AU1 West Moreton Reference Tariff Reset Maintenance Submission

(Public Release)

QueenslandRail

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1. Introduction

Total Maintenance Costs – AU1 reset period ($'000)

West Moreton Coal Maintenance	2013/14	2014/15	2015/16	2016/17
Track (excl. Mechanised Resleepering)	16,237	15,094	15,887	15,425
Mechanised Resleepering	0	0	14,497	9,384
Trackside Systems	2,300	2,288	2,271	2,250
Facilities	144	150	156	162
Structures	2,004	2,001	2,315	1,951
TOTAL	**20,686**	**19,533**	**35,126**	**29,172**

The current access undertaking, titled 'QR Network Access Undertaking (2008) June 2010' (Temporary Undertaking), was assigned to Queensland Rail via a Transfer Notice on 1 July 2010 as part of the separation of QR Limited into Aurizon (formerly QR National) and Queensland Rail.

Queensland Rail has drafted its own access undertaking, titled 'Queensland Rail's Access Undertaking 1' (AU1), which is currently being considered by the Queensland Competition Authority (QCA). As part of the development of AU1, Queensland Rail has undertaken to develop a reference tariff for the West Moreton System based on a building blocks approach. The reference tariff developed will "reset" the existing reference tariff that has applied under the Temporary Undertaking and is proposed to apply from 1 July 2013 to 30 June 2017.

The 'opening asset value' building block utilises a Depreciated Optimised Replacement Cost (DORC) valuation with a datum date of 1 August 2007. This submission supports the 'AU1 West Moreton Reference Tariff Reset Overall Submission' document and provides insight into maintenance costs proposed to be undertaken on the West Moreton System (the rail corridor bounded by Rosewood to the east and Miles to the west). The maintenance costs detailed in this AU1 West Moreton Reference Tariff Reset Maintenance submission are a vital component to the operation of a safe and reliable railway corridor on the West Moreton System and are an important part of the supply chain.

This document provides a description of the maintenance costs component of the AU1 West Moreton Tariff Reset Submission. It aims to provide further detail into the proposed maintenance program for the reference tariff reset period (FY 2013/14 to 2016/17). This paper will show how these costs are derived whilst making reference to key aspects of the costs construction such as the:

- scope of the maintenance task
- performance of the maintenance task

This document is divided into three main parts. The first part (Sections 1 and 2) provides important background information, providing the context for the maintenance submission. The second part provides an overview of Queensland Rail's maintenance regime. This includes:

- Queensland Rail's maintenance philosophy (Section 3)
- Queensland Rail's maintenance regime (Section 4)

Queensland Rail's AU1 maintenance cost forecasts are detailed in the third part. This includes:

- Key drivers of the AU1 forecasts (Section 5)
- Asset maintenance products (Section 6)
- Forecast cost of the maintenance program (Section 7)

2. Background

2.1 West Moreton System Characteristics

The West Moreton System was constructed and opened to traffic in 1865 between Ipswich and Grandchester, with subsequent extensions reaching Toowoomba in 1867. Historically the line catered for passenger, livestock, freight and primary products (e.g. grain and cotton) traffics. Coal carrying services commenced in 1982 initially from mines located just west of Ipswich. Rail export commenced via rail from Jondaryan in 1984 and from Macalister in 1994. The West Moreton System was constructed on a black soil plain, a substrate which is notoriously porous, resulting in formation regularly failing and having to be continually rebuilt to enable good track geometry. In addition traversing the Toowoomba Range poses its own problems in that large forces are exerted on track by trains through tight radius curves resulting in more frequent rail stress adjustments.

The track standard and alignment are lower than that which would be constructed for a new stand-alone heavy haul railway built specifically for coal carrying services. The condition of assets has been reflected in the DORC valuation through the residual lives attributed to them. In this context, the existing track is heavily depreciated due to its age and as a result the opening asset base is considerably lower than the cost of a purpose built heavy haul railway.

As a consequence of the system age and track standard, the track section between Rosewood and Miles requires a higher cost maintenance program in order to safely and reliably deliver contracted tonnages.

2.2 Maintenance Cost Review Process

Queensland Rail has incorporated efficient maintenance costs that are ‘fit for purpose’ for the West Moreton System into its maintenance program for the West Moreton reference tariff reset. As part of the quality control program Queensland Rail established a taskforce to develop a robust and defensible AU1 maintenance cost forecast based on a detailed maintenance plan. This plan includes:

- A detailed quantification of assets that will be maintained
- The specification of the objectives of the maintenance standards and any their objectives
- An explanation of the activities that will be undertaken to achieve these goals and how these activities are managed
- An analysis of why the proposed approach to maintenance activities was chosen and where necessary an analysis of alternative approaches
- An analysis of the forecasting approach both in terms of the scope of work and the unit rates used to derive the cost estimates
- The quantification of key risk factors and specification of how these risk factors have been accounted for in the forecasting process

Additionally WorleyParsons, an external railway engineering adviser with extensive experience in evaluating efficient maintenance costs in railways, has been commissioned to perform a review of the maintenance program to ensure that a prudent, robust and appropriate program has been presented.

3. Queensland Rail's Maintenance Philosophy

3.1 Maintenance and Supply Chain Efficiency

One of the primary ways that Queensland Rail can contribute towards the development and ongoing enhancement of an efficient coal supply chain is via its network maintenance strategy. The key way that the strategy contributes to this is by ensuring that the network is maintained to a standard that delivers an appropriate level of service to users.

Maintenance can impact service quality in a number of ways. The fundamental means is by ensuring that the network can be consistently operated at its maximum operational capability (that is, to the maximum speed and axle load that it has been designed to carry), which in turn enables throughput to be maximised. Service quality will be degraded by the introduction of speed restrictions or disruptions to network availability due to incidents such as derailments or unplanned possessions.

The management of possessions can also influence service quality, particularly in a capacity constrained environment. Track closures are a necessary part of being able to maintain the network. Their timing and duration have an impact on throughput, particularly where there is limited stockpile capacity at the port. The management of possessions is therefore an important part of Queensland Rail's maintenance strategy (particularly in the current environment). This includes actively looking for ways to do the required maintenance without increasing possessions.

3.2 Trade-offs in the Maintenance Strategy

3.2.1 Service Quality and Cost

The cost of maintenance will be driven by the standard required to achieve a given level of service quality. There is clearly a trade-off between these two factors; given there will be a direct relationship between the standard of the network and the cost of maintaining the network to that standard.

Queensland Rail's maintenance regime needs to achieve an appropriate balance between service quality and cost, which ultimately, should be driven by the requirements of users, given they will directly bear the costs of the maintenance program through Reference Tariffs as well as the consequences of service quality.

If the asset is under-maintained, there is a short-term benefit based on reduced costs and fewer maintenance possessions, however in the longer term, network availability could be reduced as speed restrictions are imposed (to ensure that safety is maintained) and the number and duration of unplanned maintenance possessions increases. It can also result in capital expenditure being brought forward where assets must be replaced due to early failure.

If an asset is over-maintained, users may be bearing a higher cost of maintenance than is necessary to maintain the desired level of service quality. It could also mean that network availability is being compromised as planned possessions are likely to be more frequent.

The balance between service quality and cost can change through time. For example, if the network is not capacity constrained, there may be a higher degree of tolerance for track closures and speed restrictions to the extent that this has less of an impact on the ability of users to meet the requirements of their customers. At the same time, Queensland Rail still has to maintain the network to an appropriate standard to preserve the long-term integrity of its assets and ensure safety is not compromised.

At the current time, the supply chain is seeking all components to maximise throughput. A capacity constrained environment places considerable pressure on the maintenance program. Maintenance of the network to a high standard is particularly important in this environment given the implications that speed restrictions and unplanned possessions could have on network availability. At the same time, while unplanned maintenance needs to be minimised it cannot be avoided, so Queensland Rail needs to maintain sufficient flexibility to be able to respond quickly and effectively where unforeseen issues arise. In the current environment, the opportunity cost of foregone throughput to the mines will be very high. However, this will still necessitate taking possession of the track for maintenance in a manner that minimises the impact on users.

Achieving and maintaining the level of service quality that will enable throughput to be maximised in a capacity constrained environment will result in a higher cost of maintenance compared to a more subdued demand environment. Further, the factors that are driving the increase in demand are also putting pressures on the costs of carrying out maintenance (i.e. labour and input costs).

A focus on maximising throughput does not mean that cost becomes less important. Queensland Rail is acutely aware that the costs of choosing to do this need to be reasonable and efficiencies should still be extracted to the extent possible. The implications of this on the maintenance strategy (and its associated cost) is a key theme that will be explored further in this document.

The appropriate balance between capital expenditure and maintenance requires the application of judgment and will vary depending on the nature of the asset, the historical maintenance regime and current market conditions. Consequently there are no ‘hard and fast’ rules that are applied by Queensland Rail in evaluating capital expenditure versus maintenance, other than ensuring that this is routinely considered in planning decisions based on a whole-of-life analysis.

3.3 Vision for the Maintenance Program

Queensland Rail’s vision for maintenance is to maintain the network to a standard that maximises supply chain efficiency in a manner that is consistent with the level of service quality desired by users. This is done within the context of a maintenance strategy that maintains the long-term integrity and safety of the network.

This document outlines the initiatives that Queensland Rail has undertaken to achieve this, some of which are embedded in the long-term strategy and others that have been implemented in response to tonnage growth. Queensland Rail’s overall approach to maintenance is outlined in Section 4.

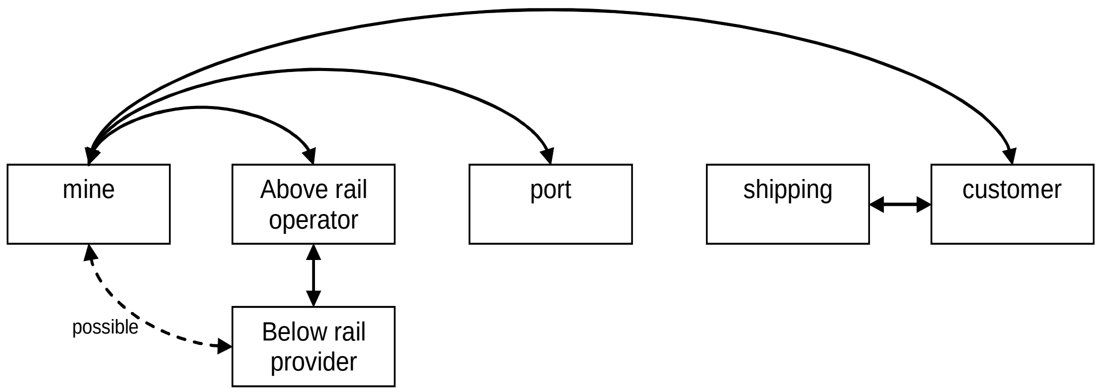
4. Queensland Rail's Maintenance Regime

4.1 Commercial Arrangements

4.1.1 Supply Chain Position

Queensland Rail's position in the supply chain has an impact on its ability to maintain all portions of the West Moreton System. The following diagram shows the current contractual flows within the coal supply chain.

Figure 4.1: Supply Chain Contracts



Queensland Rail's main contractual interface is with the above-rail operator and end-users. What this means is that Queensland Rail cannot impose obligations on other supply chain participants, for example, Queensland Rail cannot require the port to clean portions of its track or change its coal un-loading activities to minimise the impact on Queensland Rails' rail infrastructure.

4.1.2 Focus of Maintenance Activity

Queensland Rail has a contractual obligation with Aurizon as train operator to minimise below rail transit time. However, an operator such as Aurizon will also seek:

- a known cap on the number, location and time interval between track possessions
- best possible response times to any network disruption (including force majeure events)
- some spare capacity for peak production rates, or catch up capacity
- coordinated supply chain shutdowns and track possessions

Queensland Rail aims to meet these demands (which Queensland Rail believes are also the demands of coal customers) by limiting the number of speed restrictions and the total number of unavailable days for train traffic. However, these can also be impacted by factors that are not within the control of Queensland Rail.

