



Central Queensland Coal Network FY23 Final Draft Maintenance and Renewals Strategy and Budget

Prepared by Aurizon Network
21 January 2022



Aurizon Network FY23 Final Draft Maintenance and Renewals Strategy and Budget Central Queensland Coal Network

Table of Contents

Introduction	3
PART A: Aurizon Network's FY23 Final Draft Proposal	11
1. Key assumptions underpinning the FY23 Final Draft Proposal	12
2. New Information since 30 November 2021	17
3. Stakeholder Engagement	18
4. Key Improvement Initiatives	29
5. Blackwater System	35
6. Goonyella System	97
7. Moura System	158
8. Newlands System and GAPE	199
9. Four-year forward indicative cost forecast	242
PART B: Asset Management Framework	250
10. Guiding Principles and Context	251
11. The Use of OneSAP	258
12. How we identify and prioritise scope	259
13. How we plan asset activity and assess capacity impacts	270
14. How we set budgets for asset activities	277
15. How we deliver asset activity	287
16. Asset Strategies Applied within Asset Activities	291
Appendices	294
Description of practices used to carry out asset activity	295
Glossary	301

Introduction

Aurizon Network Pty Ltd (**Aurizon Network**) is the accredited Rail Infrastructure Manager (**RIM**) of the Central Queensland Coal Network (**CQCN**), the largest open-access coal rail network in Australia and one of the country's most complex rail freight networks. The CQCN is comprised of over 2,670 kilometres of heavy haul railway track, linking more than forty mines to five coal export terminals across four major Coal Systems and the Goonyella to Abbot Point Expansion (**GAPE**).

A key aspect of Aurizon Network's 2017 Access Undertaking (**UT5**) is the opportunity to enable greater customer involvement in the development and assessment of Aurizon Network's Maintenance and Renewal Strategies and Budgets on an annual basis. Since the approval of UT5, Aurizon Network has focused on providing transparency to customers over the development and execution of the maintenance and renewals programs and the improvement initiatives that underpin the delivery of safe, reliable and efficient services.

Aurizon Network welcomes the opportunity to submit the draft Maintenance and Renewals Strategies and Budgets for each Coal System for the Financial Year ending 30 June 2023 (**FY23 Final Draft Proposal**) to the Rail Industry Group (**RIG**) for consideration.

In developing the FY23 Final Draft Proposal, Aurizon Network built on the engagement during the development of the FY22 Maintenance and Renewals Strategies and Budgets (**FY22 Approved Strategy and Budget**). In preparation of the FY22 Proposal, customer engagements focused on how required maintenance and renewals activities are identified, treatment methodologies are considered, and activities are prioritised. Extending on those discussions leading into the development of the FY23 Final Draft Proposal, Aurizon Network and representatives of the RIG and customers have invested significant time discussing the drivers of maintenance and renewal costs, and how maintenance and renewals activities are planned and delivered.

These engagements reflected the commitments Aurizon Network gave in the FY22 Approved Strategy and Budget, and included:

- Provision of increased transparency on the asset condition and cost build-up of the maintenance and renewal budgets, enabling improved planning outcomes;
- Enhanced RIG Quarterly reporting to provide transparency on Aurizon Network's consistency in execution of the Approved Strategy and Budget;
- Provision of further information in relation to the Ballast Cleaning program and establishment of a Ballast Working Group to explore this and supply chain coal fouling mitigation options;
- Improved understanding of planning and procurement has resulted in agreement on the optimised delivery model for the Ballast Cleaning program and additional governance on procurement practices; and
- Establishment of a working group to progress matters associated with the allocation of asset replacement and renewal expenditure between Newlands System and GAPE users and the provision of additional information to support the approval of the FY23 Final Draft Proposal.

Going forward, Aurizon Network has committed to establishing an annual engagement process, including procurement practices, to inform the development of the coming years maintenance and renewals strategies and budgets, and ensure it remains relevant and effective.

Aurizon Network and the RIG have built on prior year engagement on scope, providing greater transparency on cost and execution planning

Structure of Aurizon Network's FY23 Final Draft Proposal

Part A – Aurizon Network's FY23 Final Draft Proposal

Part A outlines Aurizon Network's proposed strategies and budgets for maintenance and renewal activity in each Coal System. Part A is structured as follows:

- Key assumptions underpinning the FY23 Final Draft Proposal (Chapter 1);
- New Information since FY23 Draft Proposal (Chapter 2)
- Stakeholder Engagement (Chapter 3);
- Key Improvement Initiatives (Chapter 4);
- Maintenance Strategy and Budget and Renewals Strategy and Budget for the:
 - Blackwater System (Chapter 5);
 - Goonyella System (Chapter 6);
 - Moura System (Chapter 7);
 - Newlands System and GAPE (Chapter 8); and
- Four-year forward indicative cost forecasts (Chapter 9).

Part B – Asset Management Framework

Part B provides high level insight into the asset management process. It seeks to demonstrate how Aurizon Network intends to deliver asset activity in each Coal System in a way that is consistent with the UT5 Maintenance Objectives. Part B is structured as follows:

- Guiding Principles and Context (Chapter 10);
- The Use of OneSAP (Chapter 11);
- How we identify and prioritise scope (Chapter 12);
- How we plan asset activity and assess capacity impacts (Chapter 13);
- How we set budgets for asset activities (Chapter 14);
- How we deliver asset activity (Chapter 15); and
- Asset Strategies Applied within Asset Activities (Chapter 16).

In this FY23 Final Draft Proposal, except to the extent a term is expressed to the contrary, capitalised terms have the meaning given in UT5.

Aurizon Network has engaged with the Rail Industry Group and other stakeholders in developing the FY23 Final Draft Proposal and seeks to meet the UT5 Maintenance Objectives

The objective of Aurizon Network's FY23 Final Draft Proposal is to safely and efficiently deliver:

- the appropriate level of asset renewal and maintenance activity;
- at the right time to ensure continuity of service;
- in a manner that seeks to maximise supply chain throughput; and
- at a cost which is efficient and prudent.

This approach helps to promote the efficient use of the CQCN for the benefit of the entire supply chain.

Aurizon Network has developed its FY23 Final Draft Proposal for each Coal System having regard to the relevant matters as outlined in UT5, including the Maintenance Objectives. In accordance with the Maintenance Objectives, Aurizon Network must ensure that Maintenance Work is undertaken in a manner that has regard to the matters set out in the first column in Table 1 below:

Table 1 Steps Aurizon Network has taken to seek to achieve the Maintenance Objectives

Maintenance Objective	Treatment
(a) seeks to ensure that Committed Capacity is delivered.	Aurizon Network is leveraging technology to reduce the impact of network constraints and optimise the weekly train plan to meet Customer train orders and maximise throughput. In addition, Aurizon Network is working with customers on opportunities to bridge the gap between Committed Capacity and Deliverable Network Capacity identified in the Independent Expert's Initial Capacity Assessment Report (ICAR).
(b) appropriately balances cost, reliability and performance of the Rail Infrastructure in the long and short term.	Aurizon Network prioritises asset activity based on asset condition and criticality and considers planning and delivery constraints, as well as customer feedback, when determining how best to maintain or improve the cost, reliability and performance of Rail Infrastructure in each Coal System. Aurizon Network continues to refine and develop the processes and systems which allow the identification, prioritisation, planning and delivery of asset activities.
(c) coordinates outages with other Supply Chain Participants wherever reasonably possible with a view to maximising throughput.	As part of developing the FY23 access plan, Aurizon Network undertook early engagement with other Supply Chain Participants to better understand their plans for major infrastructure outages. Aurizon Network has sought to align the delivery of high impact network activities in FY23 with major infrastructure outages relevant to each Coal System. In doing so, Aurizon Network seeks to maximise throughput by minimising the impact of below rail asset activity on the supply chain.

Aurizon Network considers the FY23 Final Draft Proposal provides an appropriate level of asset activity that will promote the safety, reliability, and performance of Rail Infrastructure and, therefore, provide a service that seeks to deliver Committed Capacity.

Aurizon Network's approach to asset management aims to deliver consistent network performance

Aurizon Network seeks to deliver Committed Capacity by adopting an asset management approach which focusses on delivering the appropriate levels of asset availability and sustained, reliable below rail performance at the most efficient cost of ownership throughout the asset life cycle.

Over the last five years this approach has sought to facilitate increased throughput while maintaining below rail operational performance, as demonstrated through mean time to failure, Temporary Speed Restriction (TSR) delays and improving cost efficiency.

Operational trends by Coal System

Figure 1 Million Net Tonnes per annum

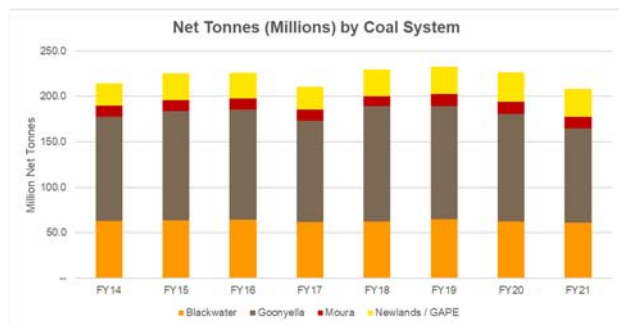


Figure 2 Average Temporary Speed Restriction Delay

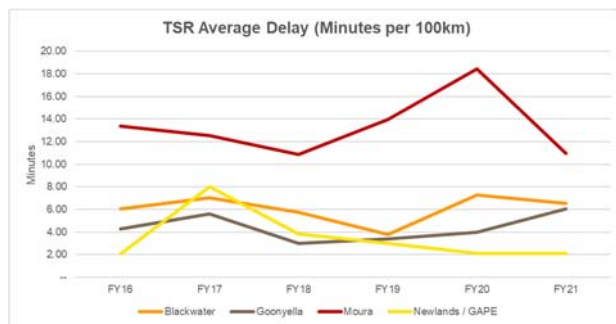


Figure 3 Mean Time to Failure (per Net Tonne Km)¹

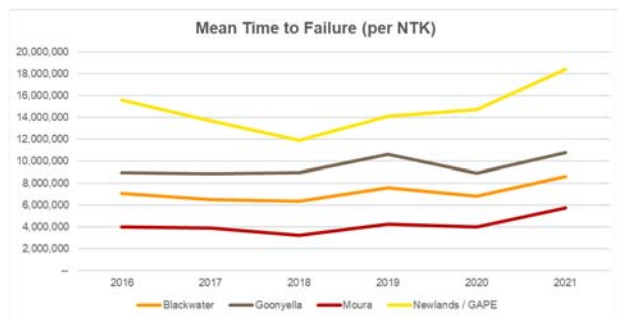
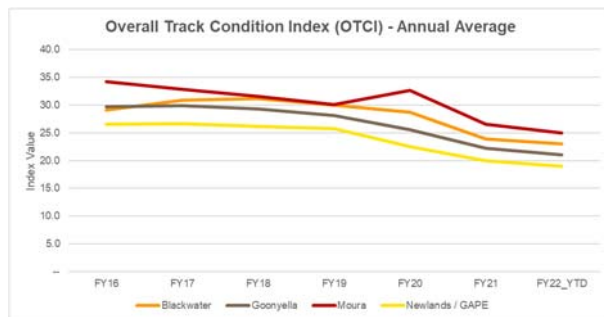


Figure 4 Overall Track Condition Index²

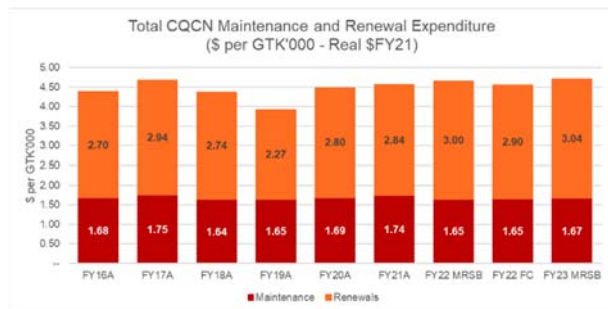


¹ In this context, a 'Failure' is deemed to occur when a Form 42 is issued by Network Control. The Form 42 provides notification of a disruption to the Daily Train Plan. Such disruption may not always be attributable to an infrastructure fault, e.g., depending on severity of impact, a Form 42 could also be issued in the event of collision with wildlife.

² The change in OTCI between FY19 and FY20 is, in part, attributable to the service provider transitioning to a new system and OTCI calculation method. This is evident in the OTCI results in May-20 for Blackwater, Goonyella and Newlands/GAPE, and in June-20 for the Moura System. The change in calculation method has seen OTCI values reduce without a material improvement in track condition; an outcome that has been field-validated by Aurizon Network. The new system cannot replicate the previous OTCI measures without manual manipulation. Aurizon Network is working with the service provider to adjust processes and outputs for the modernised track recording system.

Expenditure trends by Coal System

Figure 5 Maintenance and Renewal Expenditure (\$Real)



Aurizon Network continues to focus on identifying, trialling, and implementing initiatives aimed at progressively enhancing the asset management program and operational performance for Customers. These initiatives have typically focussed on system and processes to improve safety, enhance the quality and availability of data to support planning and decision making, improve operational discipline and reduce cost.

Key initiatives implemented, or in the process of being implemented, are focused on leveraging technology to improve transparency and insights for decision making. OneSAP (formerly NAMS - Network Assets Management System) leverages SAP modules and processes to provide transparency of scope, improving planning and alignment of works in common locations and standardising reporting. In access planning, the focus is on APS (Advanced Planning and Scheduling) to reduce the impact of network constraints on system throughput and maximise opportunities to fill customer demand in the weekly planning of train orders. This will enable the maximising of planned throughput and production of more stable and executable schedules.

Aurizon Network recognises continuous improvement is an ongoing journey and that there are further opportunities to improve the way in which it plans and conducts operations. Aurizon Network will continue to work with Customers to develop and implement initiatives to:

- Enhance Aurizon Network’s ability to safely deliver on our Customer commitments in an increasingly complex CQC;
- Improve the quality and transparency of Aurizon Network’s engagement with and reporting to Customers; and
- Continually drive improvements in cost and scope delivery performance.

Summary of Aurizon Network’s FY23 Final Draft Proposal

The FY23 Final Draft Proposal provides a level of asset activity and funding that Aurizon Network considers is appropriate to deliver a fit for purpose, sustainable, reliable, and safe rail network; one that meets the needs of Customers in each Coal System and seeks to maximise supply chain throughput.

It has been prepared following engagement with the RIG and Customers and takes into consideration capacity related information provided by other Supply Chain Participants. Aurizon Network considers the FY23 Final Draft Proposal will allow it to deliver the required asset activity consistent with the Maintenance Objectives provided for in UT5.

In aggregate, Aurizon Network’s FY23 Final Draft Proposal for the CQC provides for a maintenance budget (excluding ballast undercutting plant depreciation) of \$150.7m, which is \$4.2m above Aurizon Network’s full year forecast for FY22. The movement in cost between periods reflects the net impact of cost escalation and scope changes partially offset by estimated target efficiencies.

The FY23 Final Draft Proposal also provides for a renewals budget of \$286.5m, which is \$20.6m above Aurizon Network's full year forecast for FY22. The movement in cost between periods largely reflects changes in scope, primarily in the Blackwater and Goonyella systems across Turnouts, Control Systems and Electrical asset renewals.

The respective values for each Coal System are outlined in Table 2 and Table 3 below.

Table 2 FY23 Final Draft Proposal – Direct Maintenance Cost Budget (\$m)

System (\$m)	FY19 Actual	FY20 Actual	FY21 Actual	FY22 Approved Budget	FY22 Full Year Forecast	FY23 Draft Budget
Direct Maintenance Costs						
Blackwater	64.0	63.0	62.3	62.0	63.4	64.8
Goonyella	57.0	56.9	56.3	58.0	58.3	60.2
Moura	11.8	12.0	11.3	12.3	12.5	12.8
Newlands / GAPE	13.8	13.2	12.1	12.3	12.3	12.9
Total (excl ballast undercutting plant depreciation)	146.7	145.1	142.0	144.6	146.5	150.7
<i>UT5 FD Allowance</i>	<i>n/a</i>	<i>147.2</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>	<i>n/a</i>
Ballast undercutting plant depreciation	<i>n/a</i>	<i>n/a</i>	3.9	6.5	5.7	6.1
Total Direct Maintenance Costs	146.7	145.1	145.9	151.1	152.2	156.7
Non-Coal Allocation [^]	<i>n/a</i>	<i>n/a</i>	(1.5)	(1.5)	(1.5)	(1.5)
Total CQCN	146.7	145.1	144.4	149.6	150.7	155.2

[^]NB: A non-coal allocation for FY19 and FY20 was already provided for in the QCA's 2018 Decision.

Table 3 FY23 Final Draft Proposal - Renewals Budget(\$m)

System (\$m)	FY22 Approved Budget	FY22 Full Year Forecast	FY23 Draft Budget
Blackwater	117.1	113.7	125.8
Goonyella	120.9	112.9	122.4
Moura	11.8	14.7	15.8
Newlands / GAPE	25.3	24.7	22.5
Total CQCN	275.1	266.0	286.5

The FY23 Final Draft Proposal has been based on assumed volumes of 227mt, in line with FY20 actual results and the FY22 system forecasts³. Potential implications for maintenance and renewals activities resulting from volumes above this level, the findings of the Independent Expert's (IE) ICAR and the Transitional Arrangements proposed by Aurizon Network in response to the ICAR, or extreme weather events have not been reflected in the proposed

³ Aurizon Network has commenced engagement with End-Users to seek their input into the forecast volumes for FY23 that will be used in the Annual Review of Reference Tariffs in February 2022.

strategies and budgets. Any subsequent amendments will be addressed with the RIG through the change management process.

A detailed breakdown of the asset activity that is proposed in each Coal System is provided in Part A of this FY23 Final Draft Proposal and new information identified since the submission of the FY23 Draft Proposal on 30 November 2021 has been included in section 2.

Rail Industry Group Engagement

Leading into the development of the FY23 Final Draft Proposal, Aurizon Network has engaged with the RIG to provide greater transparency on key matters that contribute to the maintenance and renewal strategy and budget.

Both Aurizon Network and representatives of the RIG have invested significant time in meeting the commitments agreed to in the FY22 Approved Strategy and Budget. RIG representatives have indicated the process of engagement throughout this year has provided a valuable base that will inform the development of future maintenance and renewal strategies and budgets (**MRSB**). In support of this, and in response to feedback from RIG representatives, Aurizon Network will include annually, at the commencement of the development of each years MRSB, a process that identifies a number of key areas whereby Aurizon Network and the RIG can agree on the material matters that would benefit from RIG representative input. The progress and status of these matters will then be reviewed as part of monthly RIG representative meetings (or as agreed). Such matters will include:

- Corridor specific strategies relative to demand;
- Multi-year and strategic scope; and
- Upcoming material procurement activities.

Aurizon Network recognises that performance against the MRSB is a key indicator for the safety, reliability and performance of the network and the opportunity to identify areas of improvement. To this end, a number of changes have been made to the RIG Quarterly Reports to enhance readability and support the assessment of the consistency with the approved MRSB. Further information regarding these improvements and the outcome of the engagement between Aurizon Network and the RIG is included in Chapter 3.

Aurizon Network is continuing to adjust and improve its processes and systems to support and enable greater transparency and engagement with customers in the planning and forecasting process. The key areas of focus on improvement have been outlined in Chapter 4.

Rail Industry Group Feedback – 1 January 2022

On 30 December 2021, the Chair of the RIG, on behalf of a Special Majority of End Users, provided Aurizon Network with 23 queries, comments and request for additional information and proposed amendments in relation to the FY23 Draft Proposal (Additional Information) as well as a request for a consolidation of commitments Aurizon Network had made in the FY23 Draft Proposal. These were contained within three sections being:

Section A – Critical issues;

Section B – Detailed Questions and Comments; and

Section C – 2022 Commitments.

Where possible, Aurizon Network has responded to the Additional Information by including amendments in this FY23 Final Draft Proposal. A detailed written response addressing the individual comments and queries raised has also been provided to the RIG. A summary of the response to key issues and a consolidation of Aurizon Network's commitments is provided in section 3.2 below.

Next Steps

Following submission, the key milestones in relation to the FY23 Final Draft Proposal are outlined below.

Table 4 Regulatory milestones relating to the FY23 Final Draft Proposal

Date	Milestone	Description
30 November 2021	Draft Submission	Aurizon Network submits its FY23 Final Draft Proposal for each Coal System to the Chair of the RIG, Customers, and non-coal Access Holders.
Week commencing 7 December 2021	Customer Updates	During December 2021, Aurizon Network will provide to the RIG an update on the system-based scope preview presentations shared with customers during November, enabling the RIG to seek clarification and/ or provide feedback.
1 January 2022	Due date for feedback on the FY23 Draft Proposal	The Chair of the RIG, on behalf of End Users, may give Aurizon Network a notice which specifies amendments to the FY23 Draft Proposal that members of the RIG consider reasonably necessary (giving reasons).
21 January 2022	Aurizon Network submits FY23 Final Draft Proposal	Aurizon Network to respond to any proposed amendments (giving reasons if Aurizon Network does not accept them) and provide its FY23 Final Draft Proposal to the Chair of the RIG.
14 February 2022	Notification of voting outcomes	The Chair of the RIG notifies Aurizon Network and the QCA as to whether a Special Majority of End Users for each Coal System has approved Aurizon Network's FY23 Final Draft Proposal.

Aurizon Network welcomes the opportunity to discuss any aspect of this FY23 Final Draft Proposal in further detail with the RIG, its advisers, customers and/or non-coal Access Holders.

PART A: Aurizon Network's FY23 Final Draft Proposal



1. Key assumptions underpinning the FY23 Final Draft Proposal

In order to prepare the FY23 Final Draft Proposal, Aurizon Network has made a number of key assumptions relating to:

- The potential impact of changes resulting from the ICAR for each Coal System;
- The market demand outlook for Australian coal exports and the coal tonnages expected to traverse the CQCN; and
- The scope and cost of asset activity. The execution of planned asset activities presented in the FY23 Final Draft Proposal may not occur for another 18 months, during which time changes in asset condition may result in refinements to scope.

1.1 Interaction between the FY23 Final Draft Proposal and the ICAR

On 1 November 2021, the QCA published the ICAR for the CQCN. While the ICAR relates to a 5-year period from FY20 to FY24, its main focus is on the deliverable network capacity for the FY22 to FY24 period given that the financial years ended 30 June 2020 and 30 June 2021 have passed. The IE has determined that the average annual Deliverable Network Capacity of each coal system in the CQCN for the period FY22-FY24 is below Committed Capacity in each system.

For the purposes of the FY23 Final Draft Proposal, the forecast volumes in each system are in line with or below the average annual Deliverable Network Capacity as assessed by the IE. The Annual Review of Reference Tariffs process that commences in February 2022 will review the volume forecasts and Reference Tariffs for each Coal System applicable for FY23.

Table 5 Comparison average Deliverable Network Capacity (FY22 – FY24) and FY23 Final Draft Proposal forecast volumes

	Blackwater	Goonyella	Moura	Newlands	GAPE
Deliverable Network Capacity (mnt)	82.4	132.7	15.2	14.2	19
FY23 Final Draft Proposal forecast volumes (mnt)	62.6	117.7	13.6	14.1	18.8

On 12 November 2021, Aurizon Network provided its Preliminary Report on the Initial Capacity Assessment Report (the **Preliminary Report**) to the QCA. The Preliminary Report proposed operational improvements and expansions that have been assessed as directly linked to resolving the constraints identified in each system.

The capacity improvements outlined in the Preliminary Report are based on Aurizon Network's assessment for FY23. This differs from the ICAR, and the Deliverable Network Capacity results, which were derived from an indicative maintenance program. While overall maintenance outages remain similar, the closure program itself has varied month to month. The Preliminary Report provides further details on the changes. These changes will be incorporated in the Annual Capacity Review.

The FY23 Final Draft Proposal does not include any maintenance or capital expenditure for proposed Transitional Arrangements identified in the preliminary response to the ICAR.

Consultation is underway with customers to determine how capacity deficits will be addressed in each coal system. Following consultation, Aurizon Network will submit a detailed report to the QCA, the IE and the Chair of the RIG showing the outcome of this consultation process and the arrangements which Aurizon Network considers would most effectively and efficiently address the capacity deficits. Where, as part of the consultation process, the parties agree to expansions to address the deficits, the IE will consider and approve the efficiency of any capital spend

before it's incurred. Where there is no agreement, the IE will make a recommendation to the QCA for its determination as to the most efficient way of addressing capacity deficits.

The results of the ICAR consultation and approval of Transitional Arrangements and any impact on the FY23 Final Draft Proposal will be managed through the reporting and change processes and will be considered in the development of the FY24 Maintenance Strategy and Budget and Renewals Strategy and Budget.

1.2 Coal Market Demand Outlook and Volume Forecast

Australian coal export volume

Australia exported 363mt⁴ of coal in FY21, down 7% against the prior year. Although import restrictions remain for Australian export volume into China, alternative markets continue to be found for Australian Coal.

Metallurgical Coal

Australia exported 171mt⁴ of metallurgical coal in FY21, down 4% against the prior year. India remained Australia's largest metallurgical coal export market with record high export volume of 56mt (33% share), followed by Japan at 36mt (21% share) and South Korea at 20mt (12% share). The average hard coking coal (Premium Low Vol) price in FY21 fell by 15% (compared to the prior year) to US\$122/t.

Thermal Coal

Australia exported 192mt⁴ of thermal coal in FY21, down 10% against the prior year. Japan remained Australia's largest thermal coal export market with export volume of 73mt (38% share), followed by South Korea at 34mt (18% share) and Taiwan at 23mt (12% share). The average Newcastle benchmark thermal coal price in FY21 increased by 20% (compared to the prior year) to US\$78/t.

Figure 6 below outlines the Australian export volumes and price trends⁴ for Metallurgical and Thermal coal over time.

