation Methods

In 2009 QR offered a method that assumed that 6 hours per day were blacked out, resulting in 18 hours per day available for services but also minus 1.5 days per week for maintenance.

With a minimum pathway frequency determined by the longest section running time (of 26.5 minutes) on the Western System, the remaining available hours (18 hours per day minus 1.5 days) is then distributed across 26.5 minute path separation, resulting in 224 paths (east plus west directions) available per week.

In QR's "Overall Submission", QR offered a methodology that indicated that 5 hours per day was a better measure of the "black-out" because some trains could be run in the opposite direction to the peak direction, loaded in the afternoon peak and empty in the morning peak. It was indicated that this reduction in capacity would only apply to the 5 day week. The calculation of (5 hours of unavailability * 5 week days) / (24 hours in a day * 7 days in a week) = 14.88%, results in a rounding up to 15% black, the basis of their submission.

In 2013 in a QR response to clarification questions from QCA, QR also submitted a methodology which used the longest section running time of 26 minutes, 19 hours per week maintenance and a factor to account for incidents and other "external" factors estimated to result in an operational practical availability of 65% of available theoretical. This resulted in 224 paths being available, as before.

In 2014 QR subsequently provided details of the timetable coal trains that were running contra-peak.

In October 2013, New Hope submitted that 8 hours per 5 day week were effectively constrained because either side of the peak significant non-revenue suburban trains interrupted the ability of coal trains to operate. From a 7 day total this amounted to 24% of the capacity being unavailable. In addition the maintenance work performed in the metropolitan area for suburban traffic reasons would make another 7% of the theoretical paths unavailable, making a total of 31% overall.

At a meeting with QR on 1 May 2014, it was stated that as a maximum only 18 trains per day heading east from Toowoomba would be considered as a starting point for train planning given various exigencies of train running such as unplanned incidents and delays. This is a 25% reduction and compares with QR's "reduction factor" of 35% as previously mentioned, except that the 25% reduction does not include maintenance and the "blackout" effect in explicit terms, rather a more practical way to start planning.

Our Calculation

There appears to be agreement that the longest sectional running time for the Western System is 26 minutes and that realistically this means a service that approximates to a 1 hour frequency of trains coming from Toowoomba, or 30 minutes in theory each way. This means a theoretical maximum of 24 east heading trains per day, or 48 trains for the total of both directions. On a per week basis this is 326 paths although on a strictly 26 minute basis the number would be 386 paths (rounded down to nearest even number) or 380 paths for 26.5 minutes. On a practical basis we will use 326 paths and this is consistent with the estimation that a coal train path is 6 to 8 minutes wide as we have asserted in the following sections. This is because coal trains display variable speed profiles related mainly to the fact that they are driven by humans and respond in a non-mechanical manner to signals and other situations. A probability of train running encircles the theoretically infinite width path. We agree with QR[156] that a train path is 6 to 8 minutes and that this results in latitude being applied to the possible interaction of trains and the risk of conflict.

QR has variously suggested a maintenance allowance of 1.5 days (24.3%) (2009 submission) maintenance of the Western System or 19 hours per week (11.3%) (2013 Information Request response) maintenance of the Western System. Assuming the latter submission is the most up to date thinking the total available paths on the Western System (not including any effect of the suburban system) is 288 paths (rounding down to the nearest even number)

This number is different to the "18 trains per day" (252 paths per week) assertion by QR at the meeting of 1st May 2014 but which did however also include the unpredictability of the above rail and below rail performances.

Our view is that for the purposes of planning, one should not assume the performance of the system and that if there is performance problems, then those problems should be addressed in other ways such as improving the engineering reliability or human

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[156] Meeting 1st May 2014

behaviour. In any case the performance shortfalls in practice can be accounted for in contractual arrangements.

Suburban System Operations Influence

The manner in which trains that could be presented from Rosewood or Lytton Junction (near the Port) such as at regular 30 minute intervals does not match the manner in which suburban[157] services which would impact a "theoretical" coal service, are operated. A theoretical capacity analysis is discussed here rather than the contracted pathway analysis since the contracted pathway analysis is self-justifying in its conclusions.