4.2 Planning, Implementing and Managing the Maintenance Program

4.2.1 Maintenance Planning

As noted above, Queensland Rail as maintenance provider, develops a forecast of the expected works required. This forecast is done on a number of levels. The annual Network Maintenance Plan forecasts work to be done each year. A longer term Network Maintenance Plan is produced, with a rolling five year horizon which is incorporated into Queensland Rail's corporate plan.

4.2.2 Asset Monitoring and Analysis

Asset monitoring and analysis is also a very important part of maintenance planning and delivery. Asset monitoring technology and the associated analytical tools are becoming increasingly sophisticated; delivering more accurate and robust data that is then directly fed into the maintenance planning process. More accurate monitoring of potential defects enables a more proactive maintenance program, which should also generate efficiencies over the longer term.

4.2.3 Preventative versus Reactive Maintenance

One of the key trade-offs in the maintenance regime is preventative versus reactive maintenance. Preventative maintenance is maintenance that is undertaken at regular programmed intervals to maximise availability and reliability. It is a more proactive approach that seeks to anticipate the likely maintenance effort required based on an understanding of the asset's characteristics and the impact of throughput on its performance. Further, as mentioned, this assessment is improved by regular asset monitoring and analysis.

Reactive maintenance is performed in response to a failure, noting that assets can fail for a number of reasons (including incidents on the network). This will generally need to be prioritised depending on the risks arising from the failure. Immediate corrective maintenance will be undertaken where the failure has a potentially significant safety, environmental or operational risk. Deferred corrective maintenance, which may be identified during the course of preventative maintenance, is performed where the potential risk is not significant. The maintenance may be deferred because of the scale and scope of work required.

It could be argued that the more preventative maintenance is carried out, the less corrective maintenance is required; however, this does not mean preventative maintenance should not be efficient and targeted. Primarily, in a capacity constrained environment, obtaining the necessary possessions to carry out maintenance (preventative or reactive) is more difficult and can impact on operator and customer outcomes. Secondly, even if the network was not capacity constrained, there are levels of preventative maintenance beyond which additional maintenance is not efficient (that is, it is effectively 'over maintaining' the asset). Thirdly, there are circumstances that could lead to asset failure, which are independent of the level of preventative maintenance that has been undertaken, such as extreme weather events or derailments that are not caused by track defects.

Maintenance planning therefore needs to achieve an appropriate balance between preventative and reactive maintenance, taking into consideration constraints imposed by possessions.

4.2.4 Coal Chain Impacts on Maintenance Delivery

There are a number of situations or practices beyond the control of Queensland Rail which can have an effect on the cost of services delivered and also the scope of tasks required to maintain the asset for use over its design life. Some examples of this are outlined below.

- **Port Shutdowns** – planned port shutdowns and track possessions for maintenance or construction works are by negotiation only (e.g. not guaranteed). However, if well planned, they have the potential to be the most effective periods for maintenance.

- **Coal Ploughing at Ports** - coal unloading practices at the port that cause coal to remain on rail wagon 'bogies' on exit from the port have an impact on the condition of the rail around the exit of the mine.

- **Other Factors** - there are a number of other factors that are beyond the control of Queensland Rail that can influence the condition of the assets as well as the ability to undertake maintenance. Weather is a key factor in this regard. The Southern Queensland climate is subject to long periods of relatively stable weather which are interrupted by irregular bouts of extreme rainfall that typically require the maintainer to shift from planned to reactive maintenance activities for periods of upwards of four weeks at a time.

Cost Implications of Interruptions to Maintenance

Where Queensland Rail defines a scope of maintenance activity for a period and this is subsequently interrupted due to unforseen factors, maintenance costs can increase in one or more of the following ways:

- in line with stand-down and re-tool time required for both labour and consumables used

- there is an increase in future maintenance costs due to missing planned possessions, including the costs associated with re-scheduling the activity to a future time/date

Due to the specialised nature of the equipment and operators used for major track maintenance and the requirement to move this from other parts of the network, the establishment costs associated with these activities is high and much of these costs are fixed.

The above rail operator can also impact upon the efficient maintenance delivery e.g. a train not running to its planned schedule that impacts on a possession window could result in the scope of maintenance being reduced or no work being undertaken at all. Where the maintenance provider is resourced for specific activities to be in place in line with a planned track possession, any change to the scope of activities, for any reason, generally will yield an increase in cost due to the need for 'repeat' attendance to finalise works.

Queensland Rail's 'Zero Harm' Philosophy

Queensland Rail takes safety very seriously, and as such a "Zero Harm" safety philosophy. This is based on five principles:

1. No workplace fatalities - injuries and diseases are preventable
2. No task is so important that it cannot be done in a safe manner
3. We seek to identify all foreseeable hazards and manage the risk associated with them
4. Everyone has a personal responsibility for the health and safety of themselves and others
5. Our health and safety performance can always improve

The overarching principle is the right of Queensland Rail staff, and all people associated with the Queensland Rail network, to be able to expect to return home unharmed from their work activity or other activity on the network. Improvements in safety performance are focused on ensuring safety is given priority over production.

4.3 Implications of the Current Environment for Maintenance

Some of the key implications of the current demand environment for maintenance have already been mentioned. These include:

- maintaining the network to a suitable standard to minimise the risk of asset failures and network incidents

- a focus on maximising throughput, which necessitates the effective management of available possessions and minimising disruptions to network availability for both planned and unplanned maintenance

- maintaining sufficient flexibility in the maintenance regime in order to be able to:

  - accommodate customer needs (for example, rescheduling planned possessions to enable a customer to meet its schedule at the port)

  - respond quickly to unanticipated issues and incidents to minimise disruptions to the network

The growth in demand that is driving this environment is also placing pressure on the costs of doing maintenance.

In order to be able to respond to these challenges, it remains imperative to be able to continue to investigate ways of delivering maintenance more efficiently, which includes being able to do more maintenance with the same (or fewer) resources and/or being able to mobilise resources to be able to maximise the limited maintenance windows that are available. This necessitates maintaining sufficient resources in management and planning in order to be able to continue to investigate new and/or alternative ways of doing things while continuing to deliver the maintenance plan.

Some of the key improvements and innovations that have been implemented in more recent times are summarised in the following section.

4.4 Driving Efficiency and Innovation in Maintenance

4.4.1 Defining ‘Efficiency’ in the Current Environment

Driving continuous improvement needs to be an integral part of the maintenance regime irrespective of the current demand environment. However, the constraints imposed by demand pressures may determine what is regarded as ‘efficient’. For example, efficiency is not necessarily limited to doing more with less, or finding ways to reduce costs.

As noted above, where the number and duration of maintenance windows are limited, the challenge is to be able to take maximum advantage of these windows, which could actually lead to increased costs associated with the mobilisation of equipment and resources in a single location (including the costs associated with doing multiple shifts). Queensland Rail has implemented a closure program for the West Moreton System which is coordinated with the Brisbane Metropolitan Region to maximise the intensity of the maintenance effort while minimising the impact on throughput.

4.5 Performance Monitoring

Appropriate performance monitoring and reporting is fundamental to the ongoing success of Queensland Rail’s ability to ensure that it can satisfy its obligations to its customers in relation to service quality.

4.5.1 Maintenance Key Performance Indicators

The KPIs are contained in the following table.

Table 4.1: Maintenance Performance KPIs

Maintenance Performance	Description
Fault Response:	
Signal (High Priority)	A 12 month rolling average of the sum of high priority faults for the month
Production Against Program - Infrastructure:	
Resleepering	Actual Delivery vs. Plan
Resurfacing	Actual Delivery vs. Plan
Rail Grinding	Actual Delivery vs. Plan
Track Recording	Actual Delivery vs. Plan
Non Destructive Testing	Actual Delivery vs. Plan
Trackside (Signal):	
Routine Maintenance	Actual Delivery vs. Plan
Major Maintenance	Actual Delivery vs. Plan

Of the current KPIs, the two that have most influence on the total costs of maintenance activities and have a direct impact on system performance are:

1. The Overall Track Condition Index (OTCI). This is a track geometry measure which monitors, along with other forms of inspection, the condition of the track and its ability to support the required task.

2. Transit Time Delay (TTD). TTD is the theoretical delay due to speed restrictions imposed due to infrastructure issues. As the traffic task required increases so does the maintenance effort that will be required to ensure that the TTD remains within specified limits. Increased traffic not only impacts the amount of maintenance required but also the ability to deliver maintenance as access to maintain the asset (available possessions) is reduced.

5. Key Drivers of the AU1 Forecasts

5.1 Service Delivery

Typically Queensland Rail undertakes all planning of work and inspections relating to the existing assets.

The following table sets out who undertakes the delivery of these activities:

Track Management	
Activity Name	**Service Delivery**
1. Maintenance Ballast	The sourcing of ballast is achieved through competitive tendering with transport also being an external supplier
2. Formation Repairs	While the removal and reinstatement of track is undertaken by Network Regional staff, earthworks and supply of ballast is generally achieved through contractors
3. Mechanised Resurfacing	This activity is achieved by utilising Network Regional resources
4. Mechanised Resurfacing - Turnouts	This activity is achieved by utilising Network Regional resources
5. Top & Line Spot Resurfacing	This activity is achieved by utilising Network Regional resources
6. Sleeper Management	This activity is achieved by utilising Network Regional resources
7. Track Recording Inspections	This activity is achieved by utilising Network resources
8. Inspection & Testing	This activity is achieved by utilising Network Regional resources
9. Turnout Maintenance	This activity is achieved by utilising Network Regional resources
10. Minor Yard Maintenance	This activity is achieved by utilising Network Regional resources
11. Track Reconditioning & Removal	Materials are sourced externally with the activity being carried out by Network Regional resources
Rail Management	
Activity Name	**Service Delivery**
1. Rail Grinding Main Line	This activity is delivered by an external contractor
2. Rail Grinding Turnouts	This activity is delivered by an external contractor
3. Rail Joint Management	This activity is achieved by utilising Network Regional resources
4. Rail Lubrication	This activity is achieved by utilising Network Regional resources
5. Rail Renewal	This activity is achieved by utilising Network Regional resources
6. Rail Repair	This activity is achieved by utilising Network Regional resources
7. Rail Stress Adjustment	This activity is achieved by utilising Network Regional resources
8. Ultrasonic Testing – On track machine	This activity is delivered by an external contractor
9. Ultrasonic Testing – Manual	This activity is achieved by utilising Network Regional resources
Off Track Management	
Activity Name	**Service Delivery**
1. Level Crossing Construction/ Maintenance	Track work is undertaken by Network Regional with the remainder of this activity being outsourced
2. Earthworks – Non Formation	This activity is delivered by an external contractor
3. Fencing	Major fencing is outsourced with any minor repairs being undertaken by Network Regional staff
4. Fire and Vegetation Control	Network Regional staff undertake burning off and the application of on track weedicide with the majority of other activities being carried out by contractors
5. Monument/Signage Erection	This activity is typically outsourced
6. Track Clean Up	Depending on the size of the activity, large work will be outsourced