Figure 6 Australian Metallurgical and Thermal Coal - Export Volumes and Price



Outlook for FY23

The Office of the Chief Economist is projecting⁵ annual growth in **global crude steel production** of 4.5% in CY21 driven by ongoing recovery that is now underway in most major economies following COVID-19 lows. With more moderate production growth likely in CY22 (+2.8%/yr) and CY23 (+2.6%/yr). Australia's **metallurgical coal** exports are forecast to rise from 171mt in FY21 to 181mt by FY23. Supply chains disrupted by China's informal import restrictions have largely reorganised. Metallurgical coal prices have hit new peaks in the December 2021 quarter, as

⁴ Export Volume – Australian Bureau of Statistics (Customised Report). Hard Coking Coal Price – Platts (Premium Low Vol product). Thermal Coal Price - Intercontinental Exchange (Newcastle 6,300 kcal/kg Gross as Received product).

⁵ Office of the Chief Economist, Resources and Energy Quarterly, December 2021, Department of Industry, Science, Energy and Resources.

supply shortages meet rebounding global industrial production. The Australian premium hard coking coal (HCC) price is forecast to reduce from an average US\$225/t in CY21 to US\$214/t in CY22 and US\$162/t by CY23.

Australian **thermal coal** exports declined from an all-time high 213mt in FY20 to 192mt in FY21, as a result of COVID-19. Exports are expected to increase to 204mt by FY23⁵, as economies in Asia recover, with demand growth anticipated in Southeast Asia. Thermal coal spot prices reached a record high during the December 2021 quarter, amid tight global supply and high demand driven by northern hemisphere winter restocking and concerns in China of winter power-generation shortages. The Newcastle benchmark price is forecast⁴ to reduce from an average US\$136/t in CY21, reducing slowly to US\$120/t by CY22 and US\$91/t by CY23.

In FY23, Aurizon Network expects that overall demand for coal will improve from conditions seen during FY21, resulting in a higher coal tonnage forecast when compared to FY21 actuals for the CQCEN. For setting FY23 coal volumes, Aurizon Network has engaged with each End-User to seek their input into the forecast volumes that will be used for the FY23 Reference Tariffs. As communicated as part of the engagement, actual FY22 railings will be the basis for the FY23 volume forecast with end-user feedback informing any potential variations. With not all End-User choosing to respond and some responses only received just prior to this FY23 Final Draft Proposal being provided to the RIG, no material update has been provided. Aurizon Network will provide an updated coal tonnage forecast as part of the FY23 Annual Review of Reference Tariff process, due to the QCA on 28 February 2022.

For clarity, Aurizon Network has used FY22 QCA-approved forecast volumes for the purposes of developing this FY23 Final Draft Proposal.

Table 6 Proposed volume forecast for FY23 – Million Net Tonnes (mnt)

System	FY21 Actual (mnt)	FY20 Actual and FY22 Regulatory Forecast (mnt)	FY23 Final Draft Proposal (mnt)
Blackwater	61.5	62.6	62.6
Goonyella	103.4	117.7	117.7
Moura	12.7	13.6	13.6
Newlands	10.7	14.1	14.1
GAPE	20.0	18.8	18.8
Total CQCEN	208.3	226.9	226.9*

*This number may be different for the purposes of setting Reference Tariffs as part of the Annual Review of Reference Tariff process due to the QCA on 28 February 2022.

Table 7 Proposed volume forecast for FY23 – Gross Tonne Kilometres (GTK'000)

System	FY21 Actual (GTK'000)	FY20 Actual (GTK'000)	FY23 Final Draft Proposal (GTK'000)
Blackwater	35,032,389	35,724,809	35,724,809
Goonyella	33,373,557	37,733,317	37,733,317
Moura	3,301,501	3,538,134	3,538,134
Newlands	2,226,336	3,111,415	3,111,415
GAPE	9,896,061	9,467,598	9,467,598
Total CQCEN	83,829,844	89,575,273	89,575,273*

*This number may be different for the purposes of setting Reference Tariffs as part of the Annual Review of Reference Tariff process due to the QCA on 28 February 2022

Impact of minor volume variations on asset activity

In the short term, minor volume variations are not expected to have a material impact on the proposed scope and budgets for maintenance and renewal activities. For most activities, volumes would typically have to vary by a material amount and for a longer period of time to start to impact maintenance and renewal requirements to a larger extent.

For maintenance activities, slight variations in products that are driven by volume-based intervention thresholds may occur where a change in tonnage forecast alters the financial year in which the intervention is required. For example, in relation to resurfacing, rail grinding or ultrasonic testing. The other maintenance products tend to be periodic maintenance, again it would take a longer period of time to start to see general maintenance reduce in any significant way.

The scope of asset renewal activities planned for FY23 has been assessed based on its condition and criticality. A minor change to FY23 volume forecasts is unlikely to change this requirement.

1.3 Other Assumptions

The scope, access and cost requirements outlined in the FY23 Final Draft Proposal are based on the following assumptions:

- The closure hours outlined within this FY23 Final Draft Proposal represent integrated closures only and do not include activities completed in the shadow of other activities or in-between trains.
- Aurizon Network confirms its FY23 possessions planning process and associated consultation has taken the requirements of non-coal traffic into consideration when seeking to deliver the Committed Capacity.
- The Direct Maintenance costs schedules presented in this draft proposal include an adjustment to reflect an allocation of costs relating to the provision of non-coal services. This adjustment has been calculated by applying an estimate of the non-coal proportion of total system GTKs to total system maintenance costs (excluding electrical spend and ballast undercutting plant depreciation).
- The planning approach for the Ballast Cleaning Machine (**BCM**) with improved production rates, assumes it will operate within the designated integrated closures. Where possible all scope will be contained within integrated closures, however from time to time, single line possessions outside of closures may result where scope cannot be delivered within closures and will have minimal impact to capacity.
- The value of asset renewal activities represented within the FY23 Final Draft Proposal reflects the capital expenditure Aurizon Network expects to incur while delivering these works in FY23. These values may differ from the values that Aurizon Network will seek to include in the Regulated Asset Base (**RAB**) via the Annual Capital Expenditure Claim (UT5, Schedule E), which reflects the cost of assets that have been commissioned during the financial year.
- Maintenance costs outlined within the FY23 Final Draft Proposal reflect the Direct Maintenance Costs only.
- There can be a substantial timing difference (of up to 18 months) between planning and execution of works. It should be noted that estimates are made based on current information and that asset conditions may change prior to delivery. As such, refinements to the scope or cost of works presented in the FY23 Final Draft Proposal may be required.
- For the purposes of Clause 7A.11.5(f)(ii)(B)(2) of UT5 and the consideration of whether material variations in the actual cost of delivering an “item” contained within the Approved Strategy and Budget are prudent and efficient:
 - For Moura and Newlands/GAPE, the maintenance budget in its entirety should be considered an ‘item’
 - For Blackwater and Goonyella, the product areas of resurfacing, rail grinding, general track maintenance, ‘Signalling and Telecoms’ and Electrical should be considered as items. The remaining product areas should be considered a single item (Structures and Facilities, Trackside Systems, Other Civil Maintenance, Other General Maintenance).

1.4 Extreme weather and Review Event expenditure

The scope of maintenance activities that can be delivered by Aurizon Network each year can be impacted by external events, such as prolonged or extreme weather. Given the uncertainty surrounding the occurrence of such events, Aurizon Network has not included in its FY23 Final Draft Proposal any contingency nor any provision for costs associated with Rail Infrastructure repair or rectification following a Force Majeure Event.

Where a Force Majeure Event and associated cost of rectification constitutes a Review Event under UT5, Aurizon Network will seek QCA approval to recover any incremental costs (which may include ordinary labour costs where they are not already recoverable) through the UT5 process (Schedule F, Clause 5.3).

2. New Information since 30 November 2021

The development of the annual maintenance and renewal strategy and budget is part of Aurizon Network's process to manage the rail infrastructure in a way that meets the Maintenance Objectives outlined in section 7A.11 of the 2017 Access Undertaking. The draft proposal submitted on 30 November each year to the Rail Industry Group Chair takes into consideration the identification and assessment of scope that in some cases occurs up to 18 months prior to the submission date. Aurizon Network makes an informed assessment based on the available information, including the likelihood of change to the scope, cost and access impacts, for inclusion in each years' proposal.

Since 30 November 2021, Aurizon Network has continued to develop scope identified in the FY23 Draft Proposal for implementation. Consistent with section 7A.11.3(c)(iii) of the 2017 Access Undertaking, this section of the FY23 Final Draft Proposal provides an update to the members of the Rail Industry Group, non-coal Access Holders and Customers on new information in relation to the FY23 Draft Proposal that has become available between 30 November 2021 and the 21 January 2022. The changes are predominantly due to new information regarding the condition of infrastructure, design requirements or FY22 approved scope deferred due to wet weather. The changes result in a \$1.0m increase in Blackwater asset renewal expenditure in FY23. The table below provides a summary of all changes to the FY23 Draft Proposal based on new information.

Table 8: Changes to FY23 Draft Proposal from new information

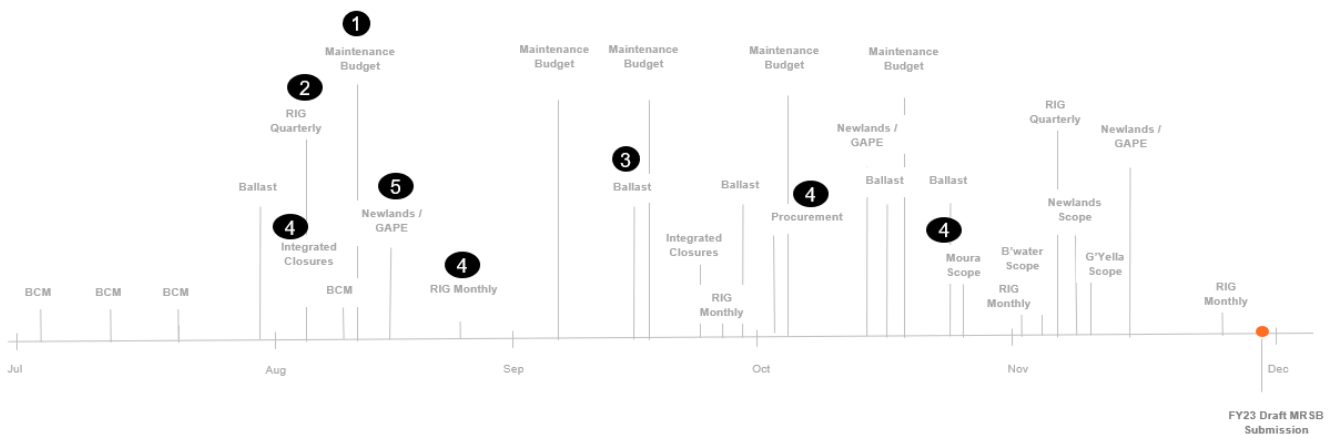
Description	Reason for Change	Impact on FY23 Draft Proposal
Coal Market Demand Outlook and Volume Forecast		
Change to Australian coal forecast volumes	New information from the Office of the Chief Economist, Resources and Energy Quarterly, December 2021, Department of Industry, Science, Energy and Resources	Information only, no change to FY23 Final Draft Proposal
Blackwater System		
Electrical – Auto Transformers	A critical failure at Callemondah Feeder Station in Q2 and the resulting renewal has meant that Rangal auto transformer replacement will now be completed in FY23 and Grantleigh replaced in FY24	Change in location/site only
Structures – Culvert Renewals (Parnabal-Walton 156.8km)	Further design work changed the solution from a “grout and divert” to a “remove and replace”	Additional budget of \$0.4m (from \$0.1m)
Ballast Cleaning - Bridge Roll Out (Lilley Waterholes)	The cost estimate has been revised with the construction costs expected to be lower than originally anticipated	Reduced budget of \$0.7m (from \$1.2m)
Permanent Way - Rail Renewal (Mount Miller – Yarwun 544.734km)	Introduced to FY23 due to accelerated wear	Additional rail renewal scope of 0.7 rail km and budget of \$0.2m
Permanent Way - Turnout Renewal (Archer)	Previously approved in FY22. however, construction was cancelled due to wet weather. The next appropriate closure is in July 2022	Additional turnout renewal and spend of \$0.7m
Permanent Way - Turnout Renewal (Wallaroo)	Previously planned as a component renewal in FY22. In addition to reopening the bad-order siding and therefore reducing the risk of delays caused by shunting, a standard turnout will be installed	Additional turnout renewal and spend of \$0.3m (FY22 \$0.8m)
Goonyella System		
Control Systems - Power Resilience	Transposition error. The FY23 Draft Proposal table 96 included 4 x UPS and 6 Genset improvements (glow plugs), this should be 6 x UPS and 4 x Glow plugs	Correction to scope quantities, no impact on budget
Moura System		
Control Systems - Interlocking (Earlsfield)	Change of station from Stirrat to Earlsfield. This is due to critical consequence of an interlocking failure at Earlsfield would have the greatest impact to operations.	Change in location only.

3. Stakeholder Engagement

This chapter presents a summary of Aurizon Network’s engagement with stakeholders during the development of the FY23 Final Draft Proposal.

In developing the FY23 Final Draft Proposal, Aurizon Network has focused on improving the quality of the engagement with the RIG and Customers, by delivering on the commitments made during development of the FY22 Approved Strategy and Budget with a view to promoting greater transparency and understanding of key processes and asset activities.

Figure 7: Summary of Customer Consultation for the FY23 Final Draft Proposal



- | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>1 Maintenance Budget Development</p> <ul style="list-style-type: none"> - To refine budgeting and forecasting processes to enable a driver based build-up of maintenance costs where appropriate | <p>3 Ballast</p> <ul style="list-style-type: none"> - To provide additional information in relation to the condition of ballast throughout the Network and to work with the RIG to explore initiatives to address any decline | <p>4 Planning, Procurement and Execution Practices</p> <ul style="list-style-type: none"> - To continue to work with the RIG to increase user understanding of Aurizon Network’s planning, procurement and execution of Maintenance and Renewals activities |
| <p>2 RIG Quarterly Report</p> <ul style="list-style-type: none"> - To work with RIG to continue to refine and enhance quarterly reporting and performance metrics | | <p>5 Newlands/ GAPE</p> <ul style="list-style-type: none"> - To review the capital allocation methodology for Newlands and GAPE system users |

3.1 FY22 Commitments

During the development of the FY22 Approved Strategy and Budget, Aurizon Network made a number of commitments to the RIG to improve transparency and levels of engagement which have been progressively implemented since approval was received. The FY22 commitments for engagement with RIG members were:

- a) To refine budgeting and forecasting processes to enable a driver-based build-up of maintenance costs where appropriate (Maintenance Budget Development);
- b) To work with the RIG to continue to refine and enhance quarterly reporting and performance metrics taking into consideration both specific feedback on the initial Quarterly Report and the monthly reporting which is to be provided by the Independent Expert (RIG Quarterly Report);
- c) To provide additional information in relation to the condition of ballast throughout the Network (including the analysis of the 2020 GPR results) and to work with the RIG to explore initiatives to address any decline (including fouling mitigation strategies);

- d) To continue to work with the RIG to increase user understanding of Aurizon Network’s planning, procurement and execution of Maintenance and Renewals activities, including through the provision of Case Studies (Planning, procurement and execution); and
- e) To review the capital allocation methodology for Newlands and GAPE system users (Newlands/ GAPE).

The outcome of engagement with the RIG and customers on the FY22 Commitments is further discussed in the following sections.

3.1.1 Maintenance Budget Development

Early in June 2021, initial discussions with the RIG representative group established an engagement plan to improve the transparency of the maintenance cost build up through a series of workshops outlined in Table 9 below.

Table 9 FY23 Maintenance Budget Development Engagement Plan

Date	Topic	Workshop Objectives & Purpose
18 June 2021	Proposed Budget & Engagement Approach	Present proposed budget approach and seek feedback from the RIG on the FY22 budget process and areas for improvement
15 August 2021	Budget Approach & Key Labour Cost Drivers	Confirm proposed approach to development of FY23 maintenance cost budget and provide overview of the sources and uses of Aurizon Network’s labour & indirect costs including the key cost drivers
6 September 2021 to 5 October 2021	Discipline Overviews	Provide overviews of the Civil Infrastructure, Electrical Systems, Mechanised Production and Structures disciplines including key cost drivers
5 October 2021	Procurement	Provide overview of Aurizon Network’s approach to procuring external labour and key materials (ballast, rail, sleepers, freight, grinding services)
18 October 2021	Draft Budget Outputs	Provide overview of preliminary draft budget outputs by system including key movements and seek feedback from RIG

The aim of these workshops was to provide the RIG with increased transparency on the underlying sources and drivers of Aurizon Network’s maintenance costs. As part of the discipline overviews conducted during September and October, further information was provided to the RIG representative group on Aurizon Network’s key underlying maintenance cost drivers including:

- Workforce size and composition;
- Labour utilisation by team and discipline;
- Cost escalation assumptions and employment arrangements;
- Activity mix assumptions by team (proportion of cost allocated to maintenance, capital, other);
- Key maintenance activities including proportion of preventative and corrective activity; and
- Maintenance labour cost flows from teams / depots to systems and RIG maintenance categories.

During the discipline overviews, further detail was provided on the key metrics that are used by each of the disciplines to track and measure performance.

Draft maintenance budget outputs by system for FY23 including key assumptions and cost movements by RIG maintenance category were presented to the RIG in October 2021.

3.1.2 RIG Quarterly Report

Aurizon Network prepares quarterly reports for the RIG to provide information and transparency on the degree to which performance is consistent with the current years MRSB. During this year, Aurizon Network has been working with the RIG to continue to refine and enhance quarterly reporting and performance metrics taking into consideration both specific feedback on the initial Quarterly Report and the monthly reporting under Part 10 of the Access Undertaking which the Independent Expert has completed since October 2021.

As a result of this engagement, Aurizon Network has made a number of changes to the quarterly reporting to improve readability, including:

- Redesign of the report with a chapter for each system;
- Provision of additional information and commentary provided for a selection of major works completed (or unable to be completed) within each closure; and
- General improved readability, e.g., better alignment of information with FY22 Approved Strategy and Budget and inclusion of prior year comparative data.
- Some feedback received from the RIG has not been addressed at this stage. Network will further discuss reporting improvement opportunities following the publication of monthly reports by the IE.

3.1.3 Ballast

Aurizon Network recognises that restoring the drainage and load distribution properties of ballast is a material component of the total maintenance and renewal expenditure per year. While Aurizon Network continues to look at opportunities to improve the effectiveness of the ballast cleaning program, there is a wider opportunity for industry to assess activities associated with preventing or mitigating coal fouling. Aurizon Network has had a series of engagements with the RIG representatives to deliver on the commitment to:

“To provide additional information in relation to the condition of ballast throughout the Network (including the analysis of the 2020 GPR results) and to work with the RIG to explore initiatives to address any decline (including fouling mitigation strategies)”

Aurizon Network has identified that the CQCN ballast fouling distribution has changed due to an increase in track centre fouling, primarily in the Goonyella and Blackwater Systems. Track centre fouling has been the consistent and dominant fouling profile in each of the Ground Penetrating Radar (**GPR**) surveys, however, an increased quantity of track was identified with increased fouling levels in the 2018 survey and validated in the 2020 survey. Centre track fouling is experienced throughout the CQCN and isn't isolated to any track, region, or operating characteristic.

Assessment of the cause for the variation has indicated that it is potentially driven by:

- A reduction in coal fouling mitigations, e.g., wheel washers, cleaning rolling stock, loading precision and unload ploughing;
- Transporting of finer coal particles that are then escaping through wagon doors, finer coal is the predominant particle size in the ballast; and/or
- Rainfall and flooding from Cyclone Debbie (March 2017) may have caused higher fouling with sediments, flood debris and formation material. However, heavily fouled areas do not strongly correlate with flood mapping.

The assessment has also determined that the variation is not driven by data quality issues and preliminary analysis of the 2021 GPR analysis has shown a strong correlation to the 2020 GPR analysis. Aurizon Network looks forward to presenting the results of the 2021 GPR analysis in Q3 FY22 to the newly established Ballast Working Group (**BWG**) once field calibration has been completed.

Despite the observed increases in track centre fouling, Aurizon Network has not identified a corresponding deterioration in track geometry nor an increase in temporary speed restrictions. To learn more about the prevailing ballast condition, Aurizon Network is completing the following activities:

- Further analysis of track geometry behaviour of centre fouled track locations, leveraging the prototype ATIS track geometry unit;
- Laboratory PVC measurements of selected ballast cleaning sites and ballast defects to improve correlation between track faults and GPR PVC measurements; and
- X-ray diffraction tests on the fouling material to understand the exact percentage breakdown of fouling material in various locations.

In identifying the scope of ballast cleaning activities, Aurizon Network considers multiple factors in addition to the GPR data, including maintenance history (e.g., resurfacing events), track geometry data, visual inspection results, and temporary speed restrictions. As part of the engagement with the BWG, Aurizon Network provided case studies to demonstrate how this information is used to inform site selection.

Since 2016, Aurizon Network has targeted cleaning 140Km per annum across the CQCEN. The GPR-determined extent of fouling above the acceptable fouling limits across the network is greater than the nominal 140Km and therefore the scope is limited by the production rates of ballast cleaning equipment. This approach has delivered a reasonably stable performance of the infrastructure as measured by track geometry and temporary speed restrictions. This approach will be reviewed during the coming year as further analysis on ballast fouling is undertaken and certainty of production rates of the RM902 Ballast Cleaning Machine (BCM) is gained post-commissioning.

During the year, Aurizon Network facilitated the establishment of the BWG, which currently includes producers and operators, with an intention to extend an invitation to the ports to participate. The objective of the BWG is to better understand both the condition of ballast and mitigation options, with a focus on:

- Efficient and effective delivery of ballast cleaning, including improving the understanding of the required scope of work; and
- Supply chain options to prevent or reduce coal fouling.

The BWG has initiated a scoping study, the output of which will include a plan and schedule to:

- Identify, prioritise, assess, and (if supported by relevant stakeholders) implement ballast fouling mitigation techniques, taking into consideration all elements of the supply chain; and
- Better define the current ballast cleaning scope and delivery approach applied to the CQCEN.

The introduction of the BWG and the demonstrated commitment from Supply Chain participants has been a positive step in the management of coal fouling and ballast cleaning in the CQCEN.

3.1.4 Planning, Procurement and Execution Practices

Aurizon Network has had a number of engagements with the RIG, RIG representatives and directly with individual producers to continue to increase user understanding of Aurizon Network's planning, procurement and execution of Maintenance and Renewals activities, including through the provision of Case Studies.

Optimised BCM Program

Aurizon Network, in consultation with the RIG representative group, investigated opportunities to improve the capacity of the CQCEN by exploring alternative delivery methods for Aurizon Network's ballast cleaning program.

The nominal operational strategy to use a single BCM in the north for five months and then the south for five months was reviewed. Four alternative operating models were identified and considered, two of which were taken further as preferred solutions, an optimised single BCM strategy and a dual BCM strategy. Both options involved prioritising integrated closure utilisation and minimising the requirement for single line working and the subsequent consumption of paths. These options were analysed in more detail through network capacity modelling, market engagement for detailed pricing and timelines for the refurbishment of the existing end of life BCM (RM900), network maintenance &

asset renewals planning and business impact assessments. Both options provided capacity benefits to customers by reducing single line possession requirements by completing more work in closures and are summarised in Table 10 below.

Table 10 Comparison Optimised Single BCM and Dual BCM Strategies

Option	Capex	Opex	Pathing Benefit	Organ'l Change	Skills Change	Closure Risk Change	Planning Flexibility	Ballast Scope Capacity	Machine Redund'cy
Single BCM	None	Low increase	Medium	No	No	Low	Low	Normal	No
Dual BCM	6.5m	Med increase	High	Yes	Yes	High	High	High	Yes

Based on the findings of the assessment, the decision was made to proceed with the optimised single BCM strategy for FY23 (the Optimised BCM Program). This option delivers most of the capacity benefits of the dual BCM strategy with no requirement for capital expenditure, reduced operating expenditure, and with reduced operational change and risk.

The Optimised BCM Program has been included in the Transitional Arrangements in Aurizon Network's preliminary response to the ICAR. For each system the capacity created from the Optimised BCM Program has been assessed and shown in Table 11 below.

Table 11 Optimised Single BCM Capacity Created from Preliminary Response

	Blackwater and Moura	Goonyella	Newlands/ GAPE	CQCN
Capacity Created (mtpa)	0.7 – 1.4	0.7 – 1.8	0.25 – 0.5	1.65 – 3.7

Integrated Closure Plan

Aurizon Network has taken a three-phase approach to the development of the integrated closure plan for FY23. In August 2021, the RIG and stakeholders were provided with an update on the scope that would form the critical path for integrated closures in FY23. In this forum, the location of where work is required to be undertaken and the likely duration of the capacity impacts was identified. Importantly, the RIG and other stakeholders were given line of sight to the increase in integrated closure hours that were being proposed for FY23 due to complex priority scope items and the large (96 hour and 72 hour) proposed closures for Blackwater. Feedback from customers was incorporated in the Phase 2 integrated closure design, which was presented to customers in September 2021. The changes from Phase 1 to Phase 2 reflected:

- Reduction in Blackwater closure in February 2023 from a 54 hour to 48-hour closure as a result of refined scope and duration required for Bluff Level Crossing;
- Removal of two proposed 60 hour and one 36-hour closure in Rolleston branch due to BCM scope modification allowing for more efficient machine utilisation and resourcing modified to allow bridge rollouts to be executed in existing integrated closures;
- Moving the April 2023 36-hour closure in Goonyella to March to increase the separation between the Goonyella and Blackwater closures, particularly around the lead up to the 96-hour Blackwater integrated closure;
- Moving the Gregory branch line 60-hour closure from July 2022 to August 2022 to remove having two 60-hour closures in one corridor for the month of July 2022; and
- Removal of the two 18-hour closures in January 2023 and February 2023 on the Gregory branch as a result of formation works on Gregory branch line timing refinement.

Other feedback incorporated included maximising alignment to Queensland Rail's North Coast Line closures and keeping December 2022 and June 2023 clear of integrated closures.

The detailed design and delivery of the integrated closures (Phase 3) has formed the basis for the FY23 Final Draft Proposal and will be entered in the Advanced Planning and Scheduling (**APS**) system for publication via the CQCN Asset Activities Power BI report on 30 November 2021. Further information on how we plan asset activity and assess capacity impacts is provided in Chapter 12.