Thus, given the path mismatch there is potential impact of suburban services on the Western System services at all times of the day, except perhaps the early hours of the morning. The so called "peak" services simply represent a higher density of probability than other periods of the day.

In QR's email of 16th April 2014 it was revealed that in fact 2 empty and 3 loaded trains are planned for the morning peak of 0700 to 0930 and that 3 empty and 5 loaded coal trains are planned in the afternoon peak 1500 to 1830 except that some of these trains in the afternoon peak start before the peak. While they are running during the peak the symmetric definition of the peak which assumes a "square" time distance schedule precludes them from this analysis because subsequent trains do not run.

One could estimate then that the probability of interference[158] by suburban trains is 100% minus (5 in 5 paths at 30 minutes) or zero for the morning peak. However at least 2 of these trains are running less than 1 hour apart meaning that while the practice is to run trains at these times, and could be convenient in practice at these times, this running compromises other parts of the system in other parts of the cycle and paths are not netted overall.

In the afternoon peak the interference was 100% minus (5 in 7 paths at 30 minutes) or 29%. These calculations are made for trains attempting to start their journeys between the hours nominated. However, the actual shape of the peak period is not square (time-distance) but of a parallelogram shape. Trains can start just before the peak and be running inside the "square" peak. Similar comments apply to the convenience of running trains at these times but of the compromise being made at other times.

In this same way for all periods of the day, the challenge is for the theoretical and evenly spaced Western System trains to mesh in with the suburban system trains. Where an exact meshing cannot occur and a train is scheduled to wait for the next gap, this impact of that wait is to eliminate that path since the theoretical path cannot be caught up in a fully saturated schedule.

The meshing is similar to the meshing of two combs that have unequal gaps and comb thicknesses, as in the diagram. Not all paths will mesh. The coal train path is a wider path than the suburban path because it is less predictable and it is also at a different slope (speed) because it travels at a different speed. Therefore there are considerable challenges in "threading" the coal train path through the suburban paths, even in out-of-peak times.

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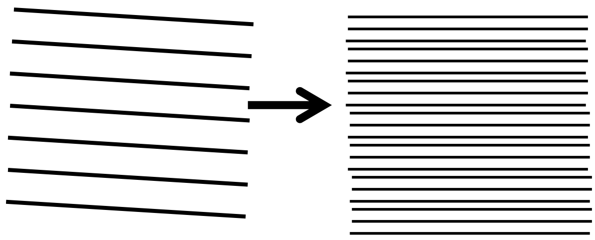
[157] Not only suburban but also other services such as North Coast container trains, interstate passenger trains, Gold Coast services

[158] Interference of the time distance path trajectory resulting in elimination of a path



While not the only source of bottlenecking, the Corinda flat junction is the most severe because coal trains must not only have their own path on the Down track heading to the city, but also take the path across the Up trains heading further west.