Structures Management	
Activity Name	**Service Delivery**
1. Structures Inspections	This activity is achieved by utilising Network Regional resources
2. Drainage Construction/Repairs	Minor work is achieved by utilising internal resources with larger repair work typically being outsourced
3. Repairs Concrete Bridges	Minor work is achieved by utilising internal resources with larger repair work typically being outsourced
4. Repairs Steel Bridges	This activity is achieved by utilising Network Regional resources
5. Repairs Timber Bridges	This activity is achieved by utilising Network Regional resources
6. Retaining Wall Construction/Repairs	Minor work is carried out in house with larger repair work typically being outsourced
7. Structures Pest Control	Typically work is carried out by Network Regional staff with the supply of product being outsourced
8. Ancillary Structure Construction/Repairs	Minor work is carried out in house with larger repair work typically being outsourced
Signalling Management	
Activity Name	**Service Delivery**
1. Preventative Signalling Maintenance	This activity is achieved by utilising Network Regional resources
2. Corrective Signalling Maintenance	This activity is achieved by utilising Network Regional resources
3. Major Network Corridor Signal	This activity is achieved by utilising Network Regional resources
4. Level Crossing Protection	This activity is achieved by utilising Network Regional resources
5. Signalling Control Systems	This activity is achieved by utilising Network Regional resources
6. Cable Route Management	This activity is achieved by utilising Network Regional resources
7. Train Protection Systems Maintenance	This activity is achieved by utilising Network Regional resources
8. Wayside Monitoring Systems Maintenance	This activity is achieved by utilising Network Regional resources
9. Operating System for Civil Infrastructure	This activity is achieved by utilising Network Regional resources
Telecommunications Management	
Activity Name	**Service Delivery**
1. Control & ECO Telephone Maintenance	This activity is achieved by utilising Network Regional resources
2. Preventative Telecoms Backbone Network Maintenance	This activity is achieved by utilising Network Regional resources
3. Corrective Telecoms Backbone Network Maintenance	This activity is achieved by utilising Network Regional resources
4. Telecoms Backbone Modifications	This activity is achieved by utilising Network Regional resources
5. Phone/Data Move/Change/Install	This activity is achieved by utilising Network Regional resources

5.2 AU1 Key Performance Indicators

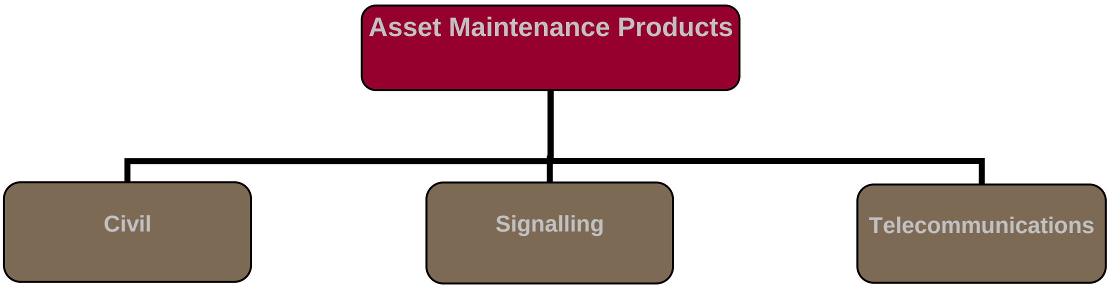
Table 5.1: Impacts of Key Activities on System Performance

Activity	Possession length required	Number of possessions required per machine per annum	Planned timescale expected to ensure efficient delivery
Ballast Cleaning	3 hours	250	4 weeks
Resurfacing Mainline	2 hours	60	4 weeks
Resurfacing Turnout	2 hours	200	7 days
Resurfacing 'Chase'	In traffic paths required	-	Annual plan, needs long term inclusion within train plan
Stoneblowing	48 hours 12 hours	Monthly 3 Per Month	Annual Plan, detail at 13 weeks
Rail Grinding	~	~	Response, <24hrs
Zonal Maintenance Shutdowns	3 hours	250	4 weeks
Disaster 'response'	2 hours	60	4 weeks

6. Asset Maintenance Products

The maintenance products that are undertaken to maintain the West Moreton System can be described using the three discipline bases: Civil, Signalling, and Telecommunications.

Figure 6.1: Asset Maintenance Products comprises Three Disciplines



Each of these three disciplines has a hierarchy of maintenance product codes that describe the maintenance tasks and are used for capturing the costs of these products. The budget for each of these products (represented by separate product codes) is shown individually in the Network Maintenance Plan. Work undertaken in these product codes is then recorded and monitored at the monthly Regional Management Team meeting.

An overall product code has been developed to capture asset management costs. The asset management costs are those associated with the management of speed restrictions, administration and execution of strategic planning, the organisation of management and data input and analysis.

An overall product code has also been developed for inventory asset management. Inventory asset management involves the management of all inventory, stocktake and clean up, retrieval of material, audits and administration.

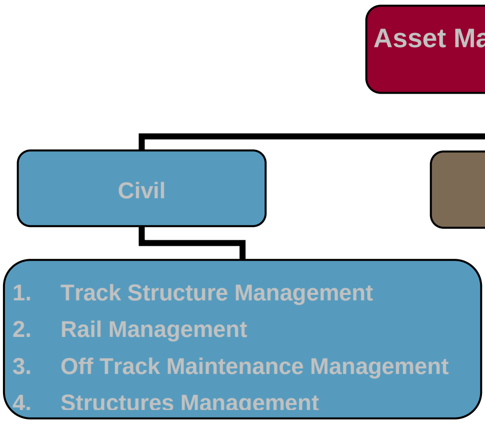
The following sections provide descriptions of each of the maintenance products in each of the three disciplines shown above.

6.1 Civil Maintenance Products

The breadth of civil maintenance products has required civil maintenance to be further characterised into the following:

- Track Structure Management
- Rail Management
- Off Track Management
- Structures Management

Figure 6.2: Civil Maintenance Products can be classified into four groups



6.1.1 Track Structure Management

Products included under track structure management are those that relate to the overall performance of the track structure. These products ensure that the geometry and stability of the track is maintained to a safe and appropriate operating level. A list of the products, their purpose and KPI relationship are shown in the following table and are described in more detail in the following sections.

Table 6.1: Activities within Track Structure Management

Track Structure Management		
Activity Name	**Purpose**	**KPI Relationship**
1. Maintenance Ballast 2. Formation Repairs	Restores ballast drainage properties Reduces speed restrictions Restores track geometry Reduces risk of track buckle	OTCI TTD Derailments
3. Mechanised Resurfacing 4. Mechanised Resurfacing - Turnouts 5. Top & Line Spot Resurfacing	Restores track geometry Prolong ballast life Prevents premature component failure	OTCI TTD Derailments
6. Sleeper Management	Replace defective sleepers	Derailments
7. Track Recording Inspections	Proactive management of track geometry Identify & prioritise corrective work	OTCI
8. Inspection & Testing	Identify work to be planned & carried out	OTCI TTD Derailments
9. Turnout Maintenance 10. Minor Yard Maintenance	Routine maintenance Replacement of components	Derailments
11. Track Reconditioning & Removal	Refurbishment to restore condition	Derailments

The majority of the products involved in civil maintenance fall under track structure management. Two of these activities, resleepering and mechanised resurfacing are the largest expense items in the maintenance budget. Consequently, these two activities have detailed descriptions provided with summary descriptions being provided for other products.

Assumptions and Influential Factors

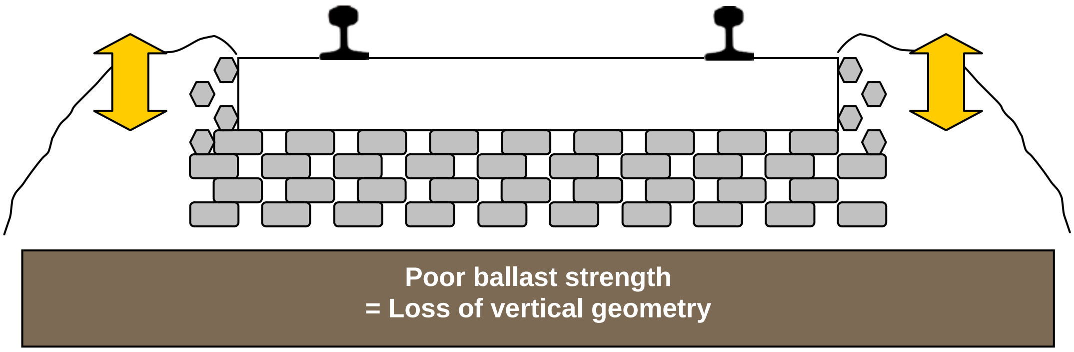
When discussing ballast maintenance, it is useful to remember what task we expect the ballast to perform. Track ballast has three main duties:

1

To spread the load from the sleepers to the underlying formation.

To carry the load, the ballast must be hard and tough; this is covered by the original specification of the ballast.

The failure mode for this is shown below.



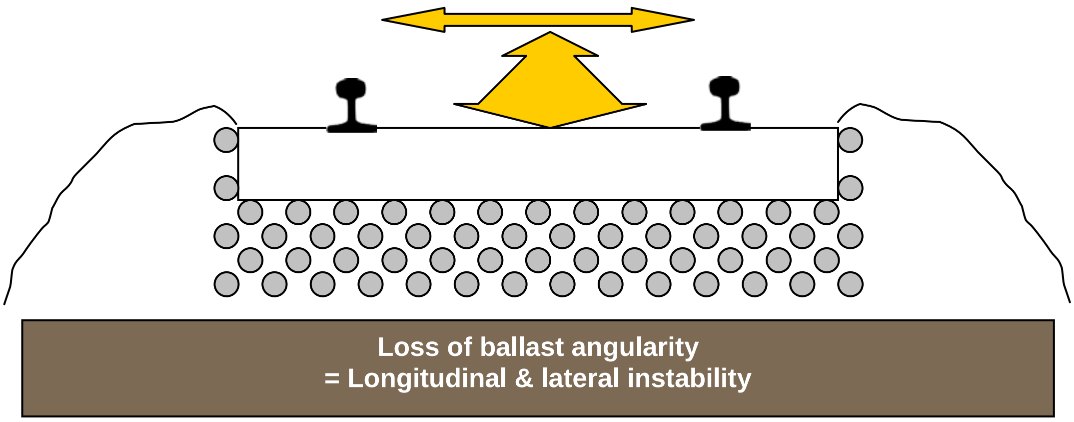
Where the ballast has failed due to (1), the ballast must be replaced.

2

To hold the sleepers in position (track geometry).

To hold the sleepers in position the angularity of the ballast is important, to provide interlock between the particles and to 'bite' into the sleepers and prevent movement.

The failure mode for this is shown below.



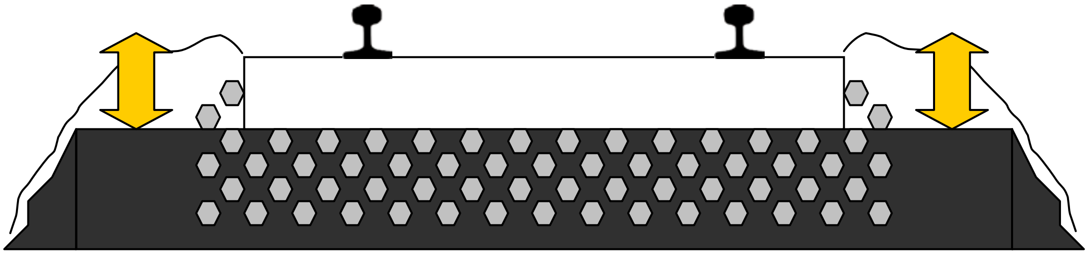
Where the ballast has failed due to (2) then at least partial replacement of the ballast should be undertaken. A secondary consequence of this failure mode is the generation of fine particles which accelerate contamination.

3

To provide adequate drainage.

To provide drainage the ballast must be clean and free from dust and other contaminants.

The failure mode for this is shown below.



Loss of voids, poor ballast drainage
= Loss of vertical geometry, and ultimately the effects stated in (1) and (2)

Where the ballast has failed due to (3), the ballast may be replaced to remove broken down ballast and other contaminants. If the ballast is not replaced two types of failure are likely to follow:

- The lower layer of ballast stays wet and causes the foundation to remain saturated and lose strength
- The ballast itself stays wet and loses strength

In both cases the sleeper is not supported elastically. That is, it does not spring back into position after each axle passes. Instead, it gradually sinks, causing vertical track geometry problems.