Scope Preview Presentations

During October and November 2021, Aurizon Network provided the RIG and other stakeholders system specific previews of the FY23 Final Draft asset renewal and maintenance scope and budget. These presentations provided customers with an early draft of the scope and cost of asset renewal work and brought together other key elements previously presented including the maintenance budget and integrated closures for each system. A key opportunity of this early engagement was to bring to life the asset management strategy by providing information on scope site selection, FY23 project details and the decisions that have driven the site selection. The system presentations provided to the RIG and other stakeholders will be updated post the submission of the draft MRSB to assist in the approval process of the FY23 Final Draft Proposal.

During the course of each of these presentations, consistent feedback was provided that the information was seen as valuable and importantly set up future collaboration with the RIG by providing more opportunities to influence the development of the MRSB prior to the submission of the draft each November.

Change Escalation Framework

In response to feedback from the RIG during the scope preview presentations seeking greater levels of collaboration, Aurizon Network developed a change escalation framework and presented this for discussion to the RIG representative group.

UT5 includes the ability to vary from the approved strategy and budget in certain circumstances, including for safety, reliability and performance of the Rail Infrastructure (refer to 7A.11.1(a)(i)(C) and 7A.11.1(a)(i)(D) for further information). In addition to the RIG Quarterly Reporting and the capital and maintenance claims process, Aurizon Network has commenced providing the RIG representative group with an opportunity to influence the planning and execution of new scope. In November, Aurizon Network presented new scope under this escalation framework that:

- Has been identified for the current year of an approved strategy and budget;
- Is material; and
- Is not critical or required to respond to an emergency or natural disaster.

Procurement Practices

In early October 2021, Aurizon Network provided the RIG representative group with an overview of the Procurement Governance Framework and major external spend activities. Following further discussions, Aurizon Network has agreed a number of initiatives to improve collaboration, governance and transparency for procurement practices. Namely the establishment of processes that will facilitate:

- An annual review with the RIG of the material contracts expiring or being re-negotiated within the coming 2 – 3 years;
- Review of the status and progress of the sourcing strategies and negotiations for material contracts;
- Utilise external consultants to run material procurement processes; and
- Strengthening Aurizon Network's governance of in-bound supply related party agreements.

Aurizon Network sees a key opportunity in relation to each of the improvements that have come about as a result of the information sharing and collaboration with the RIG this year is ensuring that decisions in relation to the performance of the Central Queensland Coal Chain take into consideration customer priorities. In this way we can work together in ensuring the delivery of safe, reliable and efficient rail services that strengthen the Central Queensland Coal supply chain.

3.1.5 Newlands/GAPE

In June 2021, the QCA approved the FY22 Annual Review of Reference Tariff submission (**FY22 ARRT**), which included Aurizon Network's existing allocation methodology for Renewal Expenditure for the common-user Rail Infrastructure in the Newlands System. The existing allocation methodology allocates the Renewal Expenditure on the shared rail corridor to the relevant system, based on which Regulatory Asset Base the renewed asset is in and the applicable System's reference tariff.

Aurizon Network considers the current allocation approach is appropriate and consistent with all Train Services on the shared rail corridor contributing to the wear and degradation of both Newlands and GAPE assets in the shared rail corridor, but we have delivered upon our commitment made as part of the FY22 Approved Strategy and Budget by engaging with GAPE and Newlands System end-users to work through the relevant issues. Further information about this engagement is provided below.

In line with the FY22 Approved Strategy and Budget, Aurizon Network has included section 8.5, which provides additional detail to clarify Aurizon Network's approach to allocating the FY23 Maintenance and Renewals Budgets for each systems user group.

UT5 provides for separate Allowable Revenues and Reference Tariffs for the Newlands System and for GAPE Access Holders. GAPE is not, however, a geographically distinct coal system due to the shared use of the rail infrastructure between Abbott Point and Newlands Junction. In addition to the construction of greenfield track between North Goonyella Junction and Newlands Junction (**GAPE Link**), the scope of the GAPE Project included significant upgrades and renewal of Newlands System Rail Infrastructure (**Newlands System Infrastructure Enhancements**). As such, information in relation to the Newlands System and GAPE has been presented together in this FY23 Final Draft Proposal.

Due to the above, Aurizon Network has separately identified each location of individual renewal projects and provided additional information in Chapter 8.5, which includes:

- a) An estimate of the share of the proposed Maintenance Budget which would be recovered from each of the Newlands System and GAPE under the current pricing arrangements (**Maintenance Indicator**); and
- b) An in-principle summary of the extent to which assets in the proposed Renewals Budget would be allocated to each of the Newlands System and GAPE RABs (**Capital Indicator**).

3.2 Rail Industry Group Feedback – 1 January 2022

On 30 December 2021, the Chair of the RIG, on behalf of a Special Majority of End Users, provided Aurizon Network with 23 comments, queries and proposed amendments in relation to the FY23 Draft Proposal (Proposed Amendments) as well as a request for a consolidation of commitments Aurizon Network had made in the FY23 Draft Proposal. These were contained within three sections being:

Section A – Critical issues;

Section B – Detailed Questions and Comments; and

Section C – 2022 Commitments.

The following information summarises Aurizon Network's response to the RIG feedback and includes feedback received from the RIG representative group prior to finalising this FY23 Final Draft Proposal.

3.2.1 Critical Issues

As part of the feedback from the RIG on the FY23 Draft Proposal, one critical issue was raised. This related to the allocation of costs in the Newlands system between Newlands and GAPE End Users and was identified as a risk to the approval of the Renewal Strategy and Budget for Newlands. The RIG acknowledged that the concerns related to

cost recovery rather than to the prudence of scope or cost but noted End Users were having difficulty in separating the two issues given that End Users are requested to approve a budget which they believe, to some extent, relates to a different system. In the context of the FY22 MRSB process, notwithstanding Aurizon Network’s commitment to work with End Users to resolve the issue, these concerns resulted in the FY22 Newlands Renewals Strategy and Budget not being approved. The RIG has recommended that Aurizon Network continues to engage with End Users to understand what, if any, commitments, or amendments to the MRSB, could reduce the risk of a similar outcome for FY23.

In line with the commitments made by Aurizon Network as part of the FY22 MRSB process, Aurizon Network established a working group with Newlands and GAPE End Users. Aurizon Network has engaged with the working group to seek a resolution to the issues pertaining to the allocation of renewal expenditure required for shared infrastructure in the Newlands rail corridor. This engagement was informed by the QCA’s approval of the FY22 Annual Review of Reference Tariffs in June 2021, and the non-binding guidance paper issued by the QCA in September 2021.

Prior to the submission of the FY23 Draft Proposal on 30 November 2021, Aurizon Network provided Newlands and GAPE End Users with a draft alternative methodology for allocating costs. Aurizon Network has continued to engage with Newlands and GAPE End Users via meetings, either with the working group as a whole or with individual End Users. The table below provides a list of the engagement with End Users on this matter to date.

Table 12: Newlands/ GAPE Working Group Engagement

Working Group Engagement	Description
19 August 21	Meeting 1 - Provide summary of issues and establish scope of working group
13 October 21	Meeting 2 - Included discussion on potential allocation methodologies.
17 November 21	Meeting 3 - Aurizon Network presented an overview of an engineering based approach to identification of usage based asset degradation
16 December 21 – 10 January 22	Direct End User meetings to discuss individual impacts of the identified pricing issues.

Aurizon Network notes that the FY23 Maintenance and Renewals Strategy and Budget for the Newlands shared rail corridor has been developed to promote the UT5 Maintenance Objectives, having regard to the condition, and the operational and service quality requirements of the rail infrastructure. As such, Aurizon Network believes that the decision by End Users to approve (or otherwise) the FY23 Final Draft Proposal should be made independently of the commercial matters (i.e., cost allocation/ pricing matters) that are currently being progressed through the Newlands and GAPE End User working group. It should be noted that these commercial matters are also broader than just the renewals allocation methodology.

To support the approval of the cost and scope of Asset Renewals in Newlands, Aurizon Network provided in the FY23 Draft Proposal (and has maintained this position in the FY23 Final Draft Proposal):

- a) A commitment to continue to work with Newlands and GAPE End Users to resolve the capital allocation methodology during 2022 (whether by agreement or a regulatory process);
- a) Full scope and cost of asset renewals for the Newlands system (including the shared corridor) and would encourage End Users to consider the reasonableness of the program of works in full when considering the maintenance and renewal strategy and budget until the pricing allocation is resolved;
- b) Identified which asset renewal scope would be allocated to the Newlands/ GAPE systems based on the current asset specific methodology.

To address End User concerns regarding the ability to approve the cost and scope of the asset renewals without understanding which system will be impacted by that cost and scope, Aurizon Network has considered the additional

information that may be provided to support the approval of the FY23 Final Draft Proposal of the Asset Renewals Strategy and Budget. To this end, Aurizon Network has recast the presentation of the final draft FY23 MRSB scope and costs to reflect the alternate allocation methodology presented to members of the Newlands and GAPE working group as part of an overall proposal of pricing related changes in December and early January. The purpose of presenting this information is to illustrate the application of an alternate allocation methodology in comparison to the current asset specific methodology of allocating asset replacement expenditure on the Newlands shared rail corridor. Aurizon Network acknowledges that this alternate position is not representative of any agreed position in relation to Newlands/ GAPE costs allocation but is intended to provide End Users with an alternative perspective of what the Asset Renewal cost allocation in FY23 could look like.

Aurizon Network reiterates the position stated in the FY23 Draft Proposal that End User approval of the FY23 Final Draft Proposal will not be considered as endorsement of the current or future allocation and pricing methodology.

The table below provides a worked example of how the costs included within the Total Allocated Variable Cost Pool have been attributed to either the Newlands or GAPE Capital Indicator. This information is provided for comparison purposes only in order to represent the relative impact of the change to the current allocation approach in the commencement year. In the proposal provided to the members of the Newlands and GAPE working group, the asset expenditure in the Total Allocated Variable Cost Pool would be included in a separate asset class, representing the shared rail corridor renewals and the allowable revenue generated by this asset class would be allocated annually to the GAPE and Newlands System Allowable Revenues based on the relative gross tonne kilometre forecasts for the relevant pricing year.

Table 13: FY23 MRSB cost build for alternate allocation methodology

Newlands / GAPE - FY23 Renewals Shared Rail Corridor (ex NML) (\$m)	TOTAL (\$m) ^	Usage Variability (%)	Fixed and Variable Costs (\$m)			Variable Cost Allocation Pool					
			Newlands Fixed Cost	GAPE Fixed Cost	Variable Cost Allocation Pool	Rail Renewal and Ballast Undercutting Variable (\$m)			Allocated Variable Cost Pool (\$m)		
						Total	Newlands Capital Indicator	GAPE Maintenance Indicator	Total	Newlands Capital Indicator	GAPE Capital Indicator
Total Civil Assets	18.8		7.0	0.4	11.4	3.7	1.4	2.3	7.7	2.9	4.7
Permanent Way Assets	5.1		0.5	0.1	4.5	1.1	0.4	0.7	3.4	1.3	2.1
Rail	1.2	90%	0.0	0.1	1.1	1.1	0.4	0.7	--	--	--
Track Upgrade	3.3	90%	0.3	--	3.0	--	--	--	3.0	1.1	1.8
Turnouts	0.6	75%	0.1	--	0.4	--	--	--	0.4	0.2	0.3
Ballast Cleaning	4.3		0.8	0.2	3.2	2.6	1.0	1.6	0.6	0.2	0.4
Ballast Undercutting	3.1	75%	0.6	0.2	2.3	2.3	0.9	1.4	--	--	--
Turnout Excavator Undercutting	0.4	75%	0.0	0.1	0.3	0.3	0.1	0.2	--	--	--
Bridge Ballast	0.9	75%	0.2	--	0.6	--	--	--	0.6	0.2	0.4
Structures	5.2		3.9	--	1.3	--	--	--	1.3	0.5	0.8
Other Structures (Short Span Bridges, RCBC)	5.1	25%	3.8	--	1.3	--	--	--	1.3	0.5	0.8
RCP	0.0	10%	0.0	--	0.0	--	--	--	0.0	0.0	0.0
Civil Renewals	4.2		1.9	--	2.3	--	--	--	2.3	0.9	1.4
Formation	2.8	75%	0.7	--	2.1	--	--	--	2.1	0.8	1.3
Level Crossings	0.9	25%	0.7	--	0.2	--	--	--	0.2	0.1	0.1
Access Roads	0.2	0%	0.2	--	--	--	--	--	--	--	--
Corridor Security and Fencing	0.2	0%	0.2	--	--	--	--	--	--	--	--
Rail Lubrication	0.0	50%	0.0	--	0.0	--	--	--	0.0	0.0	0.0
Total Control Systems	3.7		3.4	--	0.3	--	--	--	0.3	0.1	0.2
Control Systems	2.4	0%	2.4	--	--	--	--	--	--	--	--
Interlocking Signalling	1.3	25%	1.0	--	0.3	--	--	--	0.3	0.1	0.2
TOTAL	22.5		10.4	0.4	11.7	3.7	1.4	2.3	8.0	3.1	4.9
NML Works (Turnout Design)	0.0				0.0						
TOTAL	22.5		10.4	0.4	11.7	3.7	1.4	2.3	8.0	3.1	4.9

Table 14: Comparison of capital and maintenance indicators under different approaches

Newlands / GAPE - FY23 Renewals Shared Rail Corridor (ex NML) (\$m)	TOTAL (\$m) [^]	Alternate Allocations Summary (\$m)			FY23 Renewals Budget (\$m)	
		Newlands Capital Indicator	GAPE Capital Indicator	GAPE Maintenance Indicator [~]	Newlands Capital Indicator	GAPE Capital Indicator
Total Civil Assets	18.8	11.4	5.1	2.3	16.5	2.2
Permanent Way Assets	5.1	2.2	2.2	0.7	3.9	1.2
Rail	1.2	0.4	0.1	0.7	0.0	1.2
Track Upgrade	3.3	1.5	1.8	--	3.3	--
Turnouts	0.6	0.3	0.3	--	0.5	0.0
Ballast Cleaning	4.3	2.1	0.6	1.6	3.3	1.0
Ballast Undercutting	3.1	1.5	0.2	1.4	2.3	0.7
Turnout Excavator Undercutting	0.4	0.2	0.1	0.2	0.1	0.3
Bridge Ballast	0.9	0.5	0.4	--	0.9	--
Structures	5.2	4.4	0.8	--	5.2	--
Other Structures (Short Span Bridges, RCBC)	5.1	4.3	0.8	--	5.1	--
RCP	0.0	0.0	0.0	--	0.0	--
Civil Renewals	4.2	2.8	1.4	--	4.2	--
Formation	2.8	1.5	1.3	--	2.8	--
Level Crossings	0.9	0.8	0.1	--	0.9	--
Access Roads	0.2	0.2	--	--	0.2	--
Corridor Security and Fencing	0.2	0.2	--	--	0.2	--
Rail Lubrication	0.0	0.0	0.0	--	0.0	--
Total Control Systems	3.7	3.5	0.2	--	3.7	--
Control Systems	2.4	2.4	--	--	2.4	--
Interlocking Signalling	1.3	1.1	0.2	--	1.3	--
TOTAL	22.5	14.9	5.3	2.3	20.2	2.2
NML Works (Turnout Design)	0.0	--	0.0	0	--	--
TOTAL	22.5	14.9	5.3	2.3	20.2	2.2

[^] Minor variances may exist due to rounding when compared to the FY23 MRSB proposal.

[~] This analysis considers renewal expenditure only. 'GAPE Maintenance Indicator' represents the value of renewal capital that would be expensed under Aurizon Network's proposed approach. Please note that this amount would be additional to any maintenance costs allocated to GAPE.

The reader will note that in comparison to the FY23 Renewals Budget, the alternate allocation methodology could result in the following outcomes:

- a reduction to the proposed Newlands Capital Indicator from \$20.2m to \$14.9m (\$5.4m or 26%);
- an increase to the proposed GAPE Capital Indicator from \$2.2m to \$5.3m (\$3.1m or 140%); and
- an increase to the proposed GAPE Maintenance Indicator of \$2.3m attributable to Rail Renewal and Ballast Undercutting expenditure.

3.2.2 Detailed Questions and Comments

The RIG provided feedback in relation to 22 items. Generally, this has resulted in additional information included in the FY23 Final Draft Proposal. A formal response to the RIG feedback has been provided to the Chair of the RIG which outlines these amendments and provides other clarifying information. Aurizon Network has reviewed draft responses with the RIG Representative group prior to finalising the FY23 Draft Proposal, and where applicable have included their feedback.

3.2.3 FY23 Commitments

Aurizon Network believes the process of including commitments in the MRSB provides clarity on the matters for engagement during the year for both the RIG and Aurizon Network. In addition, it is a tangible demonstration from Aurizon Network to provide greater transparency to customers and an opportunity for customers to provide influence, where it makes sense, on the material decisions Aurizon Network makes balancing cost, reliability and performance that impact the operation of the supply chain.

Aurizon Network is encouraged that the significant engagement during this year has resulted in no new commitments requested by the RIG as part of the feedback on the FY23 Draft Proposal. Aurizon Network appreciates the clarity that has been provided by members of the RIG representative group during the engagement this year that their objective is not to 'run the Network business' but to ensure Aurizon Network has relevant information from End Users to inform material decisions in relation to the development of the maintenance and renewal strategy and budget and facilitate its ultimate approval.

Aurizon Network makes the following commitments subject to the approval of the FY23 Final Draft Proposal.

- a) Engage with the RIG Producer Representative Group, through monthly meetings, on:
 - Corridor specific strategies relative to demand;
 - Multi-year asset replacement strategies and strategic scope;
 - Agreed reforms to procurement practices including on major contracts expiring over the coming three years;
 - Execution and refinement of the 'Change Escalation Framework' which commenced in November 2021;
 - Improvements to forecasting and reporting.
- b) Improve quarterly reporting, following the publication of monthly reports by the Independent Expert and where appropriate Include targets within reporting and detail of specific scope item delivery against plan.
- c) Present to the RIG for consideration ATIS business case in early in 2022.
- d) Continue to work with Newlands and GAPE users to resolve the capital allocation methodology during 2022 (whether by agreement or a QCA process).
- e) Work with the Ballast Working Group to better understand the condition of ballast, required scope, efficient delivery of ballast cleaning and supply chain mitigation options, including:
 - Engaging an external consultant to undertake the agreed scoping study
 - Presenting the results of the 2021 GPR analysis to the Ballast Working Group in Q3 FY22
 - Demonstrating the use of the Ballast Condition Analyser.
 - Progressing the processes referred to in section 3.1.3 to learn more about the prevailing ballast condition.
- f) If requested by the RIG, assess the incremental capacity benefits, and costs, of a Dual BCM approach, over the benefits achieved by the Optimised BCM Program.

Aurizon Network will engage with the RIG where these additional obligations are expected to require increased cost or investment or overlap with the Independent Expert's role to report on network performance and assess capacity impacts.

4. Key Improvement Initiatives

This chapter presents a summary of key improvement initiatives that Aurizon Network has implemented, or is in the process of implementing, in order to improve the way asset activity is identified and prioritised, to release capacity for greater throughput, or to enable more efficient cost outcomes and greater transparency through to end-users, all while maintaining our focus on our safety goal of protecting ourselves, each other and our communities.

Additional information for each of these initiatives is provided below and, where relevant, an allocation of the required implementation funding to each Coal System is outlined in the respective Coal System chapters. Aurizon Network recognises that continuous improvement is a journey, and that further opportunities to improve the performance of the supply chain and engagement with Customers will arise in coming years.

4.1 Safety

Safety incidents can have an unacceptable impact on the lives of employees, contractors, their families and the general public. On the CQCN, safety incidents can also materially impact the throughput and efficiency of the system. Aurizon's Safety Strategy and Aurizon Network's FY22 Safety Plan provide the organisation with a framework and set of priorities to improve our safety culture and performance generally, but also specifically in the context of infrastructure maintenance and renewals activity. Aurizon Network has recently launched several safety initiatives with a focus on our Critical Commitments; a set of clear personal commitments to help ensure focus on the highest risks and behaviours relevant to our business.

Aurizon Network has developed, several safety initiatives with a focus on effective and safe maintenance practices in the CQCN. These initiatives are key to Aurizon Network ensuring that the Maintenance Objectives are achieved, while maintaining our focus on our safety goal, and include:

- The implementation of 'Critical Commitments', a set of behavioural commitments for all employees and contractors, designed to bring attention to the actions people take to 'choose safe' in the work they do;
- The implementation of Critical Control Management, a set of processes and assurance activities designed to help mitigate the risk of a serious life-altering injury or fatality (**SIF**) arising from one of our ten 'Critical Risks' in Network;
- The implementation of our new Safety Health and Environment system, 'Beakon', which provides a user-friendly, easy to access, centralised system to record and manage our safety, health and environment reporting activities;
- Updates to our Aurizon Safety Assurance Framework, designed to streamline assurance activity and provide actionable insights on activities that can deliver material improvements to safety;
- Review and refinement of our Safety Standards, to ensure that the Standards are able to be well understood and consistently applied across Network;
- Improvements to the way we engage and manage contractors, intended to improve safe working practices and outcomes; and
- Continued rollout of training and development activities designed to uplift the safety capability of our front-line staff and leaders, such as our Responsible Worker and Leading for Safety courses.

4.2 Improved Access Planning and Scheduling

Aurizon Network has made significant progress across several initiatives including the successful delivery of APS (Advanced Planning and Scheduling) and Movement Planner.

With the implementation of these technologies, the trialling of an optimisation-based decision support tool (RACE), and an enhanced focus on quality control and governance in execution of the train schedule in day of operations, Aurizon Network is now capable of providing an industry leading fully integrated planning, scheduling and execution service offering to its customers.

Several focus areas to support this objective are:

4.2.1 Reduce the impact of network constraints on system throughput

Aurizon Network has matured its understanding, planning, and reporting of network availability. Through modelling and analytics, leveraging our new planning and scheduling technologies, Aurizon Network is implementing several initiatives to reduce the impact of network constraints on system throughput, for example:

- Embedding new measures and processes across access planning and maintenance planning teams to reduce the risk that cancelled paths constrain system throughput (regardless of the level of overall available paths). This includes setting minimum frequency rates of available paths and reducing the size of continuous clumps of cancelled paths to ensure trains can cycle at the rate at which unloaders can operate.
- Using what-if analysis to identify opportunities to alter planned network maintenance times once the demand signal is known (reducing the impact of outages in non-pathed areas of the network). Aurizon Network's integrated access planning & scheduling, maintenance planning, and Train Control teams uniquely position the business to act on these opportunities.

4.2.2 Optimise the weekly planning of train orders to maximise planned throughput and produce more stable and executable schedules

Aurizon Network is piloting an Integrated Rail Planning (IRP) approach to improve the weekly Intermediate Train Plan (ITP). This approach compliments the existing ITP process; allowing Aurizon Network to integrate multiple Operator plans into one deconflicted throughput optimised plan for scheduling.

In the 6-month period from May to November 2021, during the IRP pilot, Aurizon Network has delivered a 64% improvement in schedule compliance against the agreed ITP, and throughout the pilot observed improved weekly planned system throughput of between 2% and 4% across all systems, although the observed benefit is greater in periods of higher demand.

The IRP approach achieves these benefits by:

- Applying consistent and accurate interpretation of the impact of supply chain constraints across all Operators;
- Planning all Operator demand concurrently rather than in-series to optimise load point, pathing and unload point utilisation; and
- Aligning and improving planning assumptions used across operators, including section run times, load and unload times and operational preferences to support crewing requirements.

The IRP pilot is currently supporting analysis to improve throughput by:

- Investigating flexible rollingstock unit maintenance, which allows unit maintenance to be planned at a time that minimises the impact to system throughput; and
- Investigating opportunities to relax pathing constraints in single-line branches and instead dynamically applying headway separations to the plan.

4.3 Improving efficiency and data for decision making

Aurizon Network has commenced several initiatives aimed at improving the quality and availability of data and the efficiency of operations generally which underpins our continuous improvement program enabling data driven decision making. Aurizon Network will provide updates to the RIG on the progress of these initiatives and any potential impact on the maintenance and renewals strategy and forecasts, through the RIG Quarterly Reporting.

4.3.1 Automated Track Inspection System (ATIS)

The Automated Track Inspection System (ATIS) is a combination of autonomous measurement devices that provide frequent measurement of track, overhead line geometry and pantograph interface plus forward-facing track vision.

ATIS will provide Aurizon Network with increased understanding of track and overhead alignment, moving decisions of rail and overhead alignment management from qualitative decisions to quantitative data driven assessments.

Table 15 Elements of ATIS

Element	Description	Benefit/ Application of data
TGMS – Track Geometry Measurement System	Laser measurement device located underneath a loco. Measures rail alignment to determine track geometry	Quantified measurement of track alignment to determine assets outside of standard. Automatic assignment of track alignment defect severity. Increase of inspection rate from every 6 months to circa 7 to 10 days allowing for defect trending to effect condition based maintenance or renewal.
WGMS – Wire Geometry Measurement System	Ultrasonic detection of overhead wire alignment relative to the track	Quantified measurement of overhead wire alignment to determine assets outside of standard. Automatic assignment of wire alignment defect severity. Increase of inspection rate from every 6 months to 2 to 4 weeks allowing for defect trending to effect condition based maintenance or renewal.
PCDS – Pantograph Collision Detection System	Accelerometers fitted to the pantograph and incident capture camera to identify hard spots of pan / wire contact	Capture of acceleration data, satellite positioning and video of pantographs and wire contact hard spots. Measuring wire height and pantograph and train interface. Reduction in time to identify fault location and pan damage.
Track Vision	Live front of train vision capture and wire voltage draw.	Providing recent vision of corridor for desktop analysis to reduce need to access rail corridor and increase remote works planning.
Data Science	Development of algorithms to run against data feed provided by ATIS	The algorithms will provide trending analysis of faults trending them to determine renewal or maintenance intervention date. Will also allow for the automatic population of the required work as a Notification in the OneSAP system.

Figure 8 ATIS elements located on revenue train services



ATIS will also require the development of data science solutions to allow for the tracking and prediction of when identified faults will reach their renewal or maintenance requirement point. ATIS will allow Aurizon Network to manage track and wire alignment defects to deliver the required repair ahead of the faults becoming a service disrupting asset failure and reduce the number of TSR's associated with track alignment faults.