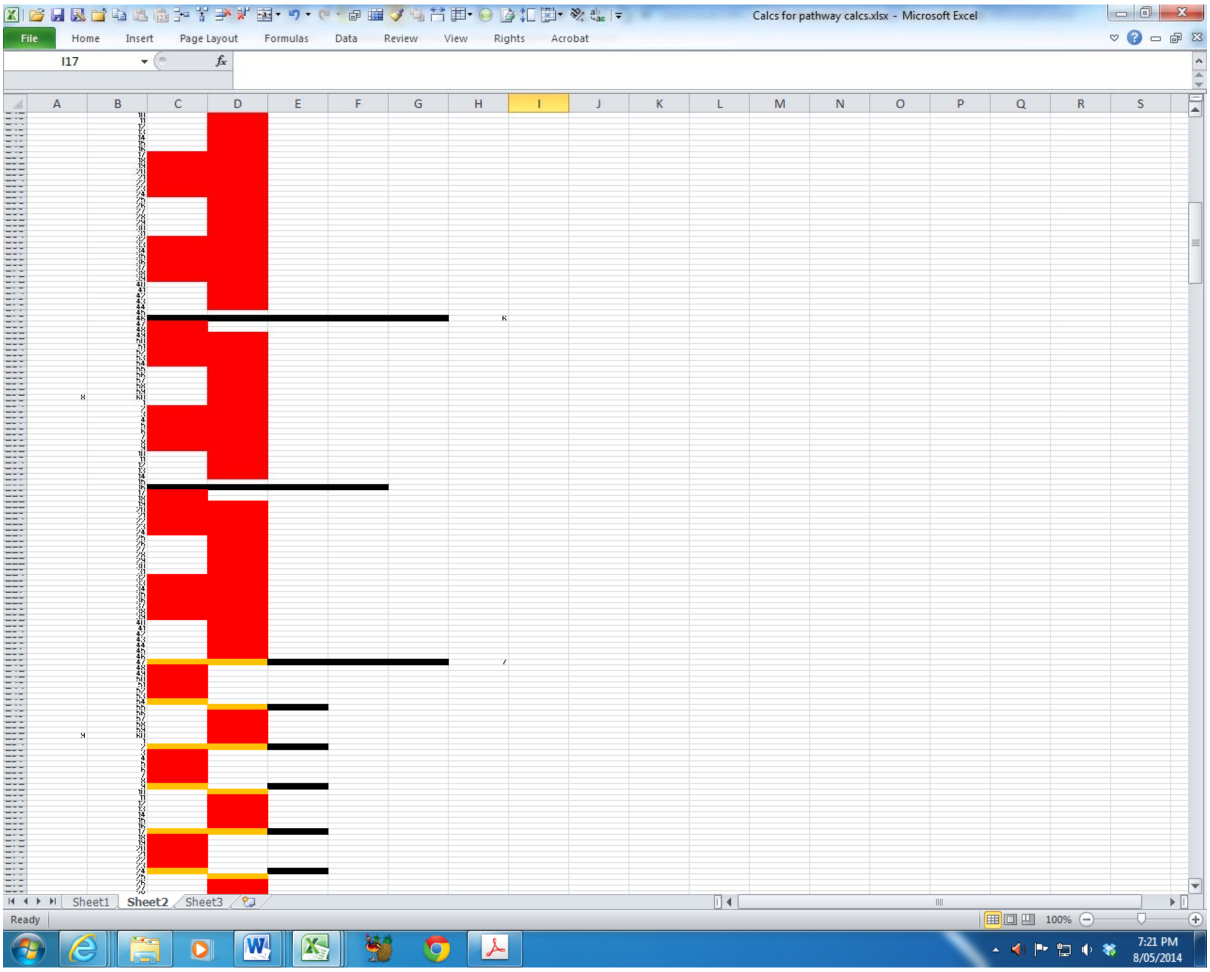
If a regular and even spacing of loaded (Down) trains are presented to the crossing point at Corinda, how many of them during the day could successfully cross the junction? We will assume the width of the coal train path is 6-8 minutes, 3-4 minutes either side of theoretical path, since the train controllers need to plan for the variation likely in the performance of the trains, both suburban and the coal train.

The diagram shows the route of a loaded train. The green line is the route of a loaded coal train and the red lines with arrows are the routes of suburban trains.

The effect of the peak is that, while a loaded train can be found a path through the peak it is positioned so as to compromise other trains at different times of the day. Similarly, in attempting to position other trains during the day they compromise other train paths either directly or subsequently. However there is a regular pattern at other times of the day where trains can operate.

On the Corinda crossover solely a total of 22 trains per day can cross without interference on the premise of a 6 to 8 minute margin for the coal train (3 to 4 minutes either side) and a coal train ready to enter the crossing at a frequency of no greater than 1 hour.

The opportunities for crossing have been plotted thus, where the yellow indicates the use of a 6 minute width rather than an 8 minute width and the longer black lines indicate the opportunities for crossing where the train spacing is 1 hour or greater.



A similar exercise can be done for the Lytton Junction to Yeerongpilly section where it is observed that 2 trains have interference but one of those trains overlaps with a Corinda crossing path.