This does not present too significant a problem when the weather is dry, however when combined with rainfall the lack of drainage available within the ballast will ultimately lead to loss of system performance.

The activities within track structure management are detailed below.

Product 1: Maintenance Ballast

This product involves the purchase, freight and running out of ballast for restoration of ballast profile only.

Product 2: Formation Repairs

The formation of the track deteriorates with increased use and also with seasonal weather conditions such as heavy rain. Formation repair activities enable Queensland Rail to allow greater running on track sections where track formation has decreased. These repair activities include the renewal of the top 600 mm of the formation, installation of drains and track reinstatement e.g. ballast, welding, resurfacing.

Product 3 and 4: Mechanised Resurfacing – Mainline and Turnouts

Mechanised resurfacing restores the geometry of the track by lifting the track to the appropriate level and compacting the ballast underneath the sleeper. If track geometry is not corrected to a standard that is fit for the traffic task, track components deteriorate leading to a marked increase in the need to perform other maintenance on the track.

Under normal conditions, ballasted track displaces slightly out of its original position under traffic, however, these changes of the horizontal and vertical positions initially occur at low rates. Over time with the passage of more traffic, the development of track geometry irregularities accelerate the rate of geometry deterioration, which requires corrective work in order to restore the track geometry and assure safe running.

A further factor that has a considerable impact on the ability of the track to hold its top and line[1] is rainfall and the ability of the track to drain. In areas of heavily fouled ballast due to clay holes, it may be necessary to treat areas of poor top and line through repeat resurfacing of relatively short lengths until such time that the formation repair is programmed.

Methodology
Mechanised resurfacing is a standard railway maintenance function applied to keep track within design geometry parameters. It assures correct levelling and lining, which keeps vertical and lateral forces and accelerations within acceptable limits. By the tamping, lining and levelling action the rails are lifted and shifted to the correct position and the tamping tools pack the ballast underneath the sleepers.

Mechanised resurfacing is performed as part of the initial construction of the track and subsequently at intervals depending on the speed, tonnage and deterioration rate of the track. The task is completed using self-propelled on-track machines that are able to lift and line the track to a pre-determined level, and compact the ballast under the rail seat to support the new track position.

In Queensland Rail, resurfacing maintenance operations are broken into two distinct products:

- Mechanised Resurfacing – Mainline
- Mechanised Resurfacing – Turnouts

Scope Development
The scope of the two resurfacing products has been forecast based on the historical performance of the asset whilst taking into account growth in tonnages and new track infrastructure that is required to be maintained over the duration of the undertaking. The scope for mechanised resurfacing is generally driven by:

- gross tonnes across the track
- the standard of track construction (e.g. rail size, sleeper type, etc.)
- the current condition of the track components
- the historical performance of the infrastructure in service

Track geometry recording outputs, along with asset performance parameters such as OTCI[2] , percentage of track under speed restriction, and TTD are all used to determine the amount of resurfacing planned for delivery each year.

Seasonal weather events also have the potential to greatly influence the occurrence of track geometry faults which are repaired via resurfacing. Variations in demand for resurfacing capacity caused by seasonal weather events will be managed through mobilising machines from nearby rail systems (i.e.

[1] Vertical and horizontal positioning of the track structure (used interchangeably with geometry).
[2] A measure of the quality of the geometry of the track calculated from track geometry recording vehicle outputs.

North Coast Line, Western and South West Systems) in the instance that machines operating in the West Moreton System are unable to meet peak demand levels within short periods of time.

The planning of track maintenance works, particularly to maintain track geometry, requires considerable skill and experience to achieve cost-effective outcomes. Mechanised resurfacing is one of a few different maintenance products that may be used to treat a particular area depending on the required response time to the defect, the underlying cause of the defect and the inherent track component condition. The following table gives an example of the geometry defect, cause and potential remedial treatment:

Table 6.2: Routine Maintenance Defect Treatment

Geometry Exception	Typical Causes	Typical Routine Maintenance Treatments
Top/Twist Defects	Settlement of ballast Change in track stiffness (e.g. bridge ends)	Lift track and packing or tamping ballast under sleepers by mechanised or manual means
Line Defects	Ineffective ballast around sleepers	Realign track laterally to design alignment and pack ballast around sleepers by mechanised or manual means

Other track defects may cause geometry exceptions, for example, areas of poor drainage or failed formation. These defects cannot be treated by resurfacing as the cause of the defect is still present and the defect will continue to occur.

Scope of Works

To continue to maintain the network within the required asset performance indicator bandwidths, the following scope has been identified for Mechanised Resurfacing – Mainline, and Mechanised Resurfacing – Turnouts.

Table 6.3: Mechanised Resurfacing – Mainline Scope (kms)

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	120	125	130	130
Toowoomba – Macalister	100	110	110	120
Macalister – Miles	70	70	70	70

Table 6.4: Mechanised Resurfacing – Turnout Scope (No. of turnouts)

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	15	10	15	15
Toowoomba – Macalister	20	25	20	25
Macalister – Miles	8	10	10	10

Product 5: Top and Line Spot Resurfacing

Top and line spot resurfacing encompasses all activities associated with restoring top and line to track using manual or mechanically assisted processes. It involves restoring top and line on bridge ends, open track, using manual processes or small spot tampering machinery (e.g. modified bobcat, portable tamper, etc). However, it excludes activities undertaken by major production resurfacing machines.

The table below shows the estimated number of top and line activities during the reference tariff reset period. This work is undertaken by the track gangs that are located throughout the network.

Table 6.5: Number of Top and Line Activities during the AU1 reset period

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	500 locations	540 locations	570 locations	600 locations
Toowoomba – Macalister	240 locations	260 locations	280 locations	300 locations
Macalister – Miles	60 locations	60 locations	60 locations	65 locations

Product 6: Sleeper Management

The sleeper management task encompasses activities such as spot insertion of sleepers, reboring and regauging by local track teams. Specifically, activities include:

- Carrying out sleeper tests (using a Zeta-Tech sleeper inspection machine)
- The use of resleepering components and fastenings
- Clipping up of concrete and steel sleepers where components are dislodged by resurfacing

Activities related to resleepering include spot tamping, reboring, regauging, replating, freight, distribution of sleepers, respacing, flagging and cascading of part worn sleepers. Ballast and rail are not renewed during the resleepering process. Due to the nature of the task, track closures are necessary to carry out the works.

Product 7: Track Recording Inspections

Track Recording (TR) is a general term used to define the use of mobile measuring vehicles used to:

- Provide an objective measure of track geometry and trends across the rail network
- Report abnormal variations in track geometry to infrastructure maintainers
- Measure track geometry improvements and deterioration rates
- Report trends in track geometry by line section, system, corridor and network
- Produce contractual maintenance bandwidths based on track geometry to ensure abnormal variations in both improvement and deterioration reported for explanation
- Provide kilometre based environmental video of track
- Monitor compliance with target construction standards for the asset owner under customer service agreements (e.g. ballast cleaning)
- Report abnormal variations in track and overhead relationship to infrastructure maintenance staff

- Monitor construction standards under scope of works (e.g. track laying)
- Monitor and report on the effect of sleeper condition, type, selection and pattern on track and overhead relationships
- Monitor rail wear rates and rail profiles for wheel rail interaction, and report abnormal rail corrugations
- Monitor and report on mechanised maintenance effects on track geometry condition
- Monitor and report on rail size, length and joint maintenance practices on track condition

The accurate, calibrated and repeatable collection of data, which is undertaken by the geometry cars, is a mandatory requirement for railways in Australia. At present the track geometry vehicle collects data three times a year. This data is used to monitor the asset condition (it is a key input into the OTCI measure of rail condition) and identify major issues that require attention. It also has a limited role in the long term planning of the programmed maintenance activities, however due to the relatively long periods between inspections (four months) it is not currently the major driver of the timing of key interventions such as resurfacing.

Product 8: Inspection and Testing

Inspections are undertaken to maintain the civil infrastructure. These inspections ensure that the infrastructure operates safely and effectively. These inspections are carried out in accordance with:

- Civil Engineering Track Standard Module CETS 1 – Track Monitoring.
- Civil Engineering Structures Standard Module CESS 1 - Structure Monitoring.

Defects found during these inspections are entered into the Rail Infrastructure Maintenance System (RIMS) for actioning and repairing. From RIMS, work programs are developed to remove/repair the defects within the timeframes that are specified. Queensland Rail Network target zero overdue repairs in line with their business principles.

The following inspections are undertaken to maintain civil infrastructure:

- **Scheduled Patrol Inspection by the Track Maintenance Supervisor (TMS)** - the TMS (or a qualified delegated worker) performs a hi-rail inspection every 96 hours (twice a week). During these inspections the TMS checks for obvious unsafe conditions, changed conditions or evidence of high rates of deterioration.
- **Front of Train General Inspection by the Track Planner (TP)** - the front of train inspection is undertaken every four months and is intended to reveal track defects under full dynamic train loading. They are at a level of detail to observe and record unsafe conditions or changes in condition of the track since the previous inspection. Any defects recorded are entered into RIMS.
- **TP and TMS Inspection** - the TP performs a hi-rail inspection at six week intervals with the TMS to coincide with a scheduled patrol inspection. This inspection monitors the overall track condition including rough track, ballast deficiencies, turnouts and fences for renewal or major repair and identifies remedial work that will be rectified during a closure or shutdown.
- **TMS onboard Track Recording Car (TRC)** - During inspections by the TRC the TMS responsible for that section of track accompanies the TRC to receive advice on high priority defects. The TRC inspects the West Moreton System at a minimum interval of four months but generally the inspection is performed every three months. The TRC measures track parameters for top, twist, gauge and applied cant.
- **Asset Maintenance Coordinator (AMC) and TMS Inspection** - The AMC performs a hi-rail inspection every six months with the TMS to coincide with a scheduled patrol inspection. This inspection monitors the overall track condition and the work verification process. This

inspection also checks that defects are not re-prioritised too often and that defect priorities are relevant and any missing or in progress defects are attended to.

- **Scheduled Patrol Inspection by the Structures Maintenance Supervisor (SMS)** - The SMS (or a qualified delegated worker) performs an inspection by road vehicle at intervals designated in the Civil Engineering Structures Standards SAF/STD/0080/CIV Module CESS 1 Structure Monitoring. During these inspections the SMS checks for obvious unsafe conditions, changed conditions or evidence of high rates of deterioration.

- **Develop Inspection Requirements for Timber Bridges**

    - Deck ground level inspection every 12 months

    - Visual load inspection every 12 months

    - Stage examination every two years for bridges over three metres

    - Underground pile inspection every five years

  All defects are checked, reprioritised and new defects added to RIMS.

- **Manual Non Destructive Testing by the Contractor and Queensland Rail Tester** - a verification test of all rail joints (welded or fishplated), thermowelds and visible surface defects in one 100 metre section of rail for each 100 km of track is undertaken. The purpose of this test is to ensure the rail mounted equipment is detecting all existing defects.

- **AMC Engineering Inspection** - this inspection is carried out yearly by hi-rail bus. The purpose of this inspection is to look at long term strategies and planning issues. This also provides an opportunity to jointly review any major remedial work that has been undertaken in the previous 12 months.

- **Hot Weather/Flood Inspection by the TMS** - these inspections are undertaken using a hi-rail vehicle when the ambient temperature exceeds 38 degrees celsius or when local flooding is evident.

- **Sleeper Inspections by TP** - every timber sleeper is inspected every five years. Testing of concrete sleepers occurs once a year at the rate of three sleepers every 10 km at selected locations.