ATIS comprises a suite of measurement systems that replace and extend Network's rail corridor condition monitoring capability. ATIS will replace the Track Recording Car and save the related maintenance inspection costs as well as remove the dedicated vehicle from the network. During the trials, ATIS measurements have been compared with track geometry and overhead line equipment (OHLE) condition measurements from Queensland Rail's track recording vehicle (MMY038). Results are favourable. Evaluation and refinement will continue as the ATIS project transitions from trial to production and this will include the OTCI measurement. No change to the current OTCI framework is presently being considered. Aurizon is committed to providing continuity of asset condition trend reporting.

In addition, trending of defects and track vision will reduce the need to conduct in-person track inspections. A reduction in physical inspections reduces capacity lost to these on-track inspections and provides a safety improvement through reduction in the driving on roads to physically access the rail corridor.

A TGMS unit is in production in the Moura and Blackwater systems. The trial of the WGMS and PCDS are expected to finish by the end of Q2 FY22. Once these trials have been successfully completed, a business case for ATIS will be presented to the RIG in Q3 FY22 seeking endorsement to progress to the full deployment of ATIS across all systems. The capital expenditure and impacts to maintenance are expected to be a variation to the approved budget and strategy.

4.3.2 Ballast Condition Analyser (BCA)

Post the successful deployment for the Rail Condition Analyser, the data capture, analysis and application processes have been leveraged to develop the Ballast Condition Analyser.

The Ballast Condition Analyser takes in data from historical Ground Penetrating Radar (GPR) surveys that identify the severity of fouling in different track sections. In addition, it considers historical track faults, rainfall data, incident data, and manual fouling measurements to:

- Identify the condition of track sections with regards to ballast fouling: and
- Predicts the future fouling at these locations based on the historical data points.

This information will be used by the Civil Asset Management team to improve the determination of the ballast cleaning scope and future year scope requirements using a data driven decision tool. The Ballast Condition Analyser

will be demonstrated to the Ballast Working Group in Q3 and Q4 of FY22 to show the insights it is providing and to understand how possible mitigating approaches may influence the ballast cleaning scope in future years.

4.3.3 OneSAP

OneSAP (formerly known as NAMS) is the SAP based enterprise asset management system that is used in Aurizon Network to track work across the end to end assets process being, scope identification, works planning, works execution, closing and reporting.

The program was renamed OneSAP in FY22 to mark the change of focus from being a project delivering SAP functionality across teams to a focus on standardising the use of the systems to leverage the value of the data being captured and to increase the transparency of works delivered. OneSAP builds on the SAP modules and processes develop by the NAMS project.

OneSAP is designed to:

- Standardise the use of the system across all maintenance and renewal tasks to improve the transparency of scope and costs against individual assets;
- Include all maintenance and renewal scope in a centralised system improving planning and alignment of works in common locations; and
- Ensure clear visibility of completed tasks against plan via standardised reporting to improve transparency and insights to enable more effective asset management and investment decisions.



Blackwater System



5. Blackwater System

This chapter presents Aurizon Network's Draft Maintenance and Renewal Strategy and Budget for the Blackwater System for FY23. In line with 7A.11.3 of UT5, this section will be subject to vote by the relevant Blackwater End Users.

Aurizon Network's FY23 Final Draft Proposal for the Blackwater System provides for:

- **A Direct Maintenance Cost Allowance (excluding ballast undercutting plant depreciation) of \$64.8m**

This represents an increase of \$1.4m compared to Aurizon Network's current FY22 full year maintenance forecast and an increase of \$2.8m compared to the FY22 Approved Maintenance Strategy and Budget.

- **A Renewals Allowance of \$125.8m**

This represents an increase of \$12.1m compared to Aurizon Network's current FY22 full year renewals forecast and an increase of \$8.7m compared to the FY22 Approved Renewals Strategy and Budget.

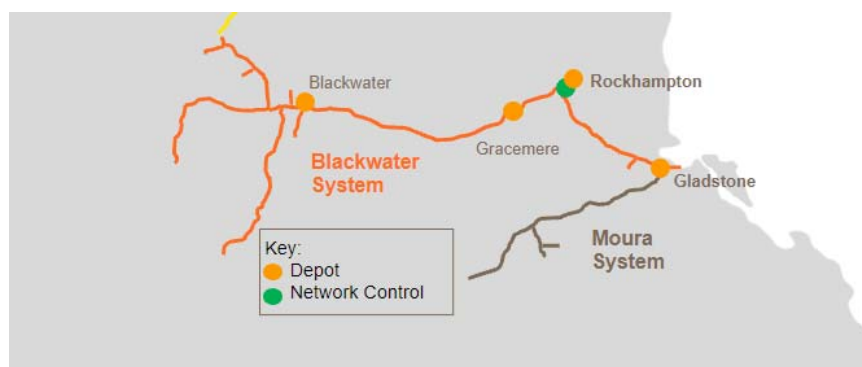
5.1 Blackwater System - Characteristics and Corridor Strategy

The Blackwater System is Aurizon Network's oldest Coal System and the largest by track length. It primarily serves coal mines in the central and southern Bowen Basin, carrying product through to export ports in Gladstone, as well as domestic electricity generation and industrial users. The Blackwater System includes approximately 1,137Km of electrified track.

Maintenance and renewal activities in the Blackwater System are primarily delivered from depots located in Gladstone, Gracemere, and Blackwater, with mobile mechanised plant based in Rockhampton.

Aurizon Network's depots are strategically located to enable incident response times across the Blackwater System within two and half hours. Mechanised plant (e.g., resurfacing) is typically able to respond to an urgent defect (e.g., a buckle or geometry defect) in the Blackwater System within 1 day.

Figure 9 Depot Locations – Blackwater and Moura System



Aurizon Network has considered asset conditions specific to this Coal System when developing the FY23 Final Draft Proposal, particularly in relation to:

- **Civil Assets** – the Blackwater System was not built as a dedicated heavy haul coal network but rather to facilitate steam-powered grain, cattle, general freight and passenger movements. Sections of formation and structures date back to the late 1800's. The rail alignment also traverses significant sections of low-lying floodplains and black soils which result in formation and track alignment issues manifesting in temporary speed restrictions during periods of alternating wet and very dry weather. Newer infrastructure constructed in the Blackwater System, including the Wiggins Island Rail Project (**WIRP**), facilitated a capacity uplift however did not address all older civil infrastructure. Despite the aged infrastructure, renewals are targeted based on

observable condition and degradation patterns. These considerations typically result in higher track resurfacing and formation renewal activity than the other three Coal Systems.

- **Control Systems Assets** – the completion of WIRP and the Blackwater Duplications in the early 2010's resulted in a significant upgrade of the telecommunications, wayside and train protection systems. However, there are aged Control Systems assets remaining, especially on the North Coast Line and west of Tunnel. In particular, the interlockings in Callemondah yard were installed in the 1970's and train detection track circuits were installed in the 1980's. These assets are nearing end of life.
- **Electrical Assets** – the Electrical assets were largely installed during the mid-1980's Main Line Electrification Project and, while four new feeder stations were installed in 2012, a significant proportion of the assets are approaching the end of their 30–40 year design life. Aurizon Network is considering options for the future renewal of Electrical assets in the Blackwater System.
- **Infrastructure West of Burngrove** – during FY22, Aurizon Network notes that coal carrying services ceased operating west of Burngrove due to the cessation of mining activities and the expiration of Access Rights using that infrastructure. It is not expected that during FY23 any coal carrying services will utilise that infrastructure, therefore Aurizon Network has excluded any maintenance or renewal costs for that infrastructure within this FY23 MRSB. Prior to the cessation of coal carrying services \$2.7M of asset renewals had been identified west of Burngrove, these have not been carried forward in this FY23 MRSB process. The FY23 Maintenance budget of the Burngrove west infrastructure was also reduced in line with actual costs incurred in FY21.

Corridor Strategy:

- The Blackwater System is a mix of aged assets and newer assets installed in the more recent WIRP, Blackwater Duplications and Blackwater Electrification projects.
- The asset management strategy for the Blackwater System is to maintain and renew assets to hold the condition of the assets steady. As a result, the level of asset availability is expected to be consistent with prior years.
- Variable soil types and age of formation result in a higher track resurfacing and formation renewal activity than the other three coal systems.
- There is a population of aged Control Systems assets including signal relay based interlockings installed in the 1970's and train detection track circuits installed in the 1980's that are at or near end of life.
- Callemondah yard (Gladstone) layout and signalling & electrical arrangements result in renewal and maintenance activities being difficult to isolate to yard sections to maintain yard throughput. Currently if maintenance or renewal works are required, large parts of the yard require to be taken out of service reducing yard throughput.
- Maintenance activity is focused on minimising the capacity effect of unplanned outages due to infrastructure failures and the removal of Temporary Speed Restrictions.
- Asset Renewals seek to renew or replace aged assets ahead of unplanned failure or obsolescence.

5.2 Blackwater System - Integrated Closure Plan

Aurizon Network has engaged with the RIG and other stakeholders to better understand their requirements and has taken the following into consideration when developing the FY23 Final Draft Proposal, Integrated Closure Plan:

Specific Blackwater Supply Chain considerations include:

- **Port operating mode and mine stockpile capacity:**
 - RG Tanna and Wiggins Island Coal Export Terminal (**WICET**) are stockpile ports and a number of producers have limited mine site stockpile capacity.
 - Some domestic terminals have limited stockpile capacity including emergency stocks.
 - Longer closures requiring increased planning and communication to ensure mine site stockpile constraints are considered.
 - Closure lengths limited to 60 hours (where possible) to minimise the likelihood that mines become “stock bound” and domestic terminals become “starved”. The length of each closure ultimately depends on the critical path scope to be completed and from time to time, require greater than 60 hours for scope delivery.
- **Queensland Rail North Coast Line (QR NCL) interface:**
 - Alignment with QR NCL outages wherever reasonably possible and to minimise the impact to passenger and freight services.
 - Scheduling Blackwater integrated closures on Mondays; a natural gap for North Coast Line traffic (i.e., non-coal traffic, including bulk, freight, passenger and livestock).
- **Closure timing:**
 - Avoid peak demand periods and closure conflicts with adjacent corridors.
 - Integrated system closures being planned in 6-weekly intervals.
 - December and June are avoided to provide the opportunity to maximise railings for the end of calendar and financial year respectively.

Table 16 below outlines the proposed Blackwater System integrated closure hours for FY23, including integrated system and branch line closures.

Table 16 Planned integrated closures including branch line – Blackwater System

FY23 Integrated System Closures													
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Location	CWL & NCL	CWL & NCL		CWL	CWL		CWL	CWL & NCL		CWL & NCL	CWL & NCL		
Hours	54	72	0	54	72	0	36	48	0	96	36	0	468
FY23 Integrated Branch Line Closures													
Location	Gregory												
Hours	0	0	0	36	0	0	0	0	0	0	0	0	36

This proposal provides an increase to integrated system closures of 96 hours compared to the FY22 Approved Strategy and Budget, which is driven by critical scope items requiring greater than 60 hours. With multiple closures exceeding the preferred maximum duration of 60 hours, Aurizon Network reviewed various access options to execute this scope and determined the closure design to be the most efficient & reliable for supply chain benefits. The extended durations also provide an opportunity for the BCM to achieve optimal production rates and maximise scope delivery within integrated closures.

In addition to the integrated system and branch line closures (outlined in Table 16), single line maintenance activities will be planned during the year (as required by the asset) and will have regard to seeking to deliver Committed

Capacity, and that outages are coordinated with other Supply Chain Participants, wherever reasonably possible with a view to maximising throughput.

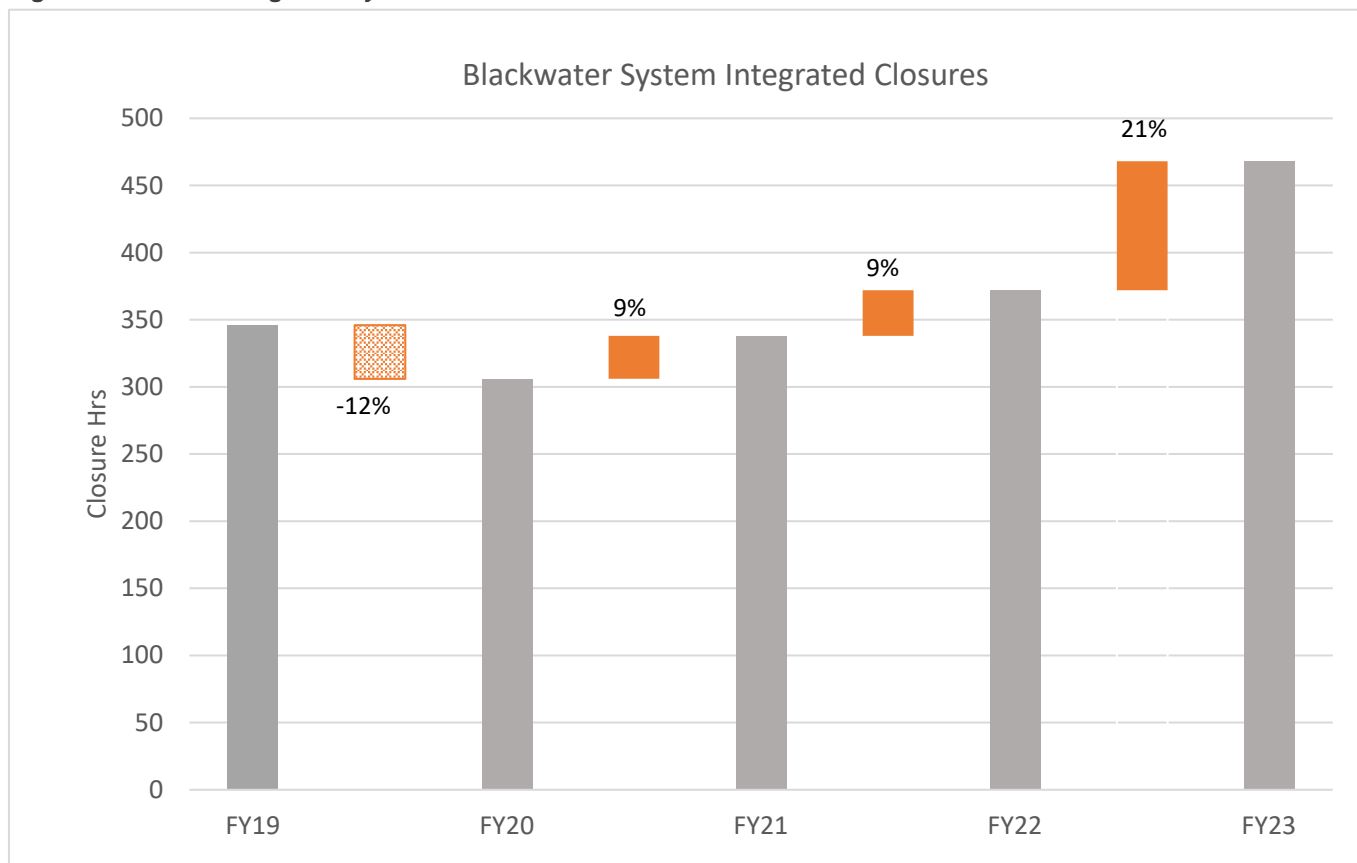
The following asset activities have determined the duration of the planned integrated closures and access requirements in the Blackwater System during FY23.

Table 17 Critical Scope in the Blackwater System

Planned Delivery (hrs)	Asset Activity	Location
96	Culvert Renewal	Tryphinia
96	Turnout Renewal	Callemondah 250 and 251
168	Ballast Renewal	Rangal to Tikardi (0.050 – 4.958Km)
72	Formation Repair – 900m	Epala to Raglan (577.3 – 578.2Km)
72	Bridge Rollout 165m	Crew to Makenzie (19.820 – 19.985Km)

Figure 10 below illustrates the historical Blackwater integrated system closure hours in comparison to the FY23 Final Draft Proposal.

Figure 10 Trend of Integrated System Closure Hours from FY19 to FY23 - Blackwater



5.3 Blackwater System - FY23 Maintenance Strategy and Budget

Aurizon Network has developed its Draft Maintenance Strategy and Budget for the Blackwater System having regard to all relevant matters outlined in clause 7A.11 of UT5, including the Maintenance Objectives. Aurizon Network considers its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of the Blackwater System rail Infrastructure and seeking to deliver Committed Capacity.

5.3.1 Summary of Historic, Forecast & FY23 Maintenance Strategy & Budget

Aurizon Network’s FY23 Final Draft Maintenance Strategy and Budget for the Blackwater System provides for a Direct Maintenance Cost Allowance of \$64.8m (excluding ballast undercutting plant depreciation) which is:

- \$2.8m higher than the FY22 Approved Maintenance Strategy and Budget; and
- \$1.4m higher than Aurizon Network’s current FY22 full-year forecast.

Figure 11 below provides a summary of historic direct maintenance costs as well as the proposed direct maintenance cost allowance in respect of FY23. To ensure comparability with prior periods, the direct maintenance costs shown in the chart below exclude depreciation on ballast plant.

Figure 11 Blackwater System Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

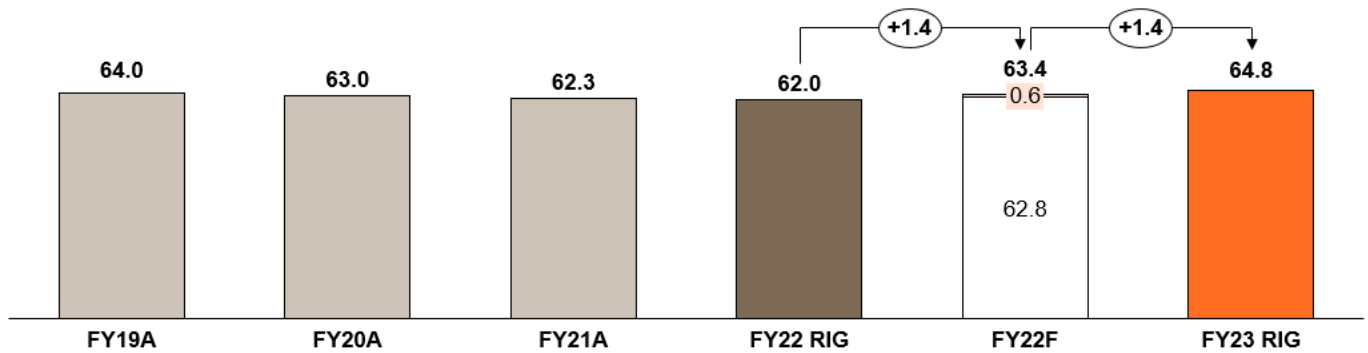
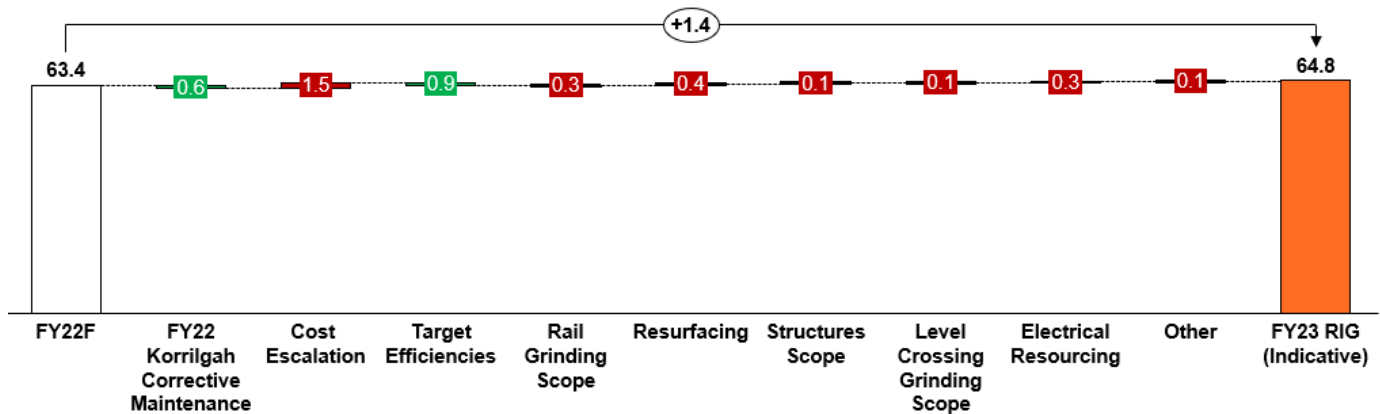


Figure 12 Blackwater System Direct Maintenance Cost Movement (excluding ballast undercutting plant depreciation)



As noted in the Quarterly Report for Q1 FY22, the current forecast for FY22 direct maintenance costs (excluding ballast undercutting plant depreciation) is \$63.4m (at 30 September 2021). The increase in forecast spend against the FY22 Approved Maintenance Strategy and Budget is primarily driven by additional corrective maintenance costs in the Koorilgah Loop. Additional costs are also expected because of the change in rostering practices at Gracemere, which have helped to improve useable pathing availability and flow of services. Costs associated with these matters were not known at the time of drafting the FY22 Approved Strategy and Budget.

An overspend is also forecast in Structures and Facilities maintenance (\$0.3m) to manage culvert and drainage assets that are deteriorating more rapidly than anticipated.

The revised forecast takes account of actual conditions and run rate costs from FY21 and Q1 FY22. None of the individual product variances is greater than the indicative materiality thresholds set in UT5. The FY22 forecast is subject to review and will be updated at the end of Q2 FY22.

An overview of the methodology used to establish the FY23 maintenance cost budget is provided in Chapter 14. The below section provides a summary of the maintenance scope and budget proposed for the Blackwater System in FY23 for each maintenance item.

5.3.2 FY23 Maintenance Strategy and Budget

As detailed in Chapter 10.1, Aurizon Network’s Asset Management approach is based on achieving the appropriate level of asset availability at the most efficient cost of ownership, through the entire asset life cycle, which will best meet customer requirements in each Coal System.

Aurizon Network’s Asset Maintenance and Renewal Policy is to maintain the condition and availability of the network consistent with previous performance. The scope and closure requirements in different systems is influenced by demand, track arrangement, operating parameters, traction mode and signalling and communications systems.

The Blackwater System contains a mix of aged and newer assets, which results in a varying asset condition given age and use. Aurizon Network’s reliability centred maintenance approach for the Blackwater System seeks to hold the asset condition steady, minimise unplanned outages due to infrastructure failures and appropriately manage the requirement for Temporary Speed Restrictions.

Blackwater is the largest system by length and the second largest by volume and oldest of the 4 coal systems. The high tonnages, long haul lengths and age of some assets, particularly formation, result in a maintenance and renewals mix very similar to the Goonyella system that has the highest intensity of train movements. The mix of maintenance to renewal cost for Blackwater can be seen in Table 18 below:

Table 18 FY23 Proposal – Blackwater System Maintenance & Capital spend % split

System	FY23 Renewals and Maintenance Cost (\$m)	% Maintenance	% Capital
Newlands	\$35.4	36%	64%
Goonyella	\$182.6	33%	67%
Blackwater	\$190.6	34%	66%
Moura	\$28.6	45%	55%

The planned and preventative maintenance activities and inspections, as well as the planned mechanised production scope, are derived in line with the intervention periods as detailed in Aurizon Network’s Asset Maintenance & Renewal Policy. This policy determines the inspection regime and period based on asset type condition and location.

The proposed FY23 maintenance scope and budget for the Blackwater System is outlined in the table below. Please note that the totals presented in the tables below may not add due to rounding.

Table 19 FY23 Proposal – Blackwater System Maintenance

Maintenance Item	Scope Units	FY22F Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
Resurfacing			8.7		9.2
- Mainline	Km	896	6.9	896	7.3
- Turnout	Site	173	1.8	173	1.9
Rail Grinding			8.0		8.6

Maintenance Item	Scope Units	FY22F Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
- Mainline	Km	█	6.0	█	6.6
- Turnout	Site	█	2.0	█	2.0
- Level Crossings	Track LX		-	█	0.1
General Track Maintenance			23.1		22.6
- General Track	Activity		21.1		20.9
- Track Recording	Km	2,588	1.2	2,588	1.1
- Ultrasonic Testing Car	Km	5,483	0.8	5,344	0.5
Signalling and Telecoms			9.9		10.2
- Signalling Corrective	Activity		1.9		2.6
- Signalling Preventative	Inspection		5.1		5.3
- Telecoms Corrective	Activity		0.4		0.4
- Telecoms Preventative	Inspection		2.5		1.9
Electrical			6.1		6.1
- OHLE Corrective	Activity		1.6		2.0
- OHLE Preventative	Inspection		3.1		2.7
- Traction Substation Corrective	Activity		0.3		0.5
- Traction Substation Preventative	Inspection		1.0		0.9
Structures and Facilities			2.2		2.3
Trackside Systems			0.8		0.8
Other Civil Maintenance			2.4		2.4
Other General Maintenance			2.3		2.5
- Asset Management & Inventory			1.3		1.3
- On Call			1.0		1.0
- RM900 Storage & Maintenance			-		0.1
Sub-Total			63.4		64.8
Ballast Undercutting Plant Depreciation			2.7		3.3
Total Direct Maintenance Costs			66.1		68.0
Non-Coal Allocation			(1.3)		(1.3)
Total			64.8		66.8

For the Blackwater System:

- **Direct Maintenance Costs** (excluding ballast undercutting plant depreciation) are budgeted to increase by **\$1.4m** from the current FY22 forecast to **\$64.8m** in FY23. The movement in cost between periods reflects the net impact of cost escalation and scope changes (**+\$2.9m**) partially offset by non-recurrence

of corrective costs incurred in FY22 (**-\$0.6m**) and estimated target efficiencies (**-\$0.9m**). Key movements are summarised below.