Thus a total of 3 loaded trains have interference.

A similar exercise for empty trains results in a total of 3 trains with interference but the paths of those trains are not the same in all cases as the loaded trains. A loss of an unrelated empty path results in the loss of another loaded path on its return.

The net result is 4 loaded paths per week day are lost due to the interference caused by the suburban system.

This interference is applied in these calculations to the theoretical maximum less maintenance giving 288 paths per week (144 in each direction or 102 paths for weekdays and 42 paths for weekends) and this contrasts with QR's 252 paths, the difference being the estimate by QR of the unplanned delays which we believe should not be built into the calculation of capacity other than to substitute for unreliable infrastructure, operations or human behaviour and which should be addressed by other means.

For weekdays, notwithstanding weekday maintenance in the suburban area, which is rare, the loss equates to 20 paths in 102 paths.

Suburban System Maintenance Influence

There is no doubt that maintenance causes path interference, especially during weekends. QR has indicated a maintenance allowance of 19 hours per week for the Western System and if the maintenance of the suburban system occurred at times that matched the disrupted path on the Western System then no other disruptive influence would occur.

However it is well known the two maintenance schedules are not aligned either absolutely in time or on a path basis when the trajectory of the path is the time distance path. This is because maintenance on the Western System mainly if not always occurs during the daytime whereas much maintenance in the suburban area occurs at nights or during the day in large blocks on weekends.

In addition, the maintenance impacting the maintenance system consists of a wider variety including overhead line maintenance and platform maintenance in which operations can only occur during specific periods of the day.

The plan for the Western Coal Supply Chain maintenance over the period 26/4/14 to 28/12/14 was provided to the QCA by Aurizon on 1st May 2014. This shows some work on 3 out of 4 weekends with varying possession lengths affecting the Western System. The total planned possessions amount to 624 hours over 37 weekends (1776 paths) some of which include Monday periods. On average this is the equivalent of 17 paths per week.

We observe overlapping maintenance programs and we estimate that approximately 372 paths are used by both the Western System and the suburban system at the same time. That is approximate 60% are shared. We note however that particularly for the 48 hour possessions the type of work being done on the Western System, namely rerailing and reconditioning are daytime only activities whereas the requirements of the suburban system are 24 hour in nature. There are some suburban activities which are wholly attributable to suburban operations.

We have allocated 75% of the requirement to possessions where there is shared work to suburban operations on the basis of the need by suburban operations for full shutdown arrangements as distinct from partial day arrangements. We estimate that the equivalent of 285 hours are attributable to suburban requirements whereas 339 hours are attributable to Western System requirements. This calculation assumes that the 19 hours per week estimated by QR for the Western System maintenance can be entirely overlapped with the suburban system requirements.

The 285 hours is equivalent to an average of 8 paths per week.

Summary Impact of Suburban Operations and Maintenance

The impact of suburban operations during weekdays has been calculated to approximate 20 loaded paths in 102 possible maximum loaded paths per week. The impact of suburban maintenance is estimated at 8 loaded paths in 42 possible loaded paths.

In total therefore we estimate the total number of lost paths due to the suburban operations and maintenance as 20 plus 8 (28) loaded paths in 144 possible loaded paths or 19.44%.

Since it is highly unlikely that the Western System maintenance requirements are able to be entirely overlapped with the suburban system requirements we suggest rounding our estimate upwards.

It is also relevant that for various reasons, QR is not planning to the full extent of the potential of the system, even with our rounding to 30 minutes for the longest sectional running time. The effect of QR's planning approach is to under-estimate the potential by 36 paths in 288.

Whether paths are reduced by suburban maintenance or some other factor, it is QR's decision to approach the planning in this way and the actual interference to pathways must have an effect on capacity.

We therefore conclude that the interference by the "black-out", or any other factor to the operation of the Western System take all of these factors into account and therefore we estimate the interference as 1.125 times 19.44% rounded up to 22%.

Our estimate therefore is that the interference by any means on the Western System capacity is 22%.