- **Walking Inspection by the TP** - the TP performs a detailed walking inspection of:

    - Curved track every six months (Toowoomba and Little Liverpool Ranges every four months)

    - Timber sleeper track every 12 months

    - Interspersed steel (1 in 2) track every two years

    - Concrete sleeper mainline track every four years (Toowoomba and Little Liverpool ranges every four months)

  During walking inspections all defects are checked, reprioritised and new defects added to RIMS.

- **Points and Crossings Inspection by the TP** - the TP undertakes a detailed inspection of all points and crossings once a year. A report is produced with defects prioritised and entered into RIMS for action.

- **Other Inspections/Events that Generate Defect Identification**

    - Driver reports

- Noise complaints
- Public complaints
- Letters to the Minister
- Station staff complaints
- Derailments
- Level crossing collisions
- Vandalism

Table 6.6: Inspections that assist with the idenfication of defects

Responsible Person	Frequency	Focus	Output
Network Infrastructure audits by Trackmasters - Hi-rail (part)	Once a year	Check Safety Standards and Quality Systems	Report produced and discussed with the Senior Manager Regional West and the Asset Manager
Special Engineering Inspections	As required	Inspects unusual defects that require specialised knowledge	Report produced

Product 9: Turnout Maintenance

This activity encompasses all maintenance associated with turnouts with the exclusion of mechanised resurfacing and turnout tie replacement. Activities include the repair or replacement of components such as switches, vees, guard rails, associated jewellery including bolts, chair lubrication, maintenance welding, top and line (manual).

Product 10: Minor Yard Maintenance

Yard maintenance entails the day-to-day maintenance performed within rail yards that do not have a corridor code. Any maintenance performed by local or mechanised work groups regardless of the product being undertaken also covers this activity. This activity does not usually require track closures.

Product 11: Track Reconditioning and Removal

Track reconditioning and removal involves the extensive maintenance effort given to a section of track to restore it to a reliable condition. The activity entails the removal of redundant infrastructure, extensive renewal of sleepers, rail and ballast used. Labour involves realigning track to the correct configuration, removing old ballast from cribs, adjustments of rail creep, respacing, reboring, respiking of sleepers to correct gauge, renewal of sleepers, performing new ballast lifts and tamping and aligning track to its final grade and alignment (ballasted and regulated to full profile). Labour also involves any removal of redundant turnouts and track. Due to the nature of the task, track closure is necessary to carry out the works.

The following table shows the estimated number of track reconditioning activities during the reset period.

Table 6.7: Track Reconditioning Activities during the reset period

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	79km to 80km – UP road	80km to 81km – UP road	81km to 82km – UP road	82km to 84km – UP road
Toowoomba – Macalister	31km to 34km – Western Line	34km to 37km – Western Line	37km to 40km – Western line	40km to 44km - Western Line
Macalister – Miles	Nil	Nil	Nil	Nil

6.1.2 Rail Management

Products included under rail management are those that relate to the overall performance of the rail. These products ensure that the rail is maintained to a safe and appropriate operating standard. The two major rail management products are:

- Rail Grinding (Mainline & Turnouts)
- Rail Renewal

A list of the products and their purpose and KPI relationship are shown below as well as an individual description for each product.

Table 6.8: Rail Management Products

Product Name	Purpose	KPI Relationship
1. Rail Grinding Main Line	Maintain appropriate rail profile and remove small surface fatigue cracks	Broken Rail
2. Rail Grinding Turnouts	Maintain appropriate rail profile and remove small surface fatigue cracks	Broken Rail
3. Rail Joint Management	Remove ‘dipped’ joints, allow thermal movement	Broken Rail Track Buckle Derailment
4. Rail Lubrication	Prevent premature rail wear	Broken Rail Derailment
5. Rail Renewal 6. Rail Repair	Removal of defective or life expired rail	Broken Rail Derailment
7. Rail Stress Adjustment	Control thermal movement	Track Buckle Derailment
8. Ultrasonic Testing – On track machine 9. Ultrasonic Testing – Manual	Detection and prioritisation of rail defects	Broken Rail Derailment

Queensland Rail Network programs replacement of rail so that the limits of wear specified in Queensland Rail's Safety Management Standard[3] are not exceeded.

Product 1 and 2: Rail Grinding – Mainline and Turnouts

Rail grinding is an essential maintenance function that Queensland Rail performs on its coal and freight systems. The objectives are to efficiently introduce, and thereafter maintain appropriate rail profiles, and to remove small surface fatigue cracks. Benefits include:

[3] Civil Engineering Track Standard STD/0077/TEC

- Extending rail life
- Reducing resurfacing cycles (predominately for turnouts)
- Extending track component life
- Reducing wear rates on rolling stock wheels
- Reducing fuel usage for locomotives through promoting better rollingstock steering
- Reducing wheel squeal and flange noise

The different types of rail grinding work carried out are as follows:

- Profile establishment (i.e. modification of rail head shape to establish a new shape)
- Profile maintenance (i.e. grinding of rail to maintain rail profile shape)
- Corrective profiling (i.e. rails with surface defects)
- Profile modification (i.e. stress reduction to allow increased axle loads)
- Removal of rail corrugations

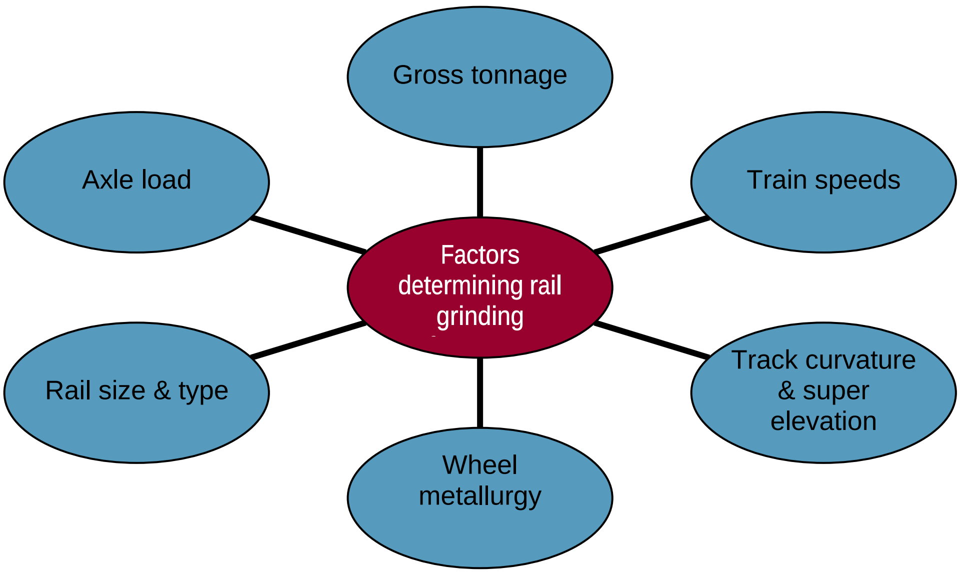
Rail Wear and Surface Defects

Wear and surface defects are the dominant factors in determining the life of rails and wheels. Rail and wheel profiles are designed to maintain a controlled average 'contact band', with sufficient contact radii to cater for a range of wear conditions. It is therefore imperative that wheel/rail contact be accurately maintained and conditions not allowed to depart too far from the average.

Mainline Rail Grinding Cycles

The maintenance grinding frequency is determined by the combined effects of the factors shown below. However, curvature and traffic loads are the dominant factors in deciding return frequencies.

Figure 6.3: Grinding frequency depends on the combined effects of the facts shown below



Rail grinding is currently performed every:

- 10 million gross tonnes (MGT) on curves less than 1,000 m radius
- 20 MGT on curves between 1,001 m and 2,500 m radius
- every 40 MGT on other track.

Through implementing a grinding regime, rail life is significantly increased. Without rail grinding the life of the rail is drastically reduced for curves less than 1000 m radius. From a risk perspective, once the 30 MGT threshold is reached without a grinding cycle, the risk of the rail breaking due to the propagation of a surface initiated cracking defects increases dramatically.

The following table summarises the planned scope for Mainline Rail Grinding for the reset period.

Table 6.9: Mainline Grinding Scope by Line Section (km/annum)

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	70.139	48.676	100.383	100.383
Toowoomba – Macalister	6.590	19.004	6.590	6.590
Macalister – Miles	0	0	0	0
TOTAL	**76.729**	**67.680**	**106.973**	**106.973**

Turnout Grinding Cycles

As with mainline track, turnouts are ground on a gross tonnage basis. Due to their position in track (located close to signals/yards) they generally experience higher traction forces than open track. This can cause a higher number of defects to form on the turnout. With the cost of a turnout being approximately 20 times greater than open track the operation has become a very important preventative maintenance practice for Queensland Rail.

The following table summarises the planned number of turnouts to be ground for the reset period.

Table 6.10: Turnout Grinding Scope (No. of Turnouts)

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	8	0	1	0
Toowoomba – Macalister	11	14	0	0
Macalister – Miles	0	0	2	13
TOTAL	**19**	**14**	**3**	**13**

Product 3: Rail Joint Management

Rail joint management includes all activities associated with the maintenance of a rail joint. This encompasses flashbutt welding, thermite welding of joints, bolt and fish plate maintenance, glue joint maintenance, joint lifting, top and lining joints.

Product 4: Rail Lubrication

This product includes all activities associated with rail lubrication which involves the lubrication of track on straights and curves, maintenance and filling of lubricators.

Product 5: Rail Renewal

Controlling the rate of rail wear is a critical aspect of optimising rail life. Managing rail wear rates through rail husbandry and monitoring ensures safety and commercial objectives are met.

Rail wear occurs as table wear, side wear or as a combination of both. The manner in which rail wears will depend upon a number of factors including; wheel and rail profiles, rail size, rail metallurgy, track structure, track geometry, traffic type, traffic loading, and traffic mix.

Queensland Rail Network civil maintenance staff examine the rail head profile for excessive wear on a regular basis. The side and table wear of the head of the rail is measured and the percentage head wear loss is determined. Queensland Rail Network programs replacement of rail so that the limits of wear specified in Queensland Rail's Safety Management Standard[4] are not exceeded.

All curves are measured a minimum of once a year with tangent track measured when deemed necessary based on rail age, tonnage, ultrasonic testing results and walking inspections. Queensland Rail Network has established a rail wear database to keep accurate records that enable rail life predications to be made and have systems in place to ensure that worn rail is replaced in a timely manner.

In general, all new rail that is installed on curves is now 50 kg/m head-hardened rail which will give an extended rail life and longer intervals between remedial grinding. Head-hardened rail is also less likely to have rail head defects occur.

The following table shows the number and length of curves categorized by the curve radius through the Toowoomba and Little Liverpool Ranges. Rail wear monitoring and management are undertaken on each of these curves.

Table 6.11: Curve Details – Toowoomba and Little Liverpool Ranges

Curve Radius	No. of Curves	Total Curve Length (km)
<120	63	9.346
> 120 and ≤ 160	70	9.627
> 160 and ≤ 240	70	11.883
> 240 and ≤ 400	79	14.016
> 400 and ≤ 800	61	11.986
> 800 and ≤ 1000	33	6.843
> 1000 and ≤ 1600	32	8.541
> 1600	18	7.936
Total Curved Rail Length	**426**	**80.178**

[4] Civil Engineering Track Standard STD/0077/TEC

Rerailing Process

Rerailing is the process whereby the rail is replaced in the railway track. It occurs for a number of reasons. These include track upgrading to a higher standard, rail failure due to fracture or damage from fatigue, derailment and wheel burns, and simple wear on the head of the rail reducing its cross sectional area.