- **Resurfacing (+\$0.5m)** – increase primarily reflects the requirement for cyclic maintenance on resurfacing plant as well as annual escalation. Resurfacing plant has varying annual maintenance cycles such that costs of maintaining the equipment will vary year on year for the life of the plant.
- **Rail Grinding (+\$0.6m)** – increase primarily reflects an increase in mainline scope partially offset by a reduction in turnout grinding scope. The draft budget also includes an allowance for the introduction of a preventative level crossing rail grinding program.
- **General Track Maintenance (-\$0.5m)** – this category represents approximately one third of overall maintenance costs in the Blackwater System. Costs are expected to reduce by \$0.6m given the non-recurrence of corrective maintenance costs on the Koorilgah Loop.
- **Ultrasonic Testing Car (-\$0.3m)** - Reduction in costs from FY22 to FY23 is due to internal labour from chase inspections being directed to Track Inspections to align with product definitions. The Ultrasonic Testing Car costs are now contractor costs only. Variance in scope compared to FY22 is due to the cessation of coal services running west of Burngrove.

Since FY21, Aurizon Network has made improvements to better align the requirement for ultrasonic testing (every 10MGT) with actual traffic movement rather than assumptions of traffic flow across the railway. Resetting intervals on (primarily) unloaded track has resulted in a reduced annual program. In addition, the ultrasonic test car is able to test up to 120km per day (dependent on sectional length and access planning), 75% more than in FY18. This is by enhancing the ultrasonic test car to be able carry more water for testing. Where the shift block durations (number of consecutive testing days) have been less than optimal to align with train access priorities, the shift count compared to a stable scope requirement will result in variations in costs from year to year.

- **Signalling & Telecoms (+\$0.3m)** – this category represents around 15% of overall costs in the Blackwater system. This increase primarily reflects annual cost escalation as well as the cost of additional trainee apprentice resources.
- **Structures and Facilities Maintenance (+\$0.1m)** – increase is primarily driven by drainage maintenance defects (mainly concrete repairs \$0.4m) that are planned to be rectified in FY23. The higher concrete repair costs are partially offset by lower culvert cleaning costs (\$0.1m) and lower cyclical structures inspection costs (\$0.2m).
- **Other General Maintenance (+\$0.1m)** – this increase reflects annual cost escalation as well as an allowance for storage and maintenance costs relating to the BCM.
- **Ballast Undercutting Plant Depreciation (+\$0.6m)** – ballast undercutting plant depreciation is forecast to increase primarily due to an increase in the number of days that the ballast plant is expected to be operating in the Blackwater system in FY23.
- **Non-Coal Allocation** – this adjustment reflects an allocation of costs to non-coal services and is calculated by applying an estimate of the non-coal proportion of total system GTKs to total system maintenance costs (excluding Electrical spend and ballast undercutting plant depreciation).

In aggregate, these changes result in an increase in direct maintenance costs of **\$2.0m** from **\$64.8m** in FY22F to **\$66.8m** in FY23.

- The scope of planned corrective and reactive maintenance tasks is heavily dependent on the faults identified via the planned inspection programs. Consequently, scope for these activities cannot be defined. Aurizon Network has assumed that in FY23, this Coal System will see a similar level of faults that require planned corrective or immediate maintenance response as in prior years.
- For the Blackwater System, the following activities will be considered “items” for the purpose of UT5, clause 7A.11.5(f)(ii)(B)(2) - Resurfacing, Rail Grinding, General Track Maintenance, ‘Signalling and Telecoms’ and

Electrical. The remaining activities, including 'Structures and Facilities', Trackside Systems, Other Civil Maintenance and Other General Maintenance are to be considered as an aggregated single item.

Set out in the chart below is a summary of historic, forecast, and budgeted direct maintenance costs by maintenance category. To ensure comparability between periods, the direct maintenance costs presented in the chart exclude depreciation on ballast undercutting plant.

Figure 13 Blackwater System - Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

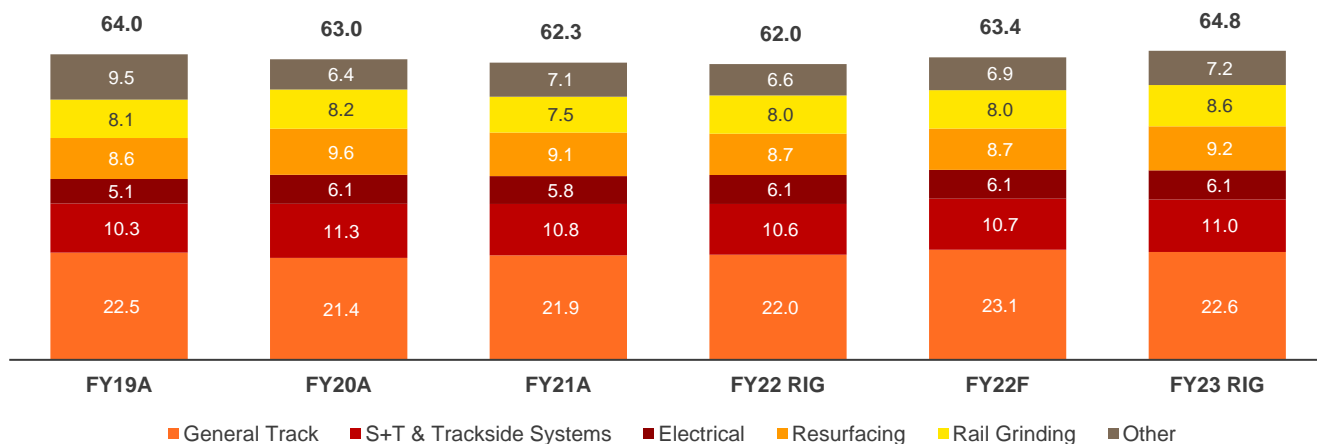
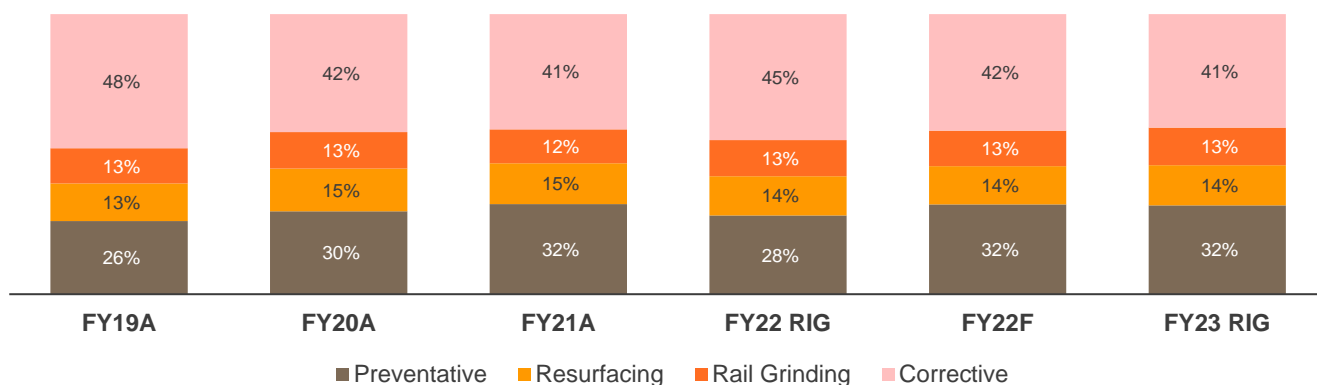


Figure 14 illustrates the proportion of preventative and corrective maintenance expenses in the Blackwater System over time. The cost of both Rail Grinding and Resurfacing maintenance activities have been categorised as preventative in nature. Approximately 60% of the Blackwater System maintenance spend in FY23 is expected to be preventative in nature, which is higher relative to the smaller systems and comparative to the Goonyella system. It reflects the asset management approach and operational performance.

Figure 14 Blackwater System – Preventative / Corrective Maintenance Spend Composition



Further information in relation to the costing methodology used by Aurizon Network in the development of the FY23 Final Draft Proposal is outlined in Chapter 14. Additional detail in relation to the make-up of costs for each maintenance activity has also been provided to the RIG Expert Advisor.

5.3.3 Alternative maintenance options considered

Aurizon Network notes that there are a number of options available as to how and when asset renewal and maintenance is performed. When implemented, each option may have an associated flow on impact to other Supply Chain Participants. Aurizon Network’s access planning process endeavours to optimise impacts through appropriate access planning. Aurizon Network welcomes further discussions to explore alternative options.

As detailed in Chapter 12.2, Aurizon Network applies several different approaches with regards to maintaining the Rail Infrastructure. These approaches lead to the application of the maintenance task across the system. A summary of alternate considerations is detailed in Table 20 below. Aurizon Network welcomes the opportunity to work with Customers and other Supply Chain Participants to further explore alternate maintenance approaches.

Table 20 Maintenance Considerations

Activity	Description	Alternative maintenance option
Mainline & Turnout Resurfacing	<p>Track settlement occurs in heavy haul railway conditions, presenting as track geometry defects that can result in derailments if not maintained effectively. Track resurfacing is an essential maintenance activity in railways to maintain safe track geometry for rolling stock. Track geometry defects can be symptomatic of an underlying defect, which is creating excessive or rapid track settlement.</p> <p>Multiple resurfacing interventions to maintain safety is a key consideration when determining whether ballast cleaning and formation renewal work is required. Resurfacing activities are currently delivered in a way that provides operational flexibility with these activities currently scheduled after customer train orders. Planned works are delivered in the shadow of other maintenance activities and/or where customer demand permits. Resurfacing scope is both preventative and corrective based on the method of identification.</p>	<ol style="list-style-type: none"> Higher Production / Lower Cost / High Short-term Access Impact Option, provides: <ul style="list-style-type: none"> Larger blocks of uninterrupted access planned before trains are pathed Focuses on plant productivity and cost minimisation Negatively impacts access providing less flexibility to schedule between train services Potential to increased response time to TSR's due to a longer planning horizon Maintenance targets more easily achieved Lower Production / Higher Cost / Low Short-term Access Impact Option, provides: <ul style="list-style-type: none"> Smaller blocks of access planned between trains Focus on capacity Able to take advantage of periods of low demand (or advantageous access due to incidents) to increase production Harder to meet maintenance targets Closures utilised to target TSR's <p>Aurizon Network currently utilises option 2 in the Blackwater system as it delivers the most appropriate outcomes for the supply chain.</p>
Grinding	<p>Rail grinding is a critical maintenance activity to reduce rail breaks and extend the life of rail.</p> <p>The rail grinding approach through the CQCN seeks to control surface initiated rail defects under a preventative regime. Intervention thresholds are based on throughput tonnage which are translated into a time-based frequency to allow long term planning. These frequencies are dictated by the 'tightness' of the curve as rail defects are directly correlated to the dynamic curving forces of trains.</p> <p>Rail grinding is also undertaken in a reactive way to remedy identified rail defects which are initiated from high traction locomotives or other unpredictable mechanisms.</p>	<ol style="list-style-type: none"> Preventative grinding strategy with a small amount of corrective allowance Corrective rail grinding strategy - A corrective rail grinding strategy would involve allowing rail surface defects to propagate to a severe condition, before reactively programming the rail grinder to perform deep rail grinding to remove the severe defect. This approach would reduce the planned rail grinding scope, however, significantly increases the risk that surface defects grow into the rail causing rail breaks and leading to disruption in the network for unplanned maintenance. Corrective rail grinding also reduces the rail asset life as more rail is removed during rail grinding to remove surface defects and cracks. Corrective rail grinding strategies are adopted in other rail networks that are lower throughput with plenty of

Activity	Description	Alternative maintenance option
General Track	<p>The current inspection approach for General Track is a mix of the Track Recording Car, Ultrasonic Test Car, High Rail Vehicle inspections, walking inspections and non-destructive hand testing as detailed in the Asset Maintenance & Renewal Policy.</p>	<p>maintenance windows or where the demand is seasonal.</p> <p>Aurizon Network currently utilises option 1 in the Blackwater system to ensure high availability and reliability of the rail asset.</p> <hr/> <p>1. Reduce Inspection Frequencies - Reduce inspection frequencies and revert to additional fix on fail methodology would require consultation and approval from the Rail Safety Regulator.</p> <p>This option is not recommended and would likely lead to an increase in unplanned delays and increased cost to rectify in an unplanned manner.</p> <p>2. Operational Intervention -To reduce the impact of high priority defects, Aurizon Network can apply temporary restrictions to manage risks e.g., Temporary Authorised Non-Conformance, Temporary Speed Restrictions, Axle Load Restrictions or rerouting loaded and empty trains. These interventions can be localised to the defect to keep the rail line open whilst working with the above rail operators to find a least impact time to rectify the defect. Whilst this keeps the rail line open, this will potentially impact operational performance and could result in unplanned closures if the defect changes.</p> <p>Aurizon Network currently utilises option 2 in the Blackwater system as it delivers the most appropriate outcomes for the supply chain.</p> <p>Aurizon Network is currently trialling ATIS, an alternative option to the Track Recording Car outlined in Chapter 3.3. The results of this trial and possible effect on the frequency of general track inspections will be discussed with the RIG in due course.</p> <hr/>
Control Systems	<p>Maintenance is based on defined time-based inspections of equipment items (e.g., points, level crossings) and of equipment enclosures and power supplies.</p> <p>The frequency of inspection varies between equipment types and is based on failure modes and criticality.</p> <p>Frequency and tasks are reviewed annually for effectiveness based on observed asset condition, fault performance, and impact on rail services.</p>	<p>1. Maintain only on failure – not recommended and would likely lead to an acceleration of faults which will reduce the reliability of the systems which in turn reduces the capacity of the railway.</p> <p>2. Planned frequency (current approach) - recommended. The current planned frequencies are reviewed on an annual basis to align the required inspections to the condition of the assets. Frequencies and activities are adjusted where it is believed that the in-service performance will be materially improved. Any change to the inspection frequencies requires consultation and approval from the Rail Safety Regulator.</p> <p>3. Increased inspection frequency and/or accelerated replacement and refurbishment to reduce the likelihood of service affecting failures – not recommended outside of the annual review of planned frequencies and would increase the cost of Control Systems maintenance.</p> <hr/>
OHLE and Power Systems	<p>The Electrical Safety Act in Queensland requires that a Prescribed Entity, such as Aurizon Network, ensures that the asset is operated in a way that is electrically safe. This includes managing the high voltage electrical</p>	<p>1. Maintain only on failure – not recommended: expect to see an acceleration of faults as asset condition drifts from an acceptable performance level. Move to a fix on fail approach would lead to more component failures and dewirements, potentially resulting in a</p>

Activity	Description	Alternative maintenance option
	<p>assets through effective maintenance and renewals activities.</p> <p>Maintenance is predominantly based on defined time-based inspections of equipment items (e.g., overhead lines, transformers, isolators, etc).</p> <p>The frequency of inspection varies between equipment types and is based on failure modes and criticality.</p> <p>Frequency and tasks are reviewed for effectiveness based on observed asset condition, fault performance, and impact on rail services.</p> <p>The maintenance frequency is defined in the Asset Maintenance and Renewal Policy, and forms part of the RIM accreditation.</p>	<p>notification of a dangerous electrical event to the Electrical Safety Regulator.</p> <p>2. Planned frequency (current approach) - recommended. The current planned frequencies are reviewed on an annual basis to align the required inspections to the condition of the assets. Frequencies and activities are adjusted where it is believed that the in-service performance, including safety outcomes, will be materially improved. Any change to the inspection frequencies requires consultation and approval from the Rail Safety Regulator.</p> <p>3. Increased inspection frequency and/or accelerated replacement and refurbishment to reduce the incidence of service affecting failures: not recommended outside the annual maintenance process review and would increase the cost of power systems maintenance.</p>

5.4 Blackwater System - FY23 Renewals Strategy and Budget

Aurizon Network has developed its Draft Renewals Strategy and Budget for the Blackwater System having regard to all relevant matters outlined in clause 7A.11 of UT5. Aurizon Network considers its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of Blackwater System rail infrastructure and seeking to deliver Committed Capacity.

5.4.1 Supply Chain Benefits of the Renewal Program

In addition to an optimised cost outcome, Aurizon Network's renewal program for the Blackwater System seeks to provide the following benefits for the supply chain.

Table 21 Supply Chain Benefits of the Renewal Program

Renewal Activity	Benefit Type	Description
Permanent Way	Asset reliability	Reduce network delays associated with unplanned asset activity. Asset components such as rail, sleepers and turnouts have a low likelihood of failure in a new state and require minimal maintenance once renewed.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition.
Ballast Cleaning	Asset reliability	Reduce network delays due to asset failure associated with track geometry defects and mudholes linked to poor ballast condition due to coal fouling.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses. Proactive ballast condition management mitigates TSR's caused by poor ballast condition.

Renewal Activity	Benefit Type	Description
	Safety	Improve the wet weather resilience of track (reduced unplanned defects which need to be responded to in a reactive manner). Reduces train derailment risk by managing asset condition.
Civil Assets	Asset reliability	Reduce network delays associated with asset failure and lifting renewed sections to the current required tonnages.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce train derailment risk by managing asset condition. Removal of redundant assets reduces the risk of rail staff accessing the rail corridor and members of the public accessing no longer required live crossings.
Transmission and Data Networks	Asset reliability	Given these assets do not wear but rather age to a point where they are no longer supported renewal ahead of failure is required to retain the assets' reliability.
	Throughput	Renewal and system improvements to best move trains through the system in an efficient and safe way.
	Safety	Ensuring the critical signalling and train control systems are robust and effective in the separation of trains. Providing clear communications functionality across the CQCN systems.
Electrical Assets	Asset reliability	These are typically long-run assets which will eventually fail due to age-related defects and/or environmental factors. Renewal decisions are typically made based on failure risk or safety.
	Throughput	Traction power systems have built-in redundancy and typically allow normal throughput to continue in the event of an outage of one major piece of plant. By contrast, a single dewirement on the overhead line system will impact both electric and diesel services.
	Safety	Many of the High Voltage traction assets have inherent safety functions (e.g., protection and earthing systems). As a "Prescribed Electricity Entity" under the Electrical Safety Act 2002, Aurizon Network has clearly defined obligations to maintain an electrically safe system. This includes a mandatory annual Safety Management System audit by a qualified external auditor to review safety systems and infrastructure integrity.

5.4.2 Summary of FY23 Renewals Strategy and Budget

Aurizon Network's FY23 Final Draft Maintenance Renewals Strategy & Budget for the Blackwater system provides for a Capital Renewals requirement of \$125.8m which is:

- \$8.7m higher than the FY22 approved Renewals Strategy & Budget; and
- \$12.1m higher than Aurizon Network's current FY22 full year forecast

A summary of the FY23 renewals budget for the Blackwater System is outlined in Table 22. Please note that the totals presented in the tables may not add due to rounding.

Table 22 FY23 Proposal – Blackwater System Renewals

Renewals Item (\$m)	Assets Include:	FY22 Approved Budget	FY22 Full Year Forecast	FY23 Draft Budget
Civil Assets		87.5	80.1	98.5
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	30.5	25.7	31.0
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	38.8	34.1	41.0
Structures	<i>Culverts, Bridges</i>	9.5	12.8	12.0
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	8.7	7.5	14.4
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>	20.3	27.1	21.8
Electrical Assets	<i>Overhead Line Equipment and Power Systems</i>	6.0	5.3	5.6
Technology Projects		3.3	1.2	--
Total		117.1	113.7	125.8

The FY22 full year forecast variance to the FY22 Approved Strategy and Budget is primarily driven by the deferral of planned FY22 scope. This being a turnout site at Bajool and two track upgrade sites at Edungalba. These scope items are now planned for and included in the FY23 Final Draft Proposal for Blackwater.

The detail of this deferral and all variances in FY22 will be detailed as part of the Quarterly RIG reporting process.

Table 23 FY23 Proposal – Blackwater System Renewals as a % of Total System Assets

Renewals Item	Assets Include:	Total system Assets	FY22 RIG Approved Scope	FY23 Proposed Scope	FY23 scope % Total System Assets
Civil Assets					
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	<ul style="list-style-type: none"> • 2,352Km rail • 1,176Km sleepers • 1,176Km track • 431 turnouts 	<ul style="list-style-type: none"> • 24.2Km rail • 5.8Km sleepers • 6.5Km track upgrade • 4 turnouts 	<ul style="list-style-type: none"> • 24.1Km rail • 5.2Km sleepers • 8.8Km track upgrade • 4 turnouts 	<ul style="list-style-type: none"> • 1.0% • 0.4% • 0.7% • 0.9%
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	<ul style="list-style-type: none"> • 1,176Km Mainline • 431 Turnouts • 140 bridges 	<ul style="list-style-type: none"> • 66.5Km Mainline • 17 Turnouts • 7 bridges 	<ul style="list-style-type: none"> • 73.6Km Mainline • 20 Turnouts • 5 bridges 	<ul style="list-style-type: none"> • 6.0% • 4.3% • 3.3%
Structures	<i>Culverts, Bridges</i>	<ul style="list-style-type: none"> • 140 bridges • 1,335 culverts 	<ul style="list-style-type: none"> • 0 bridges • 20 culverts 	<ul style="list-style-type: none"> • 1 bridge • 19 culverts 	<ul style="list-style-type: none"> • 1.3% • 0.7%
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	<ul style="list-style-type: none"> • 1,176Km formation • 257 level crossings 	<ul style="list-style-type: none"> • 1.7Km formation • 2 level crossings 	<ul style="list-style-type: none"> • 2.8Km formation • 4 level crossings 	<ul style="list-style-type: none"> • 0.2% • 1.3%
Control Systems Assets	<i>Safe Working, Train Control and Detection,</i>		<ul style="list-style-type: none"> • 44 Sites • 39.6Km Optic Fibre 	<ul style="list-style-type: none"> • 47 Sites • 48.3Km Optic Fibre 	

Renewals Item	Assets Include:	Total system Assets	FY22 RIG Approved Scope	FY23 Proposed Scope	FY23 scope % Total System Assets
	<i>Interlocking, Telecoms, Power Resilience, Transmission</i>				
Electrical Assets	<i>Overhead Line Equipment, Feeder Stations, Autotransformers, SCADA system</i>		<ul style="list-style-type: none"> • 3 sites • 51 Units 	<ul style="list-style-type: none"> • 18 Sites • 31 Units 	

Note:

- Control Systems count of assets is a collective of sites, nodes, cable routes, communications assets and systems and is included to indicate level of work comparable to prior year. Detail of actual scope is provided later in this section.
- Electrical count of assets is a collective of sites, earthing and bonding, current detection, transformer renewal, protection relay replacement etc. Detail of actual scope is provided later in this section.

5.4.3 Details of the FY23 Renewals Strategy and Budget for the Blackwater System

This section provides detailed information in relation to the individual scope items selected for renewal in FY23, along with the rationale for those selections and alternative options considered.

Aurizon Network notes that the prioritisation of renewals scope is based on currently available information and that this prioritisation may change over the period prior to execution (of up to 18 months) as a result of environmental factors, relative degradation rates or other considerations. Changes to the proposed scope will be dealt with through the reporting and change management processes as appropriate.

In the preparation of the FY23 proposal, Aurizon Network conducted a likelihood of change review to determine scope that may incur project change to either cost or delivery, time to complete or location change. Further detail of this review is detailed at Chapter 12.1.7 of Part B and change drivers against individual scope items are included in this section.

Through the likelihood of change review, it was identified that of the 371 scope items proposed in Blackwater in FY23, less than 5% had a high likelihood of change, 36% had a moderate likelihood of change and 60% of the program is expected to have no change to either site cost, scope creep or works duration. An overview of this information by asset class can be seen in Table 24 below.

Table 24 FY23 Likelihood of Change – Blackwater

Asset Class	Total scope items	Items with High Likelihood of change	% of scope with High Likelihood of change
Civil	254	8	3%
Control Systems	69	5	7%
Electrical	48	4	8%
TOTAL	371	17	4%

The percentage of scope change relative to total scope is expected to be higher in the Control Systems and Electrical assets as these are mechanical and computer based assets. The renewal of these assets is linked to the

obsolescence of the aged assets so there is an element of unknown regarding the commissioning of new generation technology into Aurizon Network's existing systems. This can lead to scope creep, cost impact or delay in delivery time.

Civil Assets – Permanent Way

Permanent Way Renewal Program

Aurizon Network's FY23 Final Draft Proposal provides \$31.0m to deliver the scope of permanent way renewals in the Blackwater System. Table 25 summarises the scope and budget for each relevant renewal item.

Table 25 FY23 Permanent Way Renewals – Blackwater

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Rail Renewal	24.1	Rail Km	9.3	Equates to 1.0% of rail in the Blackwater System.
ii. Sleeper Renewal	7,568	Sleepers	3.6	Equates to 0.4% of sleepers in the Blackwater System.
iii. Track Upgrade	8.8	Track Km	9.2	9 Track Upgrade locations are planned and assigned to planned closures, which equates to 0.7% of the track asset in Blackwater.
iv. Turnout Renewal	4	Units	4.4	Equates to 0.5% of turnouts in the Blackwater System. Scope is coordinated between all asset disciplines given the interplay between Civil, Electrical and Control Systems assets.
v. Turnout Components		Fix on Fail	2.8	Proposed cost based on historical fix on fail scope
vi. Turnout Designs			0.7	Designs for locations to be renewed in future years.
vii. Permanent Way Other		Fix on Fail	1.0	Glued Insulated Joints (GIJ's) & rail lubrication installation and fix on fail scope.
TOTAL			31.0	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Rail Renewal

The FY23 rail renewal program for the Blackwater System will be delivered across 17 sites shown in Figure 15. Rail identified for renewal has either reached (or is near) its wear limit or has seen tonnages that indicate a heightened risk of near-term failure due to rail fatigue. The proposed location and extent of these works for FY23 are outlined in Table 26.

Table 26 FY23 Rail Renewal Program - Blackwater

	Track Section		Start Km	Finish Km	Length (Km)
1	ALDOGA	MOUNT LARCOM	563.693	564.707	2.052
2	BAJOOOL	ARCHER	614.565	615.430	1.728
3	EDUNGALBA	AROONA	94.093	94.597	0.972
4	EPALA	RAGLAN	584.000	584.795	1.590
5	GRANTLEIGH	TUNNEL	75.514	75.853	0.678

	Track Section		Start Km	Finish Km	Length (Km)
6	GRANTLEIGH	TUNNEL	68.890	69.538	1.296
7	GRANTLEIGH	TUNNEL	70.554	71.276	1.440
8	MARMOR	BAJOO	597.751	599.171	2.840
9	MOUNT MILLER	YARWUN	542.542	543.073	1.062
10	MOUNT MILLER	YARWUN	544.349	544.734	0.756
11	MOUNT MILLER	YARWUN	546.635	547.385	1.512
12	ROCKLANDS	ROCKLANDS	632.440	0.191	1.519
13	TUNNEL	EDUNGALBA	86.855	87.179	0.648
14	TUNNEL	EDUNGALBA	87.605	87.875	0.540
15	TUNNEL	EDUNGALBA	76.536	77.725	2.376
16	YARWUN	ALDOGA	554.069	555.159	2.180
17	YARWUN	ALDOGA	553.083	553.568	0.864
TOTAL					24.053

Scope comments:

In the development of the rail renewal scope, site walkouts are undertaken to confirm start and end markers and identify any site-specific issues that need consideration in the planning phase. The proposed scope presented above has had site walkouts completed, as such the likelihood of change is low.

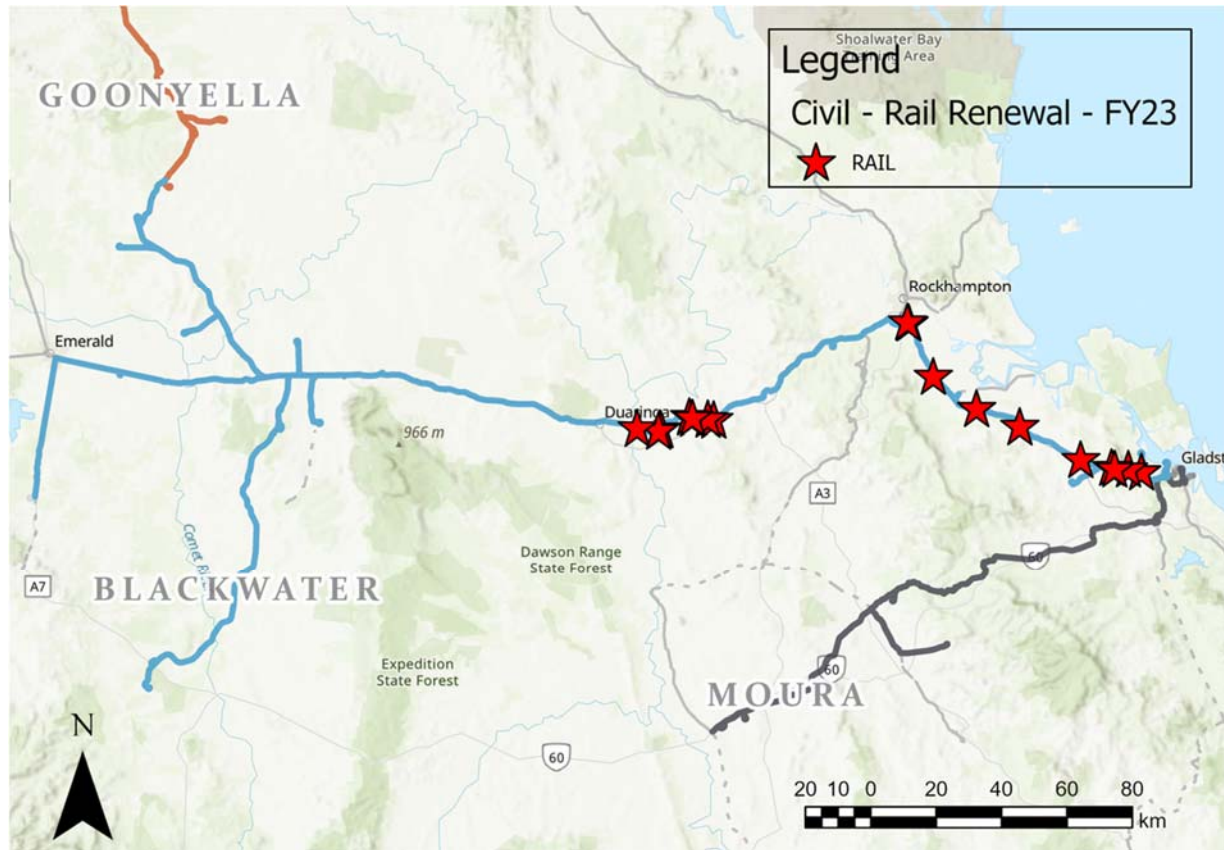
- Of the 17 sites, 15 sites for a total of 21.101Km are driven by rail wear occurring in track curves.
- 2 sites for a total of 2.952Km (locations 7 and 11) are being renewed due to reaching fatigue limits and demonstrating poor reliability through internal rail defects.
- Site 10 was introduced to the FY23 Final Draft Proposal due to accelerated wear.

"Rail fatigue" refers to the failure mechanism from an increase in rail defects which are caused through millions of wheel cycles over the rail (analogous to continuous bending of a paperclip). Rail fatigue generally only manifests itself in straight track where the rail has been in service for significant periods of time.

"Rail wear" is the progressive loss of steel in the rail head caused by the very high lateral forces under train operations and preventative grinding. The rail wears to the point where it is not sufficiently strong enough to sustain the heavy axle loads and generally only manifests itself in curved track. The sharper (i.e., tighter) the curve, the higher the wear rate.

Aurizon Network's planned unit length of rail is typically 108m, as this is the nominal longest length of rail that can be transported around the rail network. In certain circumstances lesser lengths can be used.

Figure 15 Rail Renewal Sites Blackwater FY23



ii. Sleeper Renewal

The FY23 sleeper renewal program will be delivered across 2 sites (see Figure 16 below) and see a total of 7,568 sleepers replaced. The location and extent of these works for FY23 are outlined in Table 23 below.

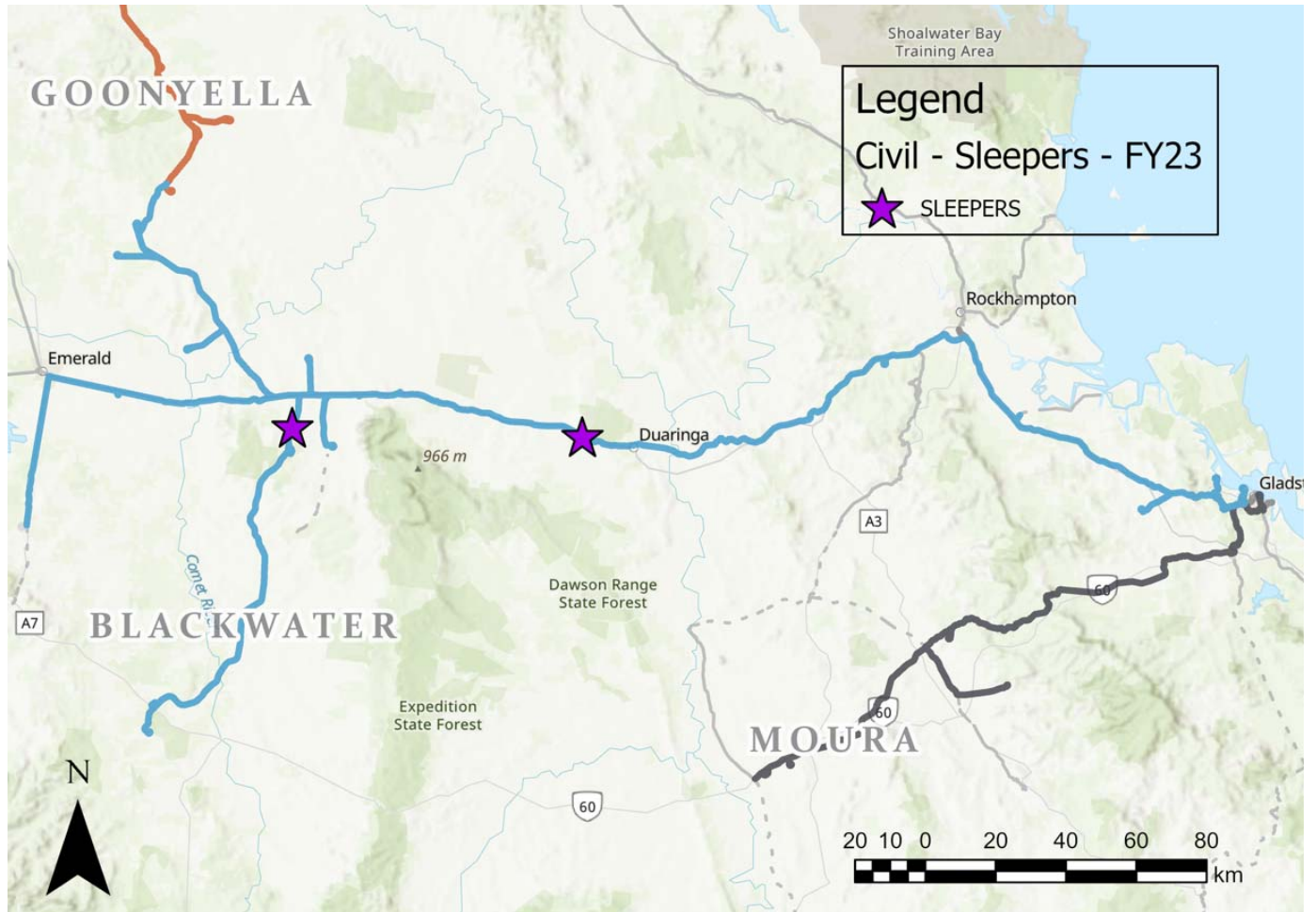
Table 27 FY23 Sleeper Renewal Program - Blackwater

	Track Section		Start Km	Finish Km	Sleepers
1	BOORGOON	BOORGOON	0.190	2.154	2,867
2	WALLAROO	TRYPHINIA	119.280	122.500	4,701
TOTAL					7,568

Scope comments:

- Location 2 will see derailment damaged sleepers renewed with new concrete 26.5tal sleepers. This derailment damage is quite old, but the condition of the sleepers has deteriorated from the initial striking damage of the dragging rollingstock. The damage has been monitored until the severity of the majority of damaged sleepers required renewal.
- A further 10,797 sleepers are planned for renewal as part of the Track Upgrade scope detailed in Table 28.

Figure 16 Sleeper Renewal Sites Blackwater FY23



iii. Track Upgrade

Track upgrade is an activity where more than one track element requires renewal at the same location. Rail and Sleepers and Ballast are completed together to maximise the required works at a site location to both realise efficient delivery and avoid the need to re visit a site several times to complete works in subsequent years. The FY23 track upgrade program will be delivered across 9 sites shown in Figure 17 below. A total of 8.8 track kilometres has been identified for renewal. The location and extent of these works for FY23 are outlined in Table 24.

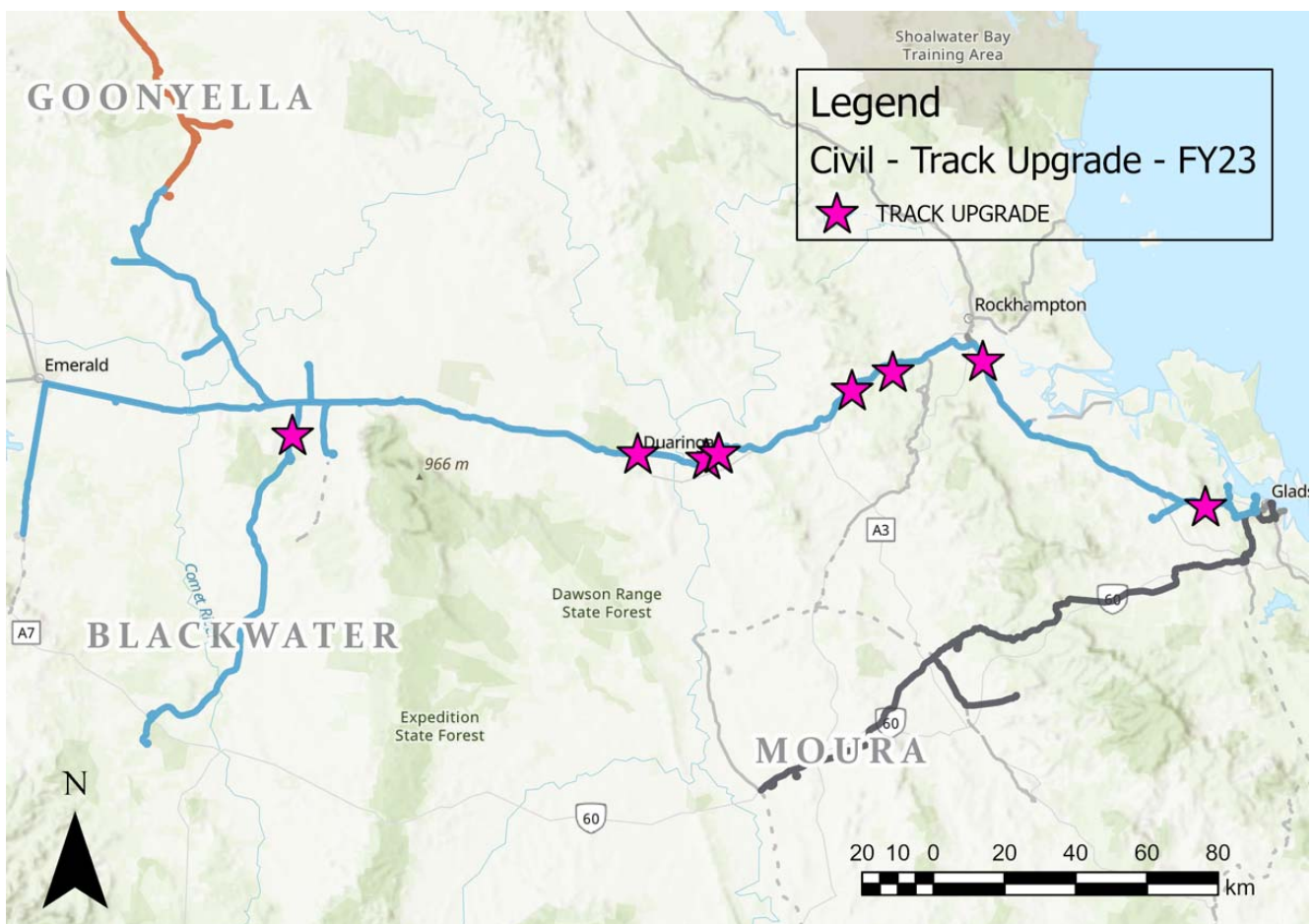
Table 28 FY23 Track Upgrade Program - Blackwater

Ref	Track Section	Start Km	Finish Km	Sleepers	Track Km
1	ALDOGA	550.891	552.405	1,709	1.514
2	BOORGOON	0.037	0.158	177	0.121
3	DUARINGA	105.035	105.467	592	0.432
4	EDUNGALBA	86.135	86.351	66	0.216
5	EDUNGALBA	82.824	82.957	24	0.133
6	EDUNGALBA	82.987	84.104	1,276	1.117
7	MIDGEE	627.545	628.733	1,579	1.188
8	STANWELL BALLOON	2.091	5.078	4,360	2.987
9	WYCARBAH	38.220	39.290	1,014	1.070
TOTAL				10,797	8.778

Scope comments:

- Locations 1, 2, 3, 4 and 7 contain fatigued or worn rail on fist clip sleepers.
- Scope at locations 5 and 6 is driven by rail wear and derailment-damaged fist clip sleepers. These sites were included in the FY22 Approved Strategy and Budget for delivery and were later deferred to FY23 following Aurizon Network's change management processes to introduce a higher priority location in FY22.
- Location 8 is renewal of fist clip sleepers, aged or corroded rail and fouled ballast. The combination of rail corrosion, fouled ballast and 20 tonne axle load fist clip sleepers is driving the criticality of this scope. The rail corrosion and ballast fouling are due to the high rate of coal fouling occurring because of the train unloading process. This site is an ideal location to use part worn rail due to the low speed and low rail wear rate. The rail will be cascaded from a FY22 track upgrade site on the Central Line.

Figure 17 Track Upgrade Renewal Sites Blackwater FY23



iv. Turnout Renewal

The FY23 turnout program will see turnouts renewed in two locations. The location and extent of these works for FY23 are outlined in the Table 25.

Table 29 FY23 Turnout Renewal Program - Blackwater

	Station	Points	Km Location
1	BAJOO	BL10A	604.68
2	CALLEMONDAH	CH251A	535.91
3	ARCHER	ER1.2A	615.50
4	WALLAROO	ER1.2A	115.70

Scope comments:

- The turnout renewal at Bajool has been deferred to FY23 from FY22 following Aurizon Network’s change management processes. Renewal of this turnout includes renewing a poor condition turnout asset, as well as improving the track and overhead alignment. The deferral from FY22 was due to difficulty integrating the scope into the planned North Coast Line closure and so holding works were completed.
- The turnout at Callemondah was installed in the 1970’s and located at the beginning of Callemondah yard, all Blackwater loaded trains traverse these turnouts as they queue for the port. The current turnout type (1 in 12) and track alignment with a series of small curves are frequently maintained to manage rail defects. Due to the complexity of turnout renewals in Callemondah yard this upgrade has been staged over multiple years. The timing of the turnout renewals is critical as deferral of this work will impact the planned interlocking upgrades in Callemondah yard.
- The turnout at Archer has been deferred from FY22 due to wet weather. The final construction works for this turnout require a 60-hour closure, there were no remaining closures in FY22 that could accommodate this, therefore deferring until FY23 has the least impact on rail traffic. This turnout has had three major componentry renewals in the last 11 years. The decision to renew the full turnout will remove the alignment issues that result in the continued major component renewal requirements.
- The turnout at Wallaroo was originally planned as a component renewal in FY22. However, due to this turnout being non-standard, work crews have experienced several issues while replacing worn/damaged component parts. All maintenance options have now been exhausted, with full replacement being the only viable option. In addition to addressing condition, reopening this bad-order siding will reduce the risk of delays caused by shunting, Work will commence on the renewal of this turnout in FY22, however will be completed in FY23.

Total Multi-year Budget: \$6m

- FY21 and FY22 - Staged works including earthworks and signal cabling were completed to reduce track possession requirements and to minimise risk of closure over run in later years.
- FY23 – Formation works underneath the existing turnouts planned to reduce the closure footprints in FY24. This includes renewing the formation and constructing and compacting the ballast layer.
- FY24 – Completion of staged project construction of new turnouts, modifying the alignment and commissioning works.

The four turnouts being renewed in this program equate to 0.9% of the total turnouts (431) in the Blackwater System.

Figure 18 Turnout Renewal Sites Blackwater FY23



v. Turnout Components

Component renewal is a standard asset management practice which allows Aurizon Network to maximise the overall asset’s useful life. Component replacements typically include switch and stock replacement or vee/crossing replacement.

In FY23, Aurizon Network has included an amount of \$2.5m for Turnout Component scope for steel rail components in the Blackwater System. Also, an allowance of \$0.3m has been allocated for Turnout Signalling component replacement which includes components that operate the turnout.

vi. Turnout Design

The FY23 Turnout Design program has a forecast budget of \$0.7m to design turnouts at eight locations summarised in Table 26.

Table 30 FY23 Turnout Design Program - Blackwater

Station	Points	Detail
1 CALLEMONDAH	CH 259A	The future renewal of these turnouts in the yard area will require significant track outages to complete the works. The railway signalling interlocking in the yard also requires renewal in the coming year. As such the Turnout and Interlocking programs are working together to coordinate their requirements with a view to minimise the track outage requirements and to maximise activities undertaken when track possessions are taken. The alignment of these programs will determine the future timing of these renewals.
2 CALLEMONDAH	CH 260A	
3 CALLEMONDAH	293BC	
4 CALLEMONDAH	GE293A	
5 MT MILLER	MM ER1.3A	Upgrade manual release and change from fixed Vee to Swing nose crossover
6 MT MILLER	MM ER2.3A	Upgrade manual release
7 MT MILLER	MM1	Upgrade turnout from current 1 in 12 to a 1 in 20 arrangement
8 LOCATION TBC		Reserve for additional site that will present in FY23 year. This budget allocation for design on need is to ensure the ability to deliver the FY23 plan.

vii. Permanent Way Other

- **Glued Insulated Joints**

An amount of \$0.3m for the renewal of defective Glued Insulated Joints (GIJ) has been included in the proposed FY23 scope of works. The renewal of 4-hole GIJs to 6-hole GIJs is to improve robustness, resilience and mitigate rail failure points from aged joints. In track sections that utilise axle counters, GIJ are redundant so will be removed prior to failure and renewed with a rail weld.

- **Rail Lubrication**

An allocation of \$0.04m has been identified for fix on fail works related to rail lubrication units. Lubricators deploy grease that is picked up by the train wheels and distributed through curves to reduce friction, aiding wheel and rail wear and reducing wheel squeal noise.

There are a total of 67 lubricator units in the Blackwater System.

- **Rail Fix on Fail**

An allocation of \$0.3m has been made for fix on fail requirements for short rail replacement. This covers reactive rail replacements that are not predictable and are over 27 metres long. Typical rail defects in this category are rail burns left by locomotives or rail foot strikes from dragging equipment.

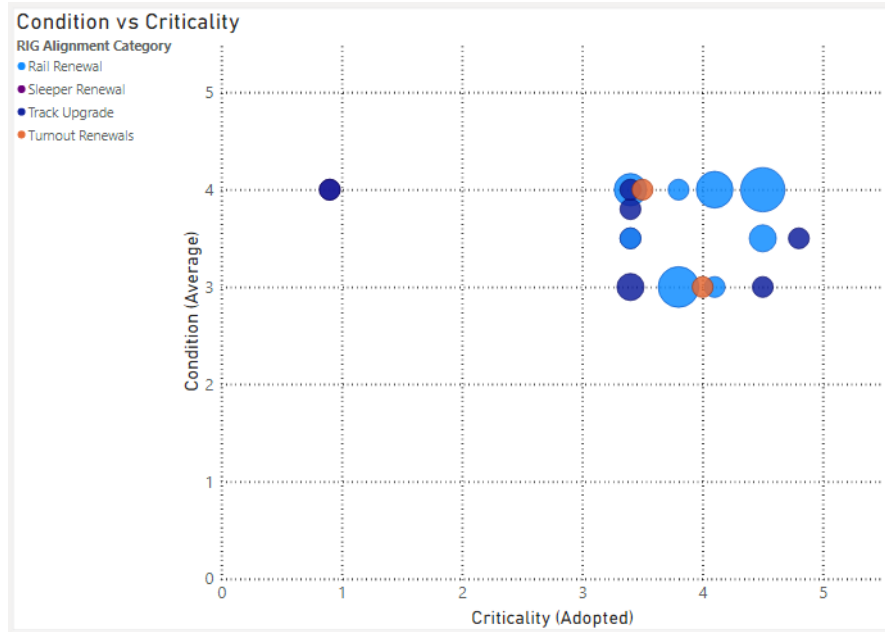
- **Slab Track Reactive Works**

An allocation of \$0.3m has been included for the management of unplanned defects that occur within slab track (i.e., the rail and fasteners are encased in concrete). Where a rail break occurs within slab track, an extended section of concrete needs to be removed, corroded plates, fasteners and the rail replaced, and the concrete reinstated to enable the permanent remedy. This work would otherwise inflate a rail renewal unit rate. This allocation enables the management of defects and improves the accuracy of delivered unit rates and cost forecasting.

Permanent Way FY23 Renewal Scope - Asset Condition and Criticality Assignment

The following graphic plots the permanent way renewals against asset condition and location/ operational criticality. As can be seen in Figure 19, all planned FY23 renewals are either advanced in wear or degradation and/ or located in track sections identified as critical to maximising throughput.

Figure 19 Permanent Way – FY23 Scope Priority Ratings - Blackwater



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and
- The size of the bubble represents the number of sites/ tasks.

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Permanent Way FY23 - Options Considered

In FY23, the permanent way assets identified for renewal have an average condition rating of 3.75, which is at or near the point of renewal identified in the Asset Maintenance and Renewal Policy.

The assets in this class degrade in condition based on usage and wear, as such a decision to defer or not do the renewal does not stop the wearing of the asset and the further degradation of condition. Deferral or removal of this scope increases the risk of the asset failing resulting in unplanned rectification. As outlined in Part B, the approach to renewals is to affect an asset renewal ahead of an asset failure to minimise the disruption to the network, reduce the mix of reactive works and maintain system throughput.

Table 31 Permanent Way Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	This scope is typically completed within existing integrated closures. Turnout components and removals are not complete renewals and can be carried out in the shadow of other activities within integrated closures	Low	The renewal or upgrade will provide enhanced system reliability through the avoidance of unplanned outages and re-life the renewed assets. Component renewal will extend the life of assets. Removal of surplus or redundant assets will reduce the associated maintenance costs for inspection and service of assets.
Defer some of the proposed scope	Deferral of worn components could result in asset failure that requires unplanned rectification and added delay.	Medium	Deferral of the renewal of worn components can lead to unplanned failure and will need to be renewed in a future year.

Option	Description	Risk of Asset Failure	Impact
	<p>Given these works are often completed in the shadow of other major tasks or between trains there would be little increase in throughput.</p> <p>Where there is a capacity impact and deferred works are moved to the next available period any capacity gain through deferral is potentially eroded by having to complete the scope later.</p>		This option will incur additional ongoing maintenance costs.
Do not complete proposed scope	<p>Worn components that are not replaced will eventually result in failure, unplanned rectification and delays.</p> <p>The benefit of any short-term access reduction is likely to be offset by the impact of future unplanned closures in the event of asset failure.</p>	Medium to High	<p>Failure to renew worn components will lead to unplanned failure.</p> <p>This option will incur additional ongoing maintenance costs.</p>

Options for the delivery of Permanent Way renewals

Always replace both rails	<p>Limited impact on throughput as time taken to replace both rails is minimal within the closure required.</p> <p>Replacing both rails would negate the need to go back to the same site in a future year to replace the other rail.</p> <p>The lower rail in a curve generally wears at a slightly higher rate given the loads are increased on the lower rail due to imperfect balance of speed and cant. That is, trains are travelling at slower speeds than that which the track is canted for. Current practice is to renew the rail closest to the wear limit and assess the other rail to determine its remaining life.</p>		<p>Replacing both rails will have the effect of replacing some rail prematurely in that rail would be replaced that had remaining life.</p> <p>There is an opportunity to cascade this rail to yards and low speed locations but would require freight charges to reposition the rail.</p>
Complete track upgrade instead of individual rail or sleeper replacement	<p>Sleepers and rail have differing deterioration rates and expected lives hence why they are currently treated as separate assets.</p> <p>Current practice is to assess the need for sleeper or rail replacement at the same site during the planning phase and where applicable bring required rail and required sleeper upgrade together as a Track Upgrade.</p>		<p>Always replacing sleepers will result in sleepers being replaced prematurely.</p> <p>Sleeper life is typically far more than rail life. As such, rail replacement is generally the predominant trigger for track upgrade.</p> <p>This will have the effect of an increase in short-term cost with longer-term efficiencies brought about through single mobilisation and reduced track access.</p>

Civil Assets - Ballast Cleaning

Ballast Cleaning Renewal Program

In FY23, Aurizon Network proposes to undertake \$41.0m of Ballast Cleaning in the Blackwater System. Table 32 summarises the scope and budget for each relevant renewal item.