Rerailing concrete sleepered track tends to be a simpler operation than rerailing timber sleepered track. In concrete sleepered track the rails are set to a fixed gauge on the sleeper, which is determined by the shoulders cast into the sleeper during original manufacture. The rerailing operation is, therefore, simply a matter of removing some clips prior to the track possession and then during the track possession removing the remaining clips. The rails are then removed and replaced, expansion set correctly (to manage rail stresses) and the rails clipped in placed every second or third sleeper initially and then after traffic resumption, every sleeper is clipped in.

Product 6: Rail Repair

Rail repair includes all activities associated with spot renewal or repair of rail due to identified defects. Failures or defects in rail such as wheel burns, defective welds, internal rail defects, defect glued joints, other associated activities such as distribution, unloading rail, and flagging are all concerned with this activity. This product also includes the repair of running rail by maintenance or arc welding.

Product 7: Rail Stress Management

This activity includes tasks such as rail stress testing, creep marker monitoring, and the complete process of rail stress adjustment, for example additional rail and anchors. Due to the nature of the task, track closure is necessary to carry out the works.

Product 8: Ultrasonic Inspection – On Track Machine

Mobile ultrasonic testing is part of Queensland Rail's risk management process that monitors rail condition and reports variations from defined civil standards. The inspections are undertaken approximately four times a year across the West Moreton System to reduce the risks associated with inclusions inherent with rail manufacture, weld inclusions and defects. At the conclusion of each data collection run the information is analysed and a report is prepared which highlights any structural defects which require immediate action and longer term trends in rail wear. This information is an important tool in determining the rail renewal strategy across the network.

Figure 6.4: Ultrasonic Testing Vehicle

Product 9: Ultrasonic Testing – Manual

This task involves all the activities associated with the manual ultrasonic testing of rail. Tasks include rail tester's ultrasonic testing of rail, turnout components, tools and welds. This excludes the support of the ultrasonic testing car.

6.1.3 Off Track Maintenance Management

Products included under off track maintenance management are those that relate to maintenance activities that do not relate directly to the track structure. A list of the products, their purpose and their KPI relationship is shown below as well as an individual description for each product.

Table 6.12: Products within Off Track Maintenance Management

Product Name	Purpose	KPI Relationship
1. Level Crossing Construction/ Maintenance 2. Earthworks – Non Formation 3. Fencing 4. Fire and Vegetation Control 5. Monument/Signage Erection 6. Track Clean Up	To keep the rail corridor clear of people, stray animals, wildfires and flood waters.	TTD and Derailments

Product 1: Level Crossing Construction and Maintenance

This product involves all activities associated with the construction, repair, elimination and replacement of all level crossings. The renewal of any track components such as rail, sleepers, plates, signage, ballast and the renewal/repair of the road surface also form part of the process. Associated activities also include track resurfacing, the construction of temporary deviations, traffic control, earthworks, flagging, advertising/notices. Due to the nature of the task, track closure is necessary to carry out the works.

The table below shows the estimated number of level crossing maintenance activities during the reset period.

Table 6.13: Level Crossing Maintenance Activities during the reset period

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	4 Major Crossings 3 Minor Crossings	4 Major Crossings 3 Minor Crossings	4 Major Crossings 3 Minor Crossings	4 Major Crossings 3 Minor Crossings
Toowoomba – Macalister	2 Major Crossings 1 Minor Crossing	2 Major Crossings 1 Minor Crossing	1 Major Crossing 1 Minor Crossing	1 Major Crossing 1 Minor Crossing
Macalister – Miles	3 Major Crossings 1 Minor Crossing	3 Major Crossings 1 Minor Crossing	3 Major Crossings 1 Minor Crossing	3 Major Crossings 1 Minor Crossing

Product 2: Earthworks – Non-Formation

This activity comprises of all non-formation related earthworks and drainage construction and maintenance. Other tasks include the maintenance of access roads, walkways, disposal of surplus material, the reshaping and cleaning of surface drains, reshaping cess drains, widening cuttings, building up embankments, widening cesses[5], and maintaining cuttings and embankments by the removal of rocks and loose materials. In recent years there have been significant experiences relating to:

- Land slips/slides
- Rock falls
- Embankment failures
- Washouts

The majority of the challenges relating to non-formation earthworks are on the Toowoomba and Little Liverpool Ranges where there is need for a continual program of drainage and access road maintenance.

The close proximity (typically 1.5 - 2m) between the railway and the cut slopes, and the tight radius curves required to manage the steep topography limits the opportunity to re-align the track further away from the toe of the cut slope to create a buffer to geotechnical hazards. Vegetation and surface water drainage have a significant influence on contributing to small scale slope instability and rock fall. If not diverted into adjacent gullies, water run-off shedding down the spurs and ridges above the railway will wash over the cutting face and recharge these slopes, increasing the potential of circular-type slumping failure in weathered rock.

The railway is designed to manage surface and groundwater flows through the use of drains along the side of the railway (known as cess drains) and across ridges and spurs on slopes above the railway (known as diversion drains), and culverts diverting water flow below the railway.

The West Moreton System requires regular re-establishment of the original diversion drains across the topography upslope of railway cuttings to effectively minimise the flow of surface water run-off away from the cuttings. This reduces the risks associated with elevated pore water pressures causing slumps, and scouring of surface water aggravating dislodgement of rocks. This work involves accessing the slopes to clear the diversion drains of re-growth vegetation, and re-establishing the flow of water along the drains by removing silt and rock build-up. These actions assist in reducing water flow over the face of cuttings and significantly reduce the risk of rock fall or larger geotechnical slope failure. The cess drains along the edge of the railway on the ranges' areas' are generally adequate to manage normal rain fall events (e.g. rain fall <25 mm per day), but in many areas are filled with fine material washed from the slope, or rock fall debris. This reduces their ability to adequately manage water flow from high rain fall events resulting in potential track washout issues. The cess drains require routine clearing of fine material and rock debris to promote water flow towards the established culverts. In many areas, the cess drain is very close to the railway, and will present access issues for earthmoving equipment.

Product 3: Fencing

Fencing activities encompass any construction, reinstatement or maintenance of fencing. Activities include installation of new fencing, complete replacement, repairs, installation of gates, warning signs, removal of fencing, and any earthworks or flagging associated with fencing. This is to ensure safety of the rail corridor for Queensland Rail customers.

[5] The area along either side of a railroad track which is kept at a lower level than the sleeper bottom, in order to provide drainage.

Product 4: Fire and Vegetation Control

Fire and vegetation management activities involve the control of vegetation by chemical and mechanical means; burn offs to eliminate vegetation interference with train running and track maintenance. This includes the following processes: vegetation control around bridges, slashing, brush cutting, hi rail and manual herbicide treatment, tree surgery, fire and vegetation management, fire breaks, burning off, tree planting, fire fighting and pest management plans. This activity does not usually require track closures.

Product 5: Monument/Signage Erection

Monument maintenance encompasses all activities associated with the survey and erection of track monuments, mast information plaques, creep markers and general signage (e.g. speed boards, etc). This activity does not require track closures.

Product 6: Track Clean Up

This product includes all activities associated with investigating and rectifying the spillage of coal and other materials on the rail network including coal removal from turnouts, track and loadouts and the removal of animal remains from the corridor. This product does not include clean up associated with a derailment.

6.1.4 Structures Management

Activities included under structures management are those that relate to maintenance that effect structures that support rail over road crossings, road over rail crossings and those structures that provide drainage under the track. A list of the key activities and their purpose and KPI relationship is shown below as well as an individual description for each product.

Table 6.14: Products within Structures Management

Product Name	Purpose	KPI Relationship
1. Structures Inspections 2. Drainage Construction/Repairs 3. Concrete Bridges Repairs 4. Steel Bridge Repairs 5. Timber Bridge Repairs 6. Retaining Wall Construction/Repairs 7. Structures Pest Control 8. Ancillary Structure Construction/Repairs	Provide safe and effective structures throughout the rail corridor	TTD and Derailments

Product 1: Structures Inspections

All inspections of structures including Civil Engineering Structures Standard (CESS) inspections, pile exams, stage exams, underwater inspections, maintenance team inspections, termite inspections, structures master audits and construction audits are included in this product.

Product 2: Drainage Construction/Repairs

This product involves the repair and construction of drainage utilising concrete and or steel components (e.g. culverts, helicore pipes). The replacement of bridges with drainage structures, and maintenance activities such as drain cleaning and grouting repairs also form part of the product. Due to the nature of the task, a track closure is necessary to carry out the works.

Product 3: Concrete Bridge Repairs

The activity covered under this product includes repairs to concrete bridges that involve the replacement/renewal of any components. This includes kerb raising, walkway repairs, pier/abutment renewals, and top and lining.

Product 4: Steel Bridge Repairs

This product covers all repairs to steel and steel and concrete composite bridges that involve the replacement/renewal of any components. This includes walkway repairs, pier/abutment renewals, top and lining, transoms renewal, girder repairs and tightening fastenings.

Product 5: Timber Bridge Repairs

This product covers all maintenance and repairs to timber bridges that involve the replacement/renewal of any components. This includes walkway/escape repairs, pier/abutment renewals, top and lining, tightening fastenings, component renewal/repairs (e.g. corbels, headstocks, girders, transoms, and piles).

The majority of existing bridges in the West Moreton System are rated to 15.75 tonne axle load (TAL). These bridges were originally designed for 12 TAL (Imperial) or B16 steam locomotives. The bridges from Rosewood to Miles have been assessed with respect to their suitability to the axle configuration of existing traffic and loading of consists. The desktop assessment has shown that, under the existing overload limits, these bridges are operating at the limit of their capability.

Owing to the existing annual gross tonnages on the West Moreton System, timber bridges will incur significantly higher maintenance costs, increased closure requirements and increased risk of derailment than the adjacent low tonnage freight lines.

Maintenance of timber bridges is necessary due to the biodegradation of timber, mechanical wear and damage, corrosion of fasteners, erosion of wood at joints and insect attack. All of these factors, cause a timber bridge to deteriorate and become less serviceable until maintenance is undertaken.

Timber bridges require a substantial quantity of timber for their maintenance. With the supply of timber decreasing and the demand for products made from wood increasing, these trends indicate that wood production is unlikely to meet forecast demand in the near future increasing the price of raw materials.

While the rate of hardwood plantation establishment has increased in recent years this timber is not suitable for most timber bridge components until it is of the order of 40 to 50 years old. In addition, hardwood saw millers have started to rationalise and amalgamate their operations reducing the supply of such construction material.

Since the first timber bridges were erected, the maximum lengths of timber spans have reduced. The main reason for this in Queensland was specifically related to the availability of large timber. Larger logs for structural components were becoming harder to obtain.

Timber bridge general maintenance involves staged pile inspections, checking of alignment and tightening of bolts to the correct geometry. A typical six metre timber span has six piles, two headstocks, six corbels, three girders and 12 transoms which as well as the need for general maintenance, requires care for, and replacement of components. Wood is a biological material, and is therefore subject to various types of degradation, fungal decay, wood destroying insects, weathering and fire, all of which can lead to hazardous situations, and to which concrete and steel are largely immune. Concrete and steel bridges do not require regular component replacement. Concrete and steel structures' general maintenance involves inspections and monitoring of cracks of all components and bearings. Steel structures require regular cyclic maintenance involving painting and transom replacement. As illustrated above, timber bridge maintenance is resource intensive compared to the maintenance regime required for concrete or steel structures.

It is becoming very difficult to recruit and retain skilled people in the regional areas of Queensland. Timber bridge carpentry is a specialised skill and one that very few other industries require. Maintenance of steel and concrete structures, as well as not being as labour intensive as that for timber structures, is adequately serviced by skills that are readily available in the labour market place.

Timber bridges on the low tonnage freight lines can sustain timber bridging for many more years. However, timber bridges on the West Moreton System are subject to large annual tonnages with most axles being loaded to the bridges' maximum capabilities making maintenance of these old structures a continuing task.