Table 32 FY23 Ballast Cleaning Program - Blackwater

Renewal Item	FY23 Scope	Scope Units	FY23 Budget (\$m)	Description
i. Mainline Undercutting	73.6	Track Km	35.1	Ballast cleaned in the mainline undercutting and bridge rollouts equates to 6.37% of the total ballast in the Blackwater System. Scope delivery for FY23 assumes the use of both the high production BCM and excavator undercutters.
ii. Turnout Undercutting	20	Units	2.8	20 turnouts to be undercut via excavator.
iii. Bridge Rollout	830	Metres	2.5	Geotechnical studies of bridge ends to be completed to finalise design of works limits. Scope for relieving slab was removed from the Lilley waterholes site in the Final Draft as this is included in the Structures Bridge Renewal for Lilley waterholes.
iv. Ground Penetrating Radar (GPR)			0.6	Collection of data used to understand the level of ballast fouling to determine future scope requirements
TOTAL			41.0	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Mainline Undercutting

The proposed FY23 mainline undercutting program will see 73.6Kms of scope delivered for a forecast cost of \$35.1m. The scope will be delivered using the BCM (C01) and excavator undercutter (C14).

Table 33 Mainline Undercutting - Blackwater

Scope	FY23 Scope	Scope Unit	FY23 Budget (\$m)
BCM - C01	66.9	Track Km	31.0
Mainline excavator undercutting - C14	6.7	Track Km	4.0
TOTAL	73.6		35.1

The location and extent of these works for FY23 are outlined in Table 34.

Table 34 FY23 Mainline Undercutting Scope – Blackwater

Track Section	Start KM	Finish KM	Length (KM)	Scope	
ALDOGA	ALDOGA	553.411	555.190	1.746	MAINLINE UNDERCUTTING
ALDOGA	ALDOGA	553.737	555.816	2.043	MAINLINE UNDERCUTTING
ALDOGA	MT LARCOM	559.724	563.200	3.472	MAINLINE UNDERCUTTING
ARCHER	MIDGEE	617.466	618.800	1.338	MAINLINE UNDERCUTTING
ARCHER	MIDGEE	617.765	618.800	1.04	MAINLINE UNDERCUTTING
ARCHER	MIDGEE (up road)	618.900	619.302	0.402	MAINLINE UNDERCUTTING

Track Section		Start KM	Finish KM	Length (KM)	Scope
ARCHER	MIDGEE (down road)	618.900	619.302	0.402	MAINLINE UNDERCUTTING
AMBROSE	RAGLAN	575.900	577.800	1.898	MAINLINE UNDERCUTTING
AMBROSE	RAGLAN	579.800	581.900	2.105	MAINLINE UNDERCUTTING
DUARINGA	WALLAROO	105.700	109.250	3.592	MAINLINE UNDERCUTTING
FAIRHILL	YAN YAN	47.100	49.878	2.775	MAINLINE UNDERCUTTING
KABRA	WARREN	21.450	23.106	1.660	MAINLINE UNDERCUTTING
MEMOOLOO	STARLEE	57.400	60.800	3.390	MAINLINE UNDERCUTTING
MEMOOLOO	STARLEE	69.450	72.078	2.627	MAINLINE UNDERCUTTING
RAGLAN	MARMOR	591.500	592.500	1.002	MAINLINE UNDERCUTTING
RANGAL	BURNGROVE	198.333	199.982	1.650	MAINLINE UNDERCUTTING
RANGAL	TIKARDI	0.050	4.958	4.904	MAINLINE UNDERCUTTING
SAGITTARIUS	BURNGROVE	192.073	195.021	2.967	MAINLINE UNDERCUTTING
SAGITTARIUS	RANGAL	194.000	195.021	1.027	MAINLINE UNDERCUTTING
STANWELL BALLOON EXIT	STANWELL BALLOON EXIT	1.900	3.900	2.001	MAINLINE UNDERCUTTING
STARLEE	ROLLESTON	83.000	87.000	4.000	MAINLINE UNDERCUTTING
TIKARDI	BOORGOON	6.956	9.390	2.434	MAINLINE UNDERCUTTING
WALLAROO	TRYPHINNIA	123.392	128.32	4.934	MAINLINE UNDERCUTTING
WESTWOOD	WINDAH	51.500	55.143	3.648	MAINLINE UNDERCUTTING
WYCARBAH	WESTWOOD	43.111	45.873	2.760	MAINLINE UNDERCUTTING
WYCARBAH	WESTWOOD	39.995	43.011	3.017	MAINLINE UNDERCUTTING
YANYAN	GREGORY	52.215	54.000	1.787	MAINLINE UNDERCUTTING
YARWUN	YARWUN	545.335	546.100	0.769	MAINLINE UNDERCUTTING
YARWUN	YARWUN	546.600	548.147	1.545	MAINLINE UNDERCUTTING

Track Section		Start KM	Finish KM	Length (KM)	Scope
EDUNGALBA	AROONA	87.676	88.576	0.896	EXCAVATOR UNDERCUTTING
EDUNGALBA	AROONA	88.576	89.265	0.686	EXCAVATOR UNDERCUTTING
YARWUN	YARWUN	546.250	546.48	0.230	EXCAVATOR UNDERCUTTING
MAINLINE ADJACENT TO 12 TURNOUTS				1.375	EXCAVATOR UNDERCUTTING
UNALLOCATED SCOPE				3.470	METHOD TBC BASED ON SITE REQUIRMENTS
TOTAL				73.592	

The scope of ballast cleaning is based on the identification of track sections with fouling above the Acceptable Fouling Limit (AFL). The AFL is expressed as a percentage of void contamination (PVC). At a level of over 38% PVC fouling, the ballast draining properties are diminished and the wet weather performance of track is impaired.

Aurizon Network utilises Ground Penetrating Radar (GPR) to determine the level of fouling. The review and analysis of the FY22 GPR run data is currently ongoing. These results will be used along with local condition data from field teams to determine scope for FY24 ballast renewals.

Through the likelihood of change review in the development of the FY23 proposed scope, it was noted that site specific test pit digs had not been completed at the sites identified for Mainline Undercutting. As such the fouling rate and return rates of ballast are based on the average rates. Prior to works these test pits are dug to better understand the fouling rate on site. A higher fouling rate will result in a less efficient return rate and the possibility that the full scope cannot be achieved in the allotted time.

Scope Comments:

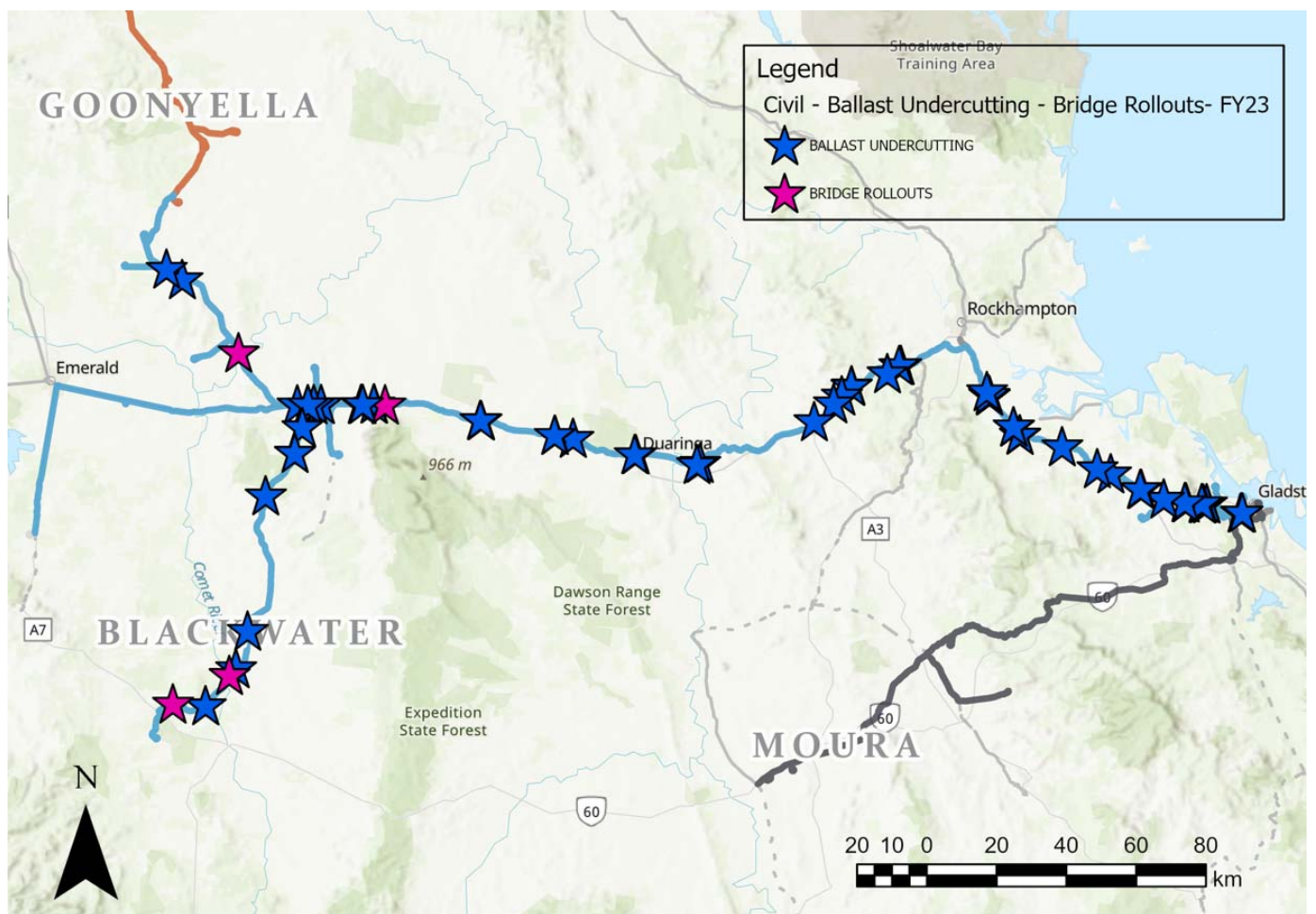
- Excavator undercutting (C14) adjacent to 12 turnouts are short ballast replacements, ranging between 25 and 50 metres, on the lead into and out of the planned undercuts of the actual turnout. Due to the dynamic forces applied by trains as they approach and travel through the turnout, these locations have an accelerated fouling rate. Historically, Aurizon Network has taken the opportunity to undercut these locations with the excavator during turnout undercuts. In the FY23 Final Draft Proposal, Aurizon Network is presenting this scope as excavator undercutting (C14) for transparency. The unallocated allowance for excavator undercutting (C14) has been reduced by the equivalent amount.
- An unallocated scope of 3.470Km has been added to the FY23 program. This is to react to sites that require ballast cleaning as sites degrade ahead of expectations or present with little notice. In prior years the planned scope was changed to accommodate the fix on fail sites. In FY23 identified sites are planned into closures and will not be disrupted in the event of a fix on fail scope site presenting. The methods of undercutting will be determined on a site by site basis but is likely to be excavator undercutting as the BCM will be on planned works across the CQCN and can't be readily deployed to fix on fail sites. In addition, fix on fail sites are typically shorter lengths than is economic to deploy the BCM.
- The 74.4 kilometres of ballast being cleaned in the mainline undercutting program and via Bridge Rollouts equates to 6.37% of the total ballast in the Blackwater System (1,174Km).
- The FY23 Final Draft Proposal includes 10.1Km of ballast cleaning on the Bauhinia Branch. Prior to FY23, there has been no "on-a-face" ballast renewal on the Bauhinia Branch since being first commissioned in 2006. This section of track has a history of temporary speed restrictions, ballast maintenance and mechanised resurfacing, and has deteriorated over time. A growing portion of this branch is now recording

ballast fouling above acceptable fouling limits and is resulting in increased maintenance effort and temporary speed restrictions. The total quantity of fouled track on the Bauhinia Branch in the 2020 GPR PVC is in excess of 40km (equivalent to approximately 36% of the Bauhinia Branch), which will be renewed gradually as efficiently and effectively as possible.

The current mainline scope is based on data up until the 2020 GPR run and the historical performance of the Blackwater system. In 2021, a further GPR run was completed and will provide a further data set to determine the rate of coal fouling throughout the CQCN. It is expected that the results of this GPR run will be presented to the Ballast Working Group in the third quarter of FY22.

In FY22, Aurizon Network, along with members of the Rail Industry Group and rollingstock operators, have established the Ballast Working Group to investigate, quantify and implement options for mitigating coal entering the ballast. The Ballast Working Group also continues to discuss the efficient delivery of the current ballast cleaning task across the CQCN.

Figure 20 Ballast Cleaning & Bridge Rollout Sites Blackwater FY23



ii. Turnout Undercutting

The proposed FY23 turnout undercutting program will see 20 turnouts undercut (units) using the excavator undercutter. The forecast cost of delivering this scope is \$2.8m. Due to the level of unpredictability of turnout ballast performance at the current planning horizon, one reactive turnout undercut has been allocated for FY23; this

allocation is to protect the planned scope as historically scope change has been managed through deferring planned works.

The location and extent of these works for FY23 are outlined in Table 35.

Table 35 FY23 Turnout Undercutting Scope - Blackwater

	Turnout Location	Km Point
1	BAJOOL	603.591
2	BAJOOL	606.441
3	BOONAL	178.120
4	BOONAL	181.184
5	BOONAL	181.479
6	CALLEMONDAH	0.253
7	KABRA	21.030
8	KINROLA	14.746
9	MT LARCOM	564.537
10	MT LARCOM	564.722
11	TRYPHINNIA	128.372
12	UMOLO	148.520
13	UMOLO	148.424
14	UMOLO	148.625
15	UMOLO	148.530
16	WYCARBAH	36.091
17	WYCARBAH	36.111
18	YARWUN	545.275
19	YARWUN	545.303
20	Reactive Turnout	TBC

Turnout undercutting was one area of the civil program identified as having a high likelihood of change through the development of FY23 scope. This is due to condition changing at sites currently planned for future years. These changes, if they eventuate, will be presented to the RIG as part of the quarterly reporting process.

iii. Bridge Rollout

The proposed FY23 program for bridge rollouts in the Blackwater System is 5 sites for a total of 830 metres. The location and extent of these works for FY23 are outlined in Table 32. The forecast cost of delivering this scope is \$2.5m.

Table 36 FY23 Bridge Rollout Scope - Blackwater

Waterway	Start Km	End Km	Length (metres)
Bridge 105.430Km DOWN TRACK - Seven Mile Ck	105.430	105.540	110
Bridge 174.200Km UP TRACK - Duckworth Creek	174.140	174.260	120
Bridge 19.850Km - Lilley waterholes	19.780	19.920	140
Bridge 72.130Km - Comet River North	72.060	72.190	130
Bridge 93.060Km - Aldebaran Creek	92.850	93.180	330

Waterway	Start Km	End Km	Length (metres)
TOTAL			830

Scope comments:

- Geotechnical studies of bridge ends are to be completed prior to the commencement of FY23 to finalise design of work. This may result in additional formation renewal or strengthening at bridge ends.
- Each of the above bridges will also have curb raising included to increase the ballast carrying capacity of the bridges. This will increase the period between bridge rollout requirements as the fouling rate will decrease given the deeper ballast.
- At the Lilley Waterholes Overflow Bridge the scope will also integrate with bridge scope to address embankment issues. This bridge structure underwent repair activities during the 2011 Western Queensland floods (abutment shoring protection).

iv. Ground Penetrating Radar

To further the refinement of ballast cleaning scope, Aurizon Network will perform an additional GPR survey in FY23. This will be the 6th run of its type (with prior surveys conducted in 2014, 2016, 2018, 2020 and 2021) and will allow Aurizon Network to not only identify sites that require cleaning, but to also trend locations over the period to understand degradation rates with a view to predict future renewal scope requirements and locations.

The costs of the GPR survey have been allocated between systems in proportion to the GPR survey kilometres planned in each Coal System. This results in a cost allocation to the Blackwater System of \$0.6m.

The proposed FY23 GPR survey will be targeting mainline track within Blackwater and Goonyella (i.e., trunk routes, branch lines and spurs - the track carrying increased risk due to higher line speeds and throughput) and selected yard track that is high-frequency and/ or critically located. The intent is to enable a data-driven assessment of the overall condition of the ballast using a risk-based approach to determine future undercutting requirements.

Aurizon Network considers it necessary to continue to collect GPR data (including in recently undercut sections) in order to assess and understand localised change in ballast condition over time. In particular, the inclusion of recently undercut sections enables an understanding of the overall fouling status of each System; excluding these sections would result in a skewed view of the fouling status. Similarly, if recently undercut sections were not surveyed, the time period between successive datasets would increase from ~24 months to ~48 months and become less valuable in the context of the undercutting scope development and subsequent planning. This would compromise Aurizon Network's ability to manage its ballast asset over the long-term.

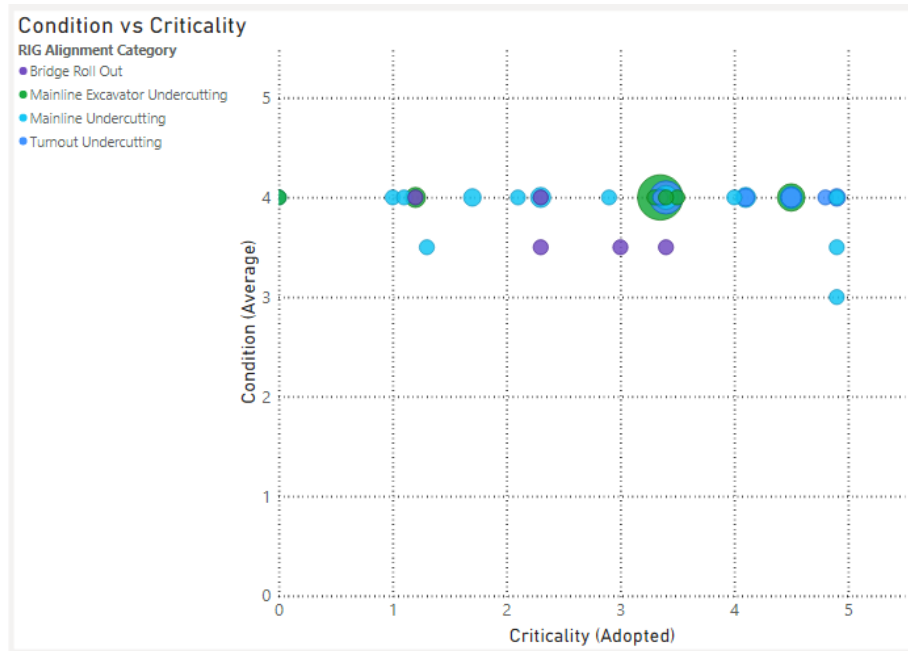
In any event, the on-track vehicle collecting GPR survey data would otherwise need to traverse the recently undercut sections and therefore, no throughput benefit is gained (nor loss suffered) through 'missing' localised and recently undercut sections. Aurizon Network would not expect any cost savings because of omitting these sections.

Ballast Cleaning FY23 Scope - Asset Condition and Criticality Assignment

Figure 21 shows the graphic plots the Ballast renewals against asset condition and location/ operational criticality.

- All sites have a condition of 3 or above with most sites being in more critical track sections of the Blackwater System; and
- All but 1 planned bridge rollouts have a condition rating of 3.5 or above.

Figure 21 Ballast Cleaning – FY23 Scope Priority Ratings - Blackwater



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23.

For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites/ tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Ballast Cleaning FY23 Program - Options Considered

A number of options have been considered in relation to Ballast Cleaning and the delivery of ballast undercutting outlined in Table 33 below.

Failure to remove fouling from the ballast results in drainage issues that affect formation condition resulting in track alignment defects. These defects manifest as temporary speed restrictions until track resurfacing or track tamping is conducted as part of the General Maintenance activity. Therefore, the options of deferring or not completing ballast cleaning works on identified locations, increases the risk of these track alignment defects propagating.

Other options are available in the delivery of the undercutting process and are assessed for the cost of doing the alternate activity and the time required to complete against the long-term asset condition benefits.

Table 37 Ballast Cleaning Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Proposed scope has been in the system-wide planning process to balance system throughput with scope requirements.	Low	All identified scope has a current condition of 3 or above with advanced fouling and will degrade further without intervention. The Risk of Asset Failure categorisation is somewhat subjective but has been assessed based on the proposed and planned scope and available data at the time of preparation. The cleaning of each site as per the proposed plan will remove the most fouled locations whilst balancing production rates and track time of the undercutting activities against throughput capacity demand.
Defer some of the proposed scope	Deferral of works will push requirement into future years with ballast condition	Medium	Locations identified for cleaning are already at a high level of fouling. Deferral will see condition worsen resulting in increased

Option	Description	Risk of Asset Failure	Impact
	<p>becoming more fouled in deferred locations.</p> <p>Some throughput would be returned to the supply chain, where ballast cleaning is the critical scope for possessions, but this would be eroded by operational restrictions and unplanned delays caused by degraded ballast condition</p>		<p>reactive maintenance and increased TSRs ahead of possible unplanned full replacements.</p> <p>The condition could worsen through the development of mud-holes and compromised track geometry, leading to speed restrictions.</p>
Do not complete proposed scope	Not completing the scope will see the ballast continue to foul and the associated impacts increase. This will lead to unplanned outages and delays that will reduce system capacity at the planned renewal sites	Medium	Locations identified for cleaning are already at a high level of fouling. Not completing the works will see condition worsen, resulting in increased reactive maintenance and increased TSRs ahead of possible unplanned full replacements.
Options for the delivery of Ballast Cleaning			
Move to 100% ballast replacement	This option would result in a slightly higher production rate of the mainline undercutter as ballast would no longer be screened and returned. It would require additional ballast at undercut sites with additional ballast train (work train) hauls to deliver or stockpile the ballast.		<p>The mainline undercutter consist includes several ballast spoil wagons but these would be filled quickly, and the rest of the ballast would be ejected to track side to be stockpiled for future removal. The increase in ballast spoil management is not accounted for in the ballast cleaning unit rates, and therefore would cause an increase in cost.</p> <p>Failing to remove spoil from the corridor or stockpiling adjacent to the track can create drainage, access and maintenance issues.</p>
Slabtrack all bridges to reduce bridge ballast replacement	<p>Slabtrack design and installation is both expensive and time consuming to execute. It will however eliminate the need to renew ballast on bridge decks and has positive capacity benefits in the long-term due to reduced renewal and maintenance activity.</p> <p>Aurizon Network has installed Slab Track on the Cooling channel bridge in Gladstone and continues to look at this as an option for other critical bridges.</p>		If the bridge and/ or slab track infrastructure is structurally damaged through derailment or bridge strike (e.g., from an over-height vehicle), the ability to recover from such an event is heavily compromised and would require new reconstruction techniques and stocks of large inventory items (e.g., slab track panels or bridge girders)
Shoulder Cleaning	Shoulder cleaning would provide, in the short-term reduced throughput impact to execute work (i.e., higher production in a given time) and in the medium-term risk to throughput due to potential TSRs from ballast fouling immediately beneath track.		Shoulder cleaning has been shown to provide short-term benefits however the intervention thresholds are very narrow, intervening too soon may result in benefits not being realised, whilst intervening too late will result in wasted effort and loss of capacity due to the need to execute a full undercut and the likely imposition of TSR's to manage the short-term geometry degradation.
Cleaning of turnouts using a Vacuum Truck	Vacuums of turnouts is appropriate in certain areas. It remains a slow process and in areas of high fouling is used to manage the otherwise high likelihood that components will be unable to be inspected and unplanned failure rates will increase.		Vacuums of turnouts does not address the underlying level of fouling and will not negate the need to undercut ballast in turnouts but rather ensure that components are able to be inspected and remain lubricated and functional.

Option	Description	Risk of Asset Failure	Impact
			<p>Aurizon Network is aware of Plasser's and other vacuum-based technologies which include on-track vacuum machines, with the ability to remove all fouled ballast, and off-track vacuum trucks which do not have this capability and, therefore, can only manage surface contamination. Aurizon Network does make use of off-track vacuum-trucks to manage heavy surface fouling at critical locations.</p> <p>Enquires in relation to this technology identified that a bespoke on-track machine would likely need to be designed and manufactured for Aurizon Network's narrow gauge railway, requiring investment in new plant. Aurizon Network also understands that the production rates of vacuum machines are lower than excavator undercutters. On-track machines will also face constraints such as the ability to store the necessary spoil.</p> <p>Essentially, use of such a machine would result in increased cost (investment in new plant either Network-owned, Leased or Contracted Machines and Labour) for a negligible change in production rate relative to the existing excavator undercutter approach.</p>

Civil Assets - Structure Renewals

Structures Renewal Program

The Blackwater System has a total of 140 Bridges and 1,335 Culverts which are designed to allow the natural flow of water through the rail network. In FY23 Aurizon Network proposes to undertake \$12.0m of structures renewal works. The location and extent of these works for FY23 are outlined in Table 34.