At present there is approximately 4,000 metres of timber bridges (over 100 bridges) still remaining in the West Moreton System. Queensland Rail is of the view that a strategy to continue the reduction in the amount of timber bridging is essential to manage the reduced supply of timber, accommodate skilled labour shortages, and provide structures that meet contemporary performance standards. Achieving this goal will take decades and therefore the continued maintenance of these assets will be necessary.

Product 6: Retaining Wall Construction/Repairs

This product includes the construction and repair of retaining walls.

Product 7: Structures Pest Control

This product includes pest control on all structures and termite control and other pest management activities.

Product 8: Ancillary Structure Construction/Repairs

The construction and repairs of ancillary structures e.g. buffer stops, foundations for gantry cranes, inspection pits, noise barriers, tank stands, light towers, electrification barriers, etc.

6.2 Trackside Systems

Maintenance for signals and telecommunications involve three main activities:

- Preventative maintenance
- Corrective maintenance
- Technical assistance with civil infrastructure works

In 2001, a structured maintenance regime for scheduling and recording maintenance activities called the Trackside System Maintenance System (TSMS) was introduced. This incorporated the Maintenance Scheduling System (MSS) and the Fault Recording System (FRS). The TSMS also implemented changes in work responsibilities defined under the job redesign process in order to make better use of the wayside workforce.

In recent times trackside systems have experienced a significant increase in costs which is largely driven by the increase in labour costs (labour comprises about 70% of the maintenance budget for trackside systems). Trackside systems maintenance requires the use of more specialised labour, such as electricians. While pressures have been experienced across the entire labour market, the market for electrical tradesman is particularly tight. This has seen an increase in wages as well as difficulties in recruiting and retaining staff. The training of new staff is a solution however this increases costs and reduces productive time.

6.2.1 Preventative Maintenance

Is maintenance that is undertaken on equipment at regular programmed intervals to maximise its availability and reliability. In the TSMS database assets are categorised into asset classes with each asset classes including various types of equipment. For each piece of equipment up to five scheduled maintenance services may apply (known as A, B, C, D and E services). Each of these services has a check sheet that details the activities undertaken.

6.2.2 Corrective Maintenance

Involve actions performed as a result of failure to restore an item or asset to its predetermined condition (as far as possible). Corrective maintenance is also known as repair or unplanned maintenance. The factors that cause assets to fail are many.

Corrective maintenance can be classified into two forms, immediate and deferred corrective maintenance.

Immediate Corrective Maintenance

Occurs as a result of asset(s) failure or an incident that has a significant safety, environmental or operational impact. The trackside systems maintenance managers are responsible for ensuring resources are in place/available to respond to trackside system asset failures or incidents. There is an instruction in place which details the response process to be followed for these types of incidents. Immediate corrective maintenance is mainly fault repair. Failed items are either replaced or some form of adjustment takes place to correct the operation of the component. After failed items are replaced, readjustment may be required and re-testing of the replaced item may be required to confirm correct operation.

Immediate corrective maintenance may also be applied to incidents where a piece of equipment has been found or has been perceived to operate in an incorrect manner e.g. a signal showing a green aspect when it should be red. This situation then translates into incident investigation and may or may not involve fault repair. Examination of any logged incident data and testing is carried out to confirm that the incident did or had the likelihood of occurring. This may then result in some form of repair work being carried out depending on the outcome of the investigation.

If a high impact asset failure cannot be repaired or resolved in a reasonable time, appropriate personnel and stakeholders are advised and alternative measures put in place.

Deferred corrective Maintenance

Occurs when the condition of the asset(s) is found to be outside of defined operational parameters but the occurrence of this condition does not have a significant safety, environmental or operational impact. Deferred corrective maintenance can be identified during the course of conducting preventative maintenance. The reason for deferring corrective maintenance is usually related to the nature and scale of work required. Preventative maintenance work teams usually consist of two people and the amount of equipment carried is only appropriate for the preventative work to be done.

Corrective maintenance is also identified through inspections and audits. Field based coordinators carry out equipment condition inspections in their respective areas on a yearly basis.

6.2.3 Technical Assistance with Civil Infrastructure Works

Trackside systems staff are often called upon to assist in civil infrastructure works. These works often have a large impact on the preventative maintenance regimes that are in place. Examples of this are:

- the removal and restoration of a point's rodding for resurfacing
- moving of track circuits for either resurfacing or rerailing
- disabling level crossing protection when upgrading a road crossing

6.2.4 Recording and Reporting of Maintenance

All corrective maintenance (immediate and deferred) is recorded in FRS. All corrective maintenance is recorded in FRS within 48 hours of the corrective action taken. Preventative maintenance is recorded in TSMS within one week of the maintenance being performed.

Targets are set each year for the maximum number of high priority system faults allowable, and for the amount of completed preventative maintenance tasks. trackside systems maintenance managers regularly review completed corrective and preventative maintenance activities relative to the set targets at various management meetings.

6.3 Signalling Maintenance Products

Activities included under signalling maintenance are those that relate to the overall performance of the signalling infrastructure. These activities ensure that the signalling system is maintained to a safe and appropriate operating level. A list of the key activities, their purpose and KPI relationship are shown below as well as an individual description for each activity.

Table 6.15: Products within Signalling Maintenance

Name	Purpose	KPI Relationship
1. Preventative Signalling Maintenance 2. Corrective Signalling Maintenance 3. Major Network Corridor Signal 4. Level Crossing Protection 5. Signalling Control Systems 6. Cable Route Management 7. Train Protection Systems Maintenance 8. Wayside Monitoring Systems Maintenance 9. Operating System for Civil Infrastructure	Provide a safe and operating signalling system	TTD and Derailments

Product 1: Preventative Signalling Maintenance

This involves the preventative maintenance of field equipment associated with signalling control including cabling. This activity takes up approximately 30% of the time of the trackside system teams and primarily involves maintenance of signalling systems assets.

Product 2: Corrective Signalling Maintenance

This involves the corrective maintenance of field equipment associated with signalling control including cabling. A significant proportion of signalling equipment is maintained on a 'fix on failure' basis, as a result there is a requirement to have a 24/7 callout roster in place.

Product 3: Major Network Corridor Signalling

This involves long term and one-off maintenance tasks/upgrades including the refurbishment of level crossings, points machines, level frames and overhaul of diesel standby alternators etc. Upgrades can include the installation of lighting arrestors, replacement of interlocking timers and power supply upgrades. These activities are planned up to six months in advance.

Product 4: Level Crossing Protection

This involves the scheduled maintenance and repair of level crossing protection installations including pedestrian gates.

Product 5: Signalling Control Systems

Maintenance of control centre based equipment relating to the signalling and power systems control of trains.

Product 6: Cable Route Maintenance

This involves the maintenance and repair of cableways, markers, troughing, cable pits and cables with the exception of fibre testing and repairs.

Product 7: Train Protection Systems Maintenance

Activities include investigations into performance issues in relation to the Automatic Train Protection (ATP), replacement of faulty transponders and adjustment of radio levels.

Product 8: Wayside Monitoring Systems Maintenance

Maintenance and repair of trackside monitoring and measuring equipment such as Dragging Equipment Detectors (DEDs), Hot Bearing Detectors (HBDs), Wheel Impact Load Detectors (WILDs), weather monitors, out-of-gauge detectors and level crossing monitors.

Product 9: Operating System for Civil Infrastructure

This product includes activities such as the removal and restoration of a point’s rodding for resurfacing, the moving of track circuits for either resurfacing or rerailing and the disabling and enabling of level crossing protection when upgrading a road crossing.

6.4 Telecommunications Maintenance Products

Products included under telecommunication maintenance are those that relate to the overall performance of the telecommunications infrastructure. These products ensure that the telecommunication system is maintained to a safe and appropriate operating level. A list of the products and their purpose and KPI relationship are shown below as well as an individual description for each product.

Table 6.16: Telecommunications is the fourth group of Asset Maintenance Products

Product Name	Purpose	KPI Relationship
1. Control & ECO Telephone Maintenance 2. Preventative Telecoms Backbone Network Maintenance 3. Corrective Telecoms Backbone Network Maintenance 4. Telecoms Backbone Modifications 5. Phone/Data Move/Change/Install	Provide an effective & safe telecommunication system	TTD

Product 1: Control and Electrical Control Operators Telephone Maintenance

Maintenance and repair of phone bearers providing direct contact to train control or electric control operators.

Product 2: Preventative Telecommunications Backbone Maintenance

This includes preventative maintenance of the major bearer systems and infrastructure providing bandwidth for voice and data services as well as the base network for train control and maintenance radio systems.

Product 3: Corrective Telecommunications Backbone Maintenance

This includes corrective maintenance of the major bearer systems and infrastructure providing bandwidth for voice and data services as well as the base network for train control and maintenance radio systems.

Product 4: Telecommunications Backbone Modifications

Upgrades and improvements to the major bearer systems and infrastructure for voice and data services as well as the base network for train control and maintenance radio systems that are not classified as capital expenditure.

Product 5: Phone and Data Move, Change and Install

Installation, moves or changes to phone and fax services including horizontal cabling installation, moves or changes to tail modem links, horizontal cabling and dumb terminal equipment for mainframe and Local Area Network (LAN) services.

7. Maintenance Costs

The previous sections have detailed the scope of the required maintenance activity and the parameters within which the maintenance task will be undertaken. This section details both the forecast cost of undertaking these maintenance activities and items which will make up these costs.

7.1 Costing Methodology

The total maintenance estimate has been built up by calculating the costs associated with each of the major maintenance cost elements including:

- Track and structures maintenance
- Mechanised resurfacing
- Rail grinding
- Trackside systems maintenance
- Track inspection vehicles

7.1.1 Direct Costs

Direct costs have been derived using a bottom up approach to estimating costs on the basis of eleven cost categories:

- Number of staff required
- Wages and salaries
- Overtime
- Allowances
- Oncosts
- An allowance for employee related costs such as human resources, information technology, payroll systems and training
- Direct consumables used to complete maintenance tasks such as rail and ballast
- Indirect consumables such as fuel, vehicle maintenance and telecoms
- Maintenance of major plant and buildings
- Motor vehicle lease charges
- Asset charges (i.e. depreciation)

7.2 Track and Structures Maintenance

The task for the Asset Manager can be categorised under the following four maintenance functions:

- **Inspection and Testing** – Inspection regimes are put in place to monitor elements of the rail infrastructure to identify and record all defects found in accordance with Queensland Rail's Governance and Management Framework.

- **Prioritisation** – Determines the most effective response time and maintenance solution required to attend to the defects identified during the asset inspections.

- **Removal/Rectification** – Removal or rectification of defects within the constraints imposed by an operating railway.

- **Audit** – Post works auditing and monitoring to close the quality system loop and ensure the defect removal was successful.

The Asset Manager team is also the front line response team to any short-term problems that occur on the network such as extreme weather events, derailments or critical equipment failure. Queensland Rail provides both the services and equipment required for planned maintenance activities, and the flexibility required for quick response (Queensland Rail has determined the appropriate mix and location of staff across the West Moreton System).

This level of flexibility is particularly important to the efficient operation of the West Moreton System because of the climate and the timetabled nature of the systems' coal services.

The system is subject to long periods of relatively stable weather which are interrupted by irregular bouts of rainfall that typically require planners to shift from planned to reactive maintenance activities for periods of upwards of four weeks at a time. These rain events typically occur during the summer months but the exact timing is always uncertain. As a track manager, Queensland Rail plans for these events by ensuring its track maintainer has the available resources and flexibility to cope with these weather events.

7.3 Rail Rectification

Queensland Rail does not own the necessary equipment to carry out rail rectification. This service is contracted out through a larger agreement where economies of scale can be achieved through a scope which covers all of Queensland Rail's network.

7.4 Mechanised Resurfacing – Mainline

The estimated cost of the mechanised resurfacing operation has been based upon the productive capacity of machines, labour resources required and the number of shifts available. From these key drivers and a review of historical costs a forecasting model was developed. Expected operational efficiency gains over the coming years have been factored into the estimated costs.

7.4.1 Scope

Section 6 identified the scope required for the Mechanised Resurfacing – Mainline, Mechanised Resurfacing – Turnouts and products for each of the systems. The scope can be broken into the following categories:

- Number of turnouts resurfaced

- Number of kilometres of track resurfaced
- Resurfacing support for other tasks such as level crossings and major track reconditioning

7.4.2 Total Costs

Table 7.1: Estimated Total Mechanised Resurfacing Costs ($'000)

	2013/14	2014/15	2015/16	2016/17
Wages	2,036	1,791	1,844	1,826
Plant	2,802	2,464	2,537	2,519
Accommodation	144	127	131	129
Other	2	2	2	2
Total	**4,984**	**4,384**	**4,514**	**4,476**

7.5 Track Inspection

Constant visual inspection and testing is vitally important in the West Moreton System due to the black soil formation, poor drainage, unsuitable track structure in areas, steep ranges and numerous curves.

Without the constant track inspection and maintenance, the severity of defects and the number of defects would increase and lead to numerous Temporary Speed Restrictions (TSRs), buckles, pull aparts and derailments.

7.5.1 Scope

Section 6 identified the scope required for the track geometry recording and ultrasonic testing in the West Moreton System. There are three core components:

- Four monthly ultrasonic testing of the rail
- Six monthly detailed testing of the curves except on the Toowoomba and Little Liverpool Ranges where it is four monthly; for 1 in 2 steel sleepered straight track every two years and once every four years for straight concrete sleepered track.
- Six monthly routine geometry testing

The frequency of these tests directly leads to a determination of the number of shifts required to complete the scope of works.

7.5.2 Consumables

Since the operation of the ultrasonic testing is outsourced through a commercial contract the consumables associated with the track recording vehicles are primarily associated with the maintenance operation of the two Track Geometry Vehicles (TGV). The group is supported by vehicles in the local track gangs and as a result there are no direct motor vehicle charges in the cost build up.

7.5.3 Ultrasonic Testing

On track inspection manages an external contract supplier for the mobile ultrasonic testing of rail. The contract was signed in 2007 following a competitive tender process and RTI International was awarded the tender. In 2012 the contract was renewed with RTI International and they supply the vehicle, an operator and the equipment (including consumables) required to undertake the ultrasonic testing. The contract is based on a per km rate but a per shift rate is payable when working on some areas of the West Moreton System due to issues with track access. The contractor provides data to Queensland Rail in a format which can be readily analysed by staff in the field.

In addition to these costs, Queensland Rail supplies the vehicle with a cat 3 driver to operate the vehicle and a support vehicle to provide supplies and transport the operators from the site. Rather than employing full time staff for these roles these resources are drawn from local staff in the region where the testing vehicle is operating. These costs are summarised in the following table.

Table 7.2: Ultrasonic Testing Costs ($'000) – reset period

Section	2013/14	2014/15	2015/16	2016/17
Rosewood – Toowoomba	94	11	12	14
Toowoomba – Macalister	66	76	86	99
Macalister – Miles	34	39	56	51
Total	**194**	**126**	**154**	**164**

7.6 Trackside Systems

Traction and Trackside activities can be categorised under the following four maintenance functions:

- **Inspection and Testing** – Inspection regimes are put in place to monitor elements of the rail infrastructure to identify and record all defects found in accordance with Queensland Rail's Governance and Management Framework.
- **Prioritisation** – Determines the most effective maintenance solution required to attend to the defects identified during the asset inspections.
- **Removal/Rectification** – Removal or rectification of defects within the constraints imposed by an operating railway.
- **Audit** – Post works auditing and monitoring to close the quality system loop and ensure the defect removal was successful.

The trackside team is also the front line response to any short term problems that occur on the network whether they are extreme weather events, derailments or critical equipment failure. To enable the provision of both the services and equipment required for planned maintenance activities, and the flexibility required for quick response, Queensland Rail has chosen not to use unit rates for specific activities. Instead Queensland Rail has determined the appropriate mix and location of staff across the network. Queensland Rail uses the same staff to undertake both planned and unplanned work and this provides an efficient means to react to changes in circumstance throughout the year.

7.6.1 Cost Structure

The term 'trackside' is used to capture those costs associated with the two interrelated areas of:

- Telecoms and backbone maintenance

- Signals and point maintenance

As detailed in Section 6, the maintenance of these three areas is a combination of preventative and corrective maintenance but the nature of the electronic equipment involved means that there is a significantly higher proportion of fix on failure work amongst these teams than is evident in the track and structures gangs. Costs are primarily a function of required 24 hour response times and inspection regimes and as a result the cost build up is presented in terms of the depot and support structure rather than the by unit rate for specific activities.

Total Signal Maintenance Costs

Table 7.3 and Table 7.4 summarise the Signal Maintenance costs forecast for the reset period.

Table 7.3: Estimated Signal System Maintenance – reset period ($'000)

Item	Financial Year			
	2013/14	2014/15	2015/16	2016/17
Labour	2,013	2,003	1,989	1,970
Consumables	215	214	212	210
Plant	3	2	2	2
Total	**2,231**	**2,219**	**2,203**	**2,182**

Table 7.4: Estimated Signal System Maintenance by line item – reset period ($'000)

Line Section	Financial Year			
	2013/14	2014/15	2015/16	2016/17
Rosewood - Toowoomba	1,235	1,228	1,219	1,207
Toowoomba - Macalister	849	844	838	831
Macalister - Miles	147	147	146	144
Total	**2,231**	**2,219**	**2,203**	**2,182**

7.6.2 Telecoms Maintenance

The telecom costs have been built up for the non-backbone telecoms systems, the cost of maintaining the backbone is network wide and has been estimated on an proportional allocation approach.

Table 7.5: Estimated Telecoms System by line section – reset period ($'000)

Line Section	Financial Year			
	2013/14	2014/15	2015/16	2016/17
Rosewood - Toowoomba	59	58	58	57
Toowoomba - Macalister	7	7	6	7
Macalister - Miles	3	3	3	3
Total	**69**	**68**	**67**	**67**

7.7 Total Costs

The maintenance program has been developed by Queensland Rail for the West Moreton System for the reference tariff reset period. Maintenance works are forecasted to increase significantly compared to the allowances provided by the QCA (as part of the 2010 Access Undertaking) and works planned are deemed necessary to continue railing contracted volumes safely and efficiently.

It should be noted that no provision for derailments or flooding events has been made in the forecast maintenance costs below. Should a significant event occur, Queensland Rail may need to either submit a review event reference tariff variation, in accordance with clause 5 of schedule A of AU1, or request a one-off contribution from end-users.

The table below summarises the forecast maintenance costs by activity for the reset period.

Table 7.6: Total Maintenance Costs – reset period ($'000)

West Moreton Coal Maintenance	2013/14	2014/15	2015/16	2016/17
Track (excl. Mechanised Resleepering)	16,237	15,094	15,887	15,425
Mechanised Resleepering	0	0	14,497	9,384
Trackside Systems	2,300	2,288	2,271	2,250
Facilities	144	150	156	162
Structures	2,004	2,001	2,315	1,951
TOTAL	**20,686**	**19,533**	**35,126**	**29,172**

7.7.1 Total Cost Increase Relative to Previous Maintenance Cost Allowances

An increase in volumes has contributed to the increase in planned maintenance. Summarised below is a comparison of volumes between the first year of the 2010 Access Undertaking and the AU1 reference tariff reset period.

Table 7.7: Comparison of UT3 (2009/10) to AU1 reset period (2013/14)

System	Financial Year		
	2009/10	2013/14	% change
Net tonnes (million)	5.545	7.545	36.1%
GTK (million)	1.800	2.714	50.8%
Train Paths (one way)	5,805	7,700	32.6%

7.7.2 Allocation to Coal Traffics

Since the West Moreton System extends from Rosewood to Miles and the traffic mix varies between Rosewood to Macalister and Macalister to Miles, it is necessary to allocate maintenance costs to derive separate estimates for each of the sections. Once this allocation has been performed a further allocation is required for each of the sections to attribute costs to either coal or non-coal traffics. The basis proposed to perform both allocations is 000 GTKs, an approach that was accepted by the Authority in its December 2009 Draft Decision as reasonable[6].

[6] QCA Draft Decision on the QR Network 2009 Draft Access Undertaking, December 2009, pp. 88 & 89.

The allocations are outlined in the following table:

Table 7.8: AU1 Planned Maintenance Program Allocation Mix

Item (000 GTKs)	2013/14	2014/15	2015/16	2016/17
Allocation 1:				
Total 000 GTKs				
Rosewood to Macalister	2,735,270	2,735,270	2,735,270	2,735,270
Macalister to Miles	245,997	245,997	245,997	245,997
	2,981,267	**2,981,267**	**2,981,267**	**2,981,267**
Rosewood to Macalister	**91.75%**	**91.75%**	**91.75%**	**91.75%**
Macalister to Miles	**8.25%**	**8.25%**	**8.25%**	**8.25%**
Allocation 2:				
Rosewood to Macalister 000 GTKs				
Coal	2,490,288	2,490,288	2,490,288	2,490,288
Non-Coal				
Grain & Molasses	190,482	190,482	190,482	190,482
Livestock	8,719	8,719	8,719	8,719
Mixed Freight	29,620	29,620	29,620	29,620
Passenger	16,161	16,161	16,161	16,161
Total Non-Coal	244,982	244,982	244,982	244,982
	2,735,270	**2,735,270**	**2,735,270**	**2,735,270**
Coal %	**91.04%**	**91.04%**	**91.04%**	**91.04%**
Non-Coal %	**8.96%**	**8.96%**	**8.96%**	**8.96%**
Macalister to Miles 000 GTKs				
Coal	[redacted]			
Non-Coal				
Grain & Molasses				
Livestock				
Mixed Freight				
Passenger				
Total Non-Coal				
Coal %	**90.99%**	**90.99%**	**90.99%**	**90.99%**
Non-Coal %	**9.01%**	**9.01%**	**9.01%**	**9.01%**

Applying the above allocations to the planned maintenance program results in the following:

Table 7.9: Allocation of AU1 Maintenance Program

Item ($000's)	2013/14	2014/15	2015/16	2016/17
West Moreton System Maintenance				
Track (excl. Mechanised Resleepering)	16,237	15,094	15,887	15,425
Mechanised Resleepering	0	0	14,497	9,384
Trackside Systems	2,300	2,288	2,271	2,250
Facilities	144	150	156	162
Structures	2,004	2,001	2,315	1,951
	20,686	**19,533**	**35,126**	**29,172**
Apply Allocation 1:				
Rosewood to Macalister Proportion %	91.75%	91.75%	91.75%	91.75%
Macalister to Miles Proportion %	8.25%	8.25%	8.25%	8.25%
Rosewood to Macalister Proportion	18,979	17,921	32,227	26,765
Macalister to Miles Proportion	1,707	1,612	2,898	2,407
	20,686	**19,533**	**35,126**	**29,172**
Apply Allocation 2:				
Rosewood to Macalister Proportion	18,979	17,921	32,227	26,765
Rosewood to Macalister Coal Proportion %	91.04%	91.04%	91.04%	91.04%
Proposed Allowance Rosewood to Mac'	**17,279**	**16,316**	**29,341**	**24,368**
Macalister to Miles Proportion	1,707	1,612	2,898	2,407
Macalister to Miles Coal Proportion %	90.99%	90.99%	90.99%	90.99%
Proposed Allowance Macalister to Miles	**1,553**	**1,467**	**2,637**	**2,190**