Table 38 FY23 Structures Renewal Scope - Blackwater

Renewal Item	FY23 Scope	Scope Units	FY23 Budget (\$m)	Description
i. Bridges	1.0	Sites	0.2	Installation of a relieving slab on 1 bridge to improve transition between the bridge deck and formation at the embankment end. Equates to <1% of bridges in Blackwater
ii. Culvert Renewal	19.0	Sites	11.4	Equates to 1.4% of culverts in Blackwater
iii. Culvert Design	9	Sites	0.4	Design package for 9 locations to be installed in FY24 and FY25 Release of design packages for identified sites to be renewed in future years

Renewal Item	FY23 Scope	Scope Units	FY23 Budget (\$m)	Description
TOTAL			12.0	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Bridges

As detailed in the table below, one bridge renewal works package is proposed for FY23. This is not a full bridge replacement, rather the installation of a relieving slab to address track alignment issues between the transition from the fixed bridge structure to the formation.

Table 39 Bridge Renewals – Blackwater

Bridge Renewal Location	Start Km
Bridge 19.850Km - Lilley waterholes	19.850

Scope comments:

- This scope will be completed at the same time as the planned bridge roll out of this structure in FY23
- The bridge embankment protection is showing signs of undermining and drainage issues with sinking gabion baskets. There is currently no relieving slab present on bridge.
- Scope of works is to install new relieving slab to improve transition and drainage away from abutment. Additional filling material is likely to be required during closure.
- Top of rail alignment issues are currently present and undermining embankment protection. Until drainage issue is resolved reoccurrence of top of rail alignment issues will reoccur after heavy rain events.

In Blackwater, over 90% of bridges are ranked as Condition rating 2.5 or less i.e., is in good to moderate condition. The limited number of structures above 2.5 are performing as expected and do not require any intervention or future design effort at this stage.

ii. Culverts

The culverts used in the railway are typically concrete culverts and corrugated metal pipes similar to those used in civil construction and maintenance in other heavy civil uses (roads, mines, airport runways etc). Given this, the design activity for culvert renewals is outsourced to design houses with demonstrated experience in site specific design matching standard units to local conditions to achieve the required hydrology functionality.

19 culverts in the Blackwater System are proposed for renewal in FY23. Specific locations are outlined in Table 36 below:

Table 40 FY23 Culvert Renewal Scope Locations - Blackwater

Culvert Renewal Location	Km Point
1 Culvert 563.060Km	ALDOGA-MT LARCOM 563.060
2 Culvert 564.130Km	ALDOGA-MT LARCOM 564.130
3 Culvert 188.800Km	BLACKWATER 188.800
4 Culvert 0.080Km Waterway	BLACKWATER CONNECTION 0.080
5 Culvert 180.740Km Drain	BOONAL 180.740

Culvert Renewal Location		Km Point
6	Culvert 18.400Km Drain	CREW-MACKENZIE JCT 18.400
7	Culvert 69.550Km	GRANTLEIGH- TUNNEL 69.550
8	Culvert 15.010Km Drain	KABRA 15.010
9	Culvert 156.800Km waterway	PARNABAL-WALTON 156.800
10	Culvert 161.200Km	PARNABAL-WALTON 161.200
11	Culvert 76.720Km waterway	TUNNEL-EDUNGALBA 76.720
12	Culvert 78.230Km waterway	TUNNEL-EDUNGALBA 78.230
13	Culvert 79.170Km Drain	TUNNEL-EDUNGALBA 79.170
14	Culvert 79.500Km	TUNNEL-EDUNGALBA 79.500
15	Culvert 128.840Km Drain	TYPHINIA 128.840
16	Culvert 155.620Km	UMOLO-PARNABAL 155.620
17	Culvert 155.680Km	UMOLO-PARNABAL 155.680
18	Culvert 156.000Km	UMOLO-PARNABAL 155.950
19	Culvert 36.720Km Drain	WYCARBAH- WESTWOOD 36.720

Of the 19 sites identified:

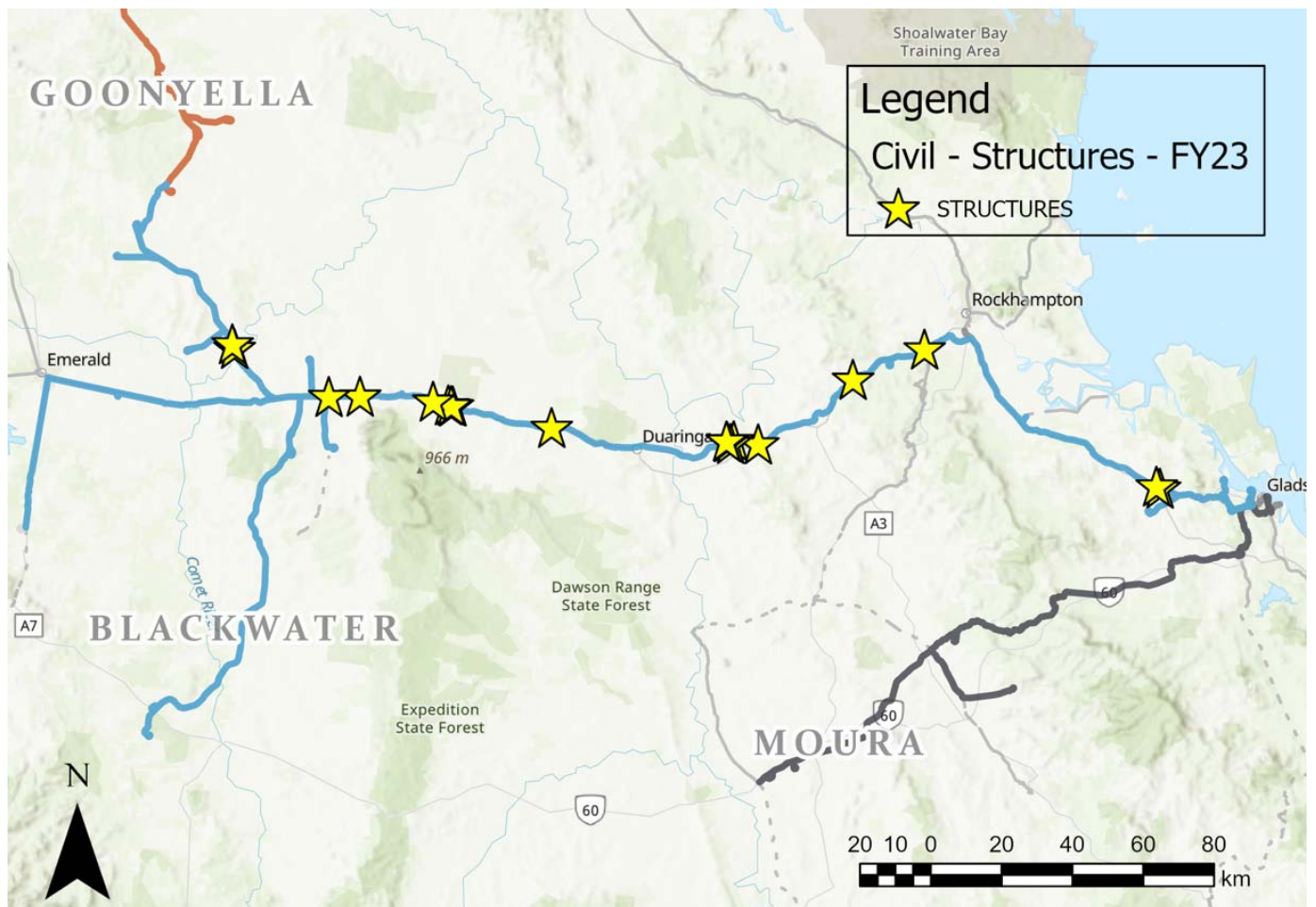
- Location 1 – requires removal and replacement of the old structure. The old structure has a design rating of 15 tonne axle load and is operating under current 26.5tal traffic task. Structure is currently propped to reduce track pumping under loaded trains.
- Location 2 – to be removed and replaced with 4 / 1200x1200 reinforced concrete box culvert (RCBC) cells.
- Location 3 & 4 – remove and replace culvert due to severe spalling and cracking in ceiling and base slab. Location 4 needs to be replaced to prevent negative hydrological impacts to the track and surrounding properties when location 3 site is renewed. These two culverts impact the same drainage pathways.
- Location 5 – remove and replace with 1/900x600 RCBC, size limited due to TMR hydrological impacts.
- Location 6 – culvert is currently proposed to be concrete lined.
- Locations 7 & 8 – significant cracking leading to some deformed shape requires these sites to be removed and replaced with RCBC's.
- Locations 10 – remove and replace old culvert with 1200x1200 RCBC
- Location 11, 12 & 14 – to prevent closure of track, it is proposed to have a Cured in Place Pipe lining system installed.
- Location 13 – to be a partial replacement of the reinforced concrete pipe.
- Location 15 – renewal of a bank of culverts at Tryphinia that is the driver of the 96hour possession in April 2023. The scope of works is to fully remove and replace a culvert bank 16 x 8 cells (128 RCBC's). Currently 6 of the 16 culvert cells in the bank are grout filled or have diminished flow due to pipe sleaving and grout filling to manage failed cells.
- Location 9, 16, 17 & 18 – 8 culverts between 155 and 157Km were investigated to determine the best hydrological outcome for the area and these four sites were identified as requiring removal and replacement.
- Location 19 – the existing culvert is in very poor condition with cracked base slab and units. To avoid impacting overhead mast foundations with the renewal activity, it is proposed to relocate the culvert 20m

from the existing site. The existing culvert will be grouted filled and a new 3 / 1200x450 RCBC will be installed.

Figure 22 shows the 19 culverts renewed in this program equates to 1.4% of the total culverts in the Blackwater System (1,335).

All sites have full design and were assessed as having a low likelihood of change during construction. The design also included hydrology assessments to ensure the works will improve or hold current flow requirements.

Figure 22 Structures Renewal Sites Blackwater FY23



iii. Culvert Design

Aurizon Network also proposes to undertake culvert design works for 10 locations in the Blackwater System for future years construction. These locations are outlined in the table below.

Table 41 FY23 Culvert Design Locations - Blackwater

	Culvert Design Location	Km Point	Design Being developed
1	AROONA	95.965	Pipe sleaving and grout filling
2	BOONAL	181.200	Remove and Replace RCBC
3	MARMOR-BAJOOOL	596.240	Remove and Replace RCBC

	Culvert Design Location	Km Point	Design Being developed
4	MARMOR-BAJOO	597.290	Pipe sleeve and grout filling
5	MEMOOLLOO-STARLEE	51.150	Concrete line Corrugated Metal Pipe (CMP)
6	MIDGEE-ROCKLND	626.390	Remove and Replace RCBC
7	SAGITTARIUS-RANGAL	194.620	Remove and Replace RCBC
8	EDUNGALBA-TUNNEL	77.090	Remove and Replace RCBC
9	EDUNGALBA-TUNNEL	77.980	Remove and Replace widening
10	WALLAROO-TYPHINIA	115.510	Delete culvert, grout fill and drainage

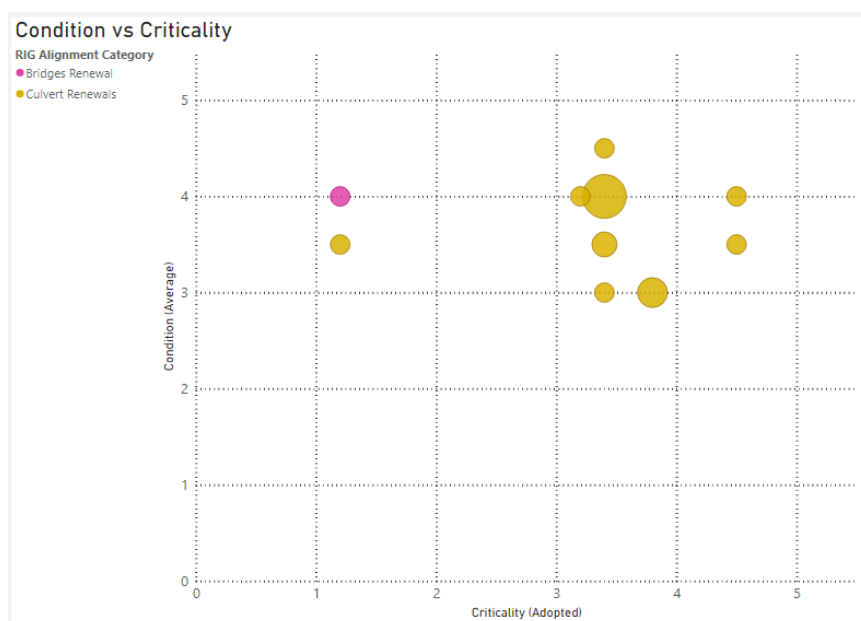
Scope Comments:

- The design works identified above are in preparation for delivery in FY24.

Structures FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Structures renewals against asset condition and location/ operations criticality. As can be seen all planned FY23 renewals have poor to near end of life condition.

Figure 23 Structures – FY23 Scope Priority Ratings – Blackwater



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- The location of the bubble indicates the SPM Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and
- The size of the bubble represents the number of sites / tasks.

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic

Structures FY23 Program – Options Considered

The average condition rating of the proposed FY23 scope is 3.7. As such they are at or near a condition state that the next condition will be asset failure. As such deferral or not completing the scope introduces a higher risk of asset failure that would require an unplanned intervention to correct.

In developing the scope of structures renewal there are a range of options available to retain the drainage requirements of the structure. As evident in the Blackwater scope a number of these options have been progressed.

Culvert assets are managed so that they can continue to do the water flow management task they were designed for. As such the renewal treatment, size of culvert and number of culverts at each site is different. The culverts are looked at as individual assets and as part of the group of structures that manage water flow at different locations.

The renewal of culverts is to reduce the risks associated with track wash out, under mining and water egress over the rail and formation.

Table 42 Structures Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Renewing in a planned manner allows for optimal access planning and track occupancy for the required renewal works. Where appropriate Aurizon Network seeks to sleeve pipe culverts so the renewal works can occur under traffic not requiring an extended track possession.	Low	In order to renew a culvert or upgrade an element of the culvert, as is the scope in FY23, the culvert is required to be in good alignment, and not heavily deformed and out of shape. The planned renewals in FY23 are currently in a condition that the proposed scope is achievable. Culverts that present as a risk, either structurally or hydraulically, create impacts which include load and speed restrictions and a higher likelihood of track washouts respectively,
Defer some of the proposed scope	11 of the planned 20 renewals are at condition rating 4 or above, as such they would be expected to fail in the near term leading to unplanned outages and associated throughput losses. Deferral will push the renewal requirement to a future year and increase the risk of failure during the period of extension.	Medium	Deferral of renewal of worn components can lead to unplanned failure. Deferral can see further alignment degradation negating the opportunity for lining of pipes or element upgrades.
Do not complete proposed scope	Failure to renew planned scope will leave faulty structures that if not treated will fail in the near term and effect the alignment of the railway such that emergency possessions will be required to remedy or a TSR would be required until a renewal could be planned.	High	Failure to renew worn components will lead to unplanned failure and increase derailment risk related to track misalignment at defective structure sites. The loss of hydraulic capacity of the culvert during the wet season could cause the track to washout.

Civil Assets - Civil Renewals

Civil Assets Renewal Program

In FY23, Aurizon Network proposes to undertake the following asset replacement and renewal activities for the civil assets. Table 43 summarises the scope and budget for each relevant renewal item.

Table 43 FY23 Civil Asset Renewal Program - Blackwater

Renewal Item	FY23 Scope	Scope Units	FY23 Budget (\$m)	Comments
i. Formation Renewal	2.8	Track Km	4.8	Equates to 0.2% of formation length
i. Formation Reactive		Fix on Fail	1.5	Fix on fail scope allocation to accommodate formation that fails in a yet to be known location
i. Formation Other		Design	0.2	
ii. Level Crossing Renewals	4.0	Sites	5.8	Equates to 1.2% of level crossing sites. Includes Level Crossing Renewals & Major Signage Upgrades.
ii. Level Crossing Design	7.0	Design	0.2	Design of identified renewal sites to be completed in future years.
ii. Level Crossing Other		Fix on Fail	0.4	Fix on fail scope allocation to accommodate level crossing elements that fail or reduce the safety of the road rail interface.
iii. Access Points & Access Roads		Fix on Fail	1.3	Equates to 0.22% of access points
iv. Corridor Fencing & Security		Fix on Fail	0.4	Fix on fail allocation to reinstate required corridor fencing to sperate the rail corridor from neighbouring land.
TOTAL			14.4	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Formation

Formation Renewal - There is 1,176 kilometres of formation in the Blackwater System. The location and extent of the proposed works for FY23 are outlined in the following table.

Table 44 FY23 Formation Scope - Blackwater

Location	Start Km	End Km	Distance (Km's)
EPALA RAGLAN	577.300	578.200	0.900
ROCKLANDS ROCKLANDS	631.900	632.500	1.200
WARREN WYCARBAH	28.000	28.750	0.658
TOTAL			2.758

Scope comments:

- Location 1 – this location has seen several track alignment defects, and track geometry issues associated with the formation condition. Scope will renew formation by rebuilding 900mm below ballast base
- Location 2 – 2 formation fix on fail formation jobs were completed in this location in FY20. This scope will rebuild between these two fix on fail sites.
- Locations 3 – the scope at this location is being delivered in two parts with the bridge at Kennedy Creek (28.217 to 28.309) in the middle of the site. The bridge received a ballast roll out in FY21.

Pretesting of formation via test pits to determine condition below the track structure and ballast, is not fully conclusive to the requirement of formation rebuild. As such there is a moderate likelihood of change to scope at these sites regarding the amount of unsuitable material that will be required to be removed and rebuilt. Dynamic

Cone Penetration testing is undertaken to determine the weight bearing capacity of the formation once the track and ballast has been removed to determine the actual amount of materials required.

Estimated time to complete works, scope, and cost are subject to minor change from current proposal. Effect could be negative or positive.

Formation Fix on Fail - An allocation of \$1.5m has been made for fix on fail formation sites in Blackwater.

- Scope of fix on fail work is identified by the local Track Inspection staff and assessed by the District Engineer; and
- A site estimate is developed and will draw down on the fix on fail allocation in this system.

Formation Design – An allocation of \$0.2m has been made for the design of the formation renewal at Rocklands to Gracemere (1.5Km) to be completed in FY24.

ii. Level Crossings

There are 236 level crossings in the Blackwater System. In FY23, Aurizon Network proposes a Level Crossing program that includes level crossing renewals, signage upgrades and future location designs.

Level Crossing Renewals - Full upgrade of crossing track structure and/or active protection (flashing lights and boom gates) or incremental safety upgrades. The location and extent of these works for FY23 are outlined in the following table.

Table 45 FY23 Level Crossing Scope - Blackwater

Scope	Location	KM Point
1 MAJOR RENEWAL	LX1776 - 606.646Km Magazine Road	606.650
2 MAJOR RENEWAL & SIGNAL UPGRADE	LX5559 - 123.342Km Tryphinia Road	123.342
3 MAJOR RENEWAL	LX5612 - 173.253KM Substation Access Road	173.258
4 MAJOR UPGRADE SIGNAL	LX 5560 – 133.187 Mourindilla Road	133.187

Scope comments:

- Locations 1 & 3 – Renewal of track structure through level crossing. Includes removal of rail, road pavement and formation. Rebuild of subgrade, reinstate road surface new rails, and install rubber flangeways.
- Location 2 – Renewal of track structure as per locations 2 & 3 plus upgrade from stop signs to active protection with new flashing lights and ½ boom gates increasing the safety interface at this crossing, as there is a history of incidents at this crossing. The interlocking at this location is being renewed so there is an efficiency to add the active protection as a part of this upgrade.
- Location 4 – Upgrade from stop signs to active protection with new flashing lights and ½ boom gates increasing the safety interface at this crossing, as there is a history of incidents at this crossing. The interlocking at this location is being renewed so there is an efficiency to add the active protection as a part of this upgrade.

Level Crossings Fix on Fail - An allocation of \$0.3m has also been made for fix on fail or unplanned safety upgrades for level crossings in Blackwater.

Level Crossing Signage Upgrade - Crossings where signage does not meet Aurizon Network standards are to be upgraded.

- 9 sites at Ensham Mine Balloon will see minor signage upgrades replacing faded and non-standard level crossing signs.

Level Crossing Design - Crossings with active protection require coordination into the localised signalling system and therefore require a level of design works. The designs are for delivery in future years.

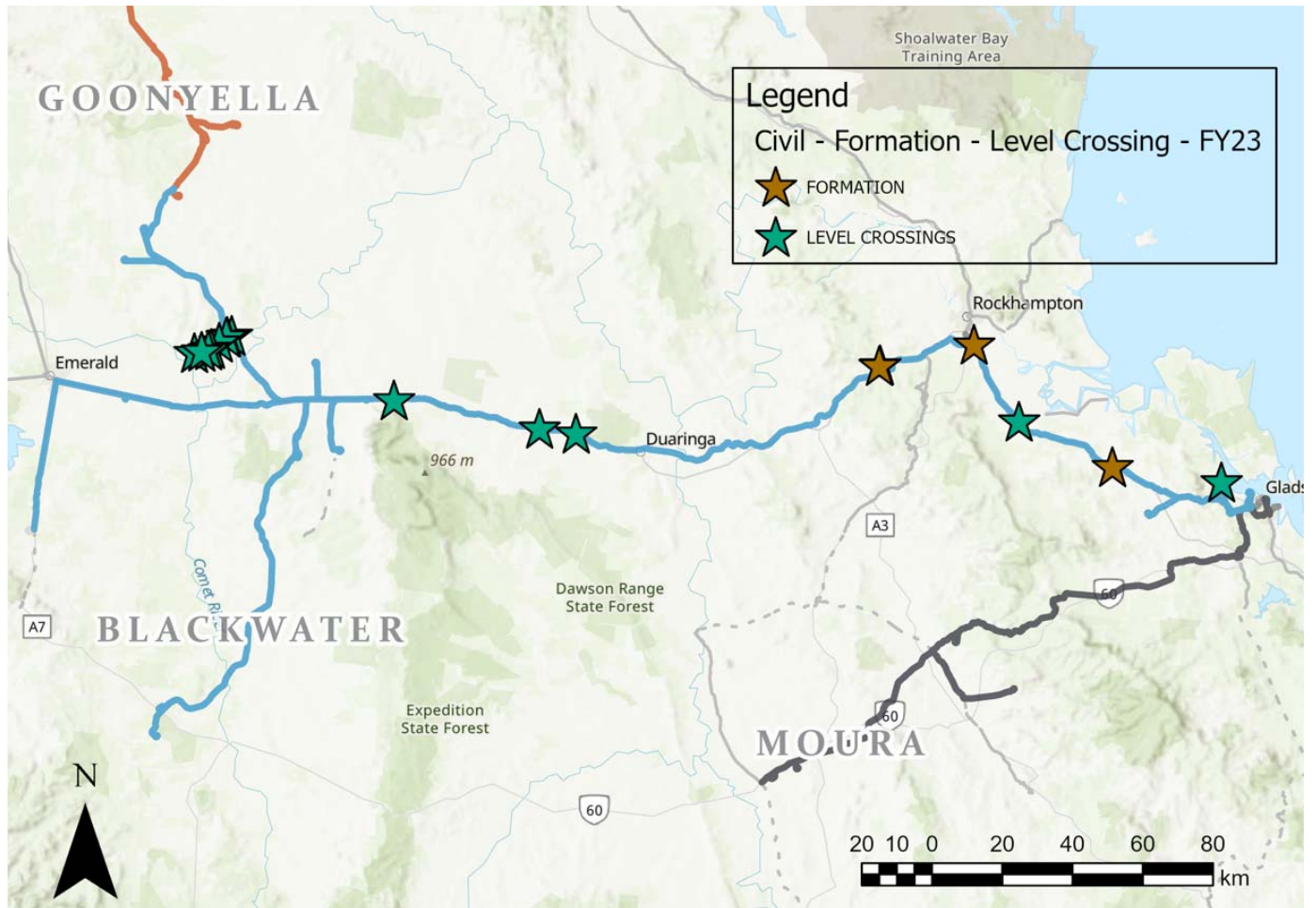
The location and extent of these works for FY23 are outlined in the following table.

Table 46 FY23 Level Crossing Design Scope - Blackwater

	Location	KM Point
1	LX20243 – RANGAL	195.761
2	LX 7099 – BLUFF	169.970
3	LX7100 – BLUFF	170.030
4	LX5614 – BOONAL	181.293
5	LX5587 – EPALA	579.836
6	LX3457 – MCKENZIE	20.860
7	LX0985 – RANGAL	197.038

- There are two additional sites to be designed as per the Department of Transport and Main Roads standard (DTMR). These sites are for decommission and located in Bluff; this may not require detail designs, but standard design provided by DTMR.

Figure 24 Formation and Level Crossing Renewal Sites Blackwater FY23



iii. Access Points and Access Roads

Corridor access points are locations where Train Crew and Aurizon Network workers and contract staff need to leave the public road network to access the rail corridor. These access points are turnoffs that intersect with public and private roads. “Drive to stay alive” is a critical safety commitment in the Aurizon Network business so the safe access to the public road system from the rail corridor is part of the treatment of this risk.

There are 685Km of rail access roads in the Blackwater system that provide passage along the rail corridor. They are utilised by maintenance and rail operations staff to access the rail corridor.

There are approximately 908 known access points across the Blackwater System. In Blackwater the railway and the road network are quite aligned for most of the network. As such these turnoffs include turns at formed intersection and undefined turnoffs. These undefined or un-engineered turn offs pose a significant risk. Aurizon Network has been working with local road authorities (DTMR & local Council) to better sign access points. A focus is to progressively eliminate unsafe or high-risk access points and to better define and identify the controlled access points.

Given the alignment of the system to the public road network in the Blackwater system there are an excess of access locations that have been established over the years. The decommissioning of not required access points or

access point that have difficult access and limited sighting distance is a key initiative to manage the risks associated with access points.

Access Points Scope Comments:

- Decommissioning includes the reinstatement of fencing or placement of physical barriers.
- There are two sites which have been proposed for road surface, signage and slip lane upgrade. These sites are (1) Raglan – Marmor section at 591.665Km and (2) Westwood-Wycarbah section at 37.190Km. These scope items have a high likelihood of change.
- There are 46 access points being proposed for removal in this program which require consultation with stakeholders before physical removal.
- Currently Aurizon Network does not have full designs for these works and an assumed allowance has been assigned for each site. With local requirements it is expected that the costs to decommission each site may vary around the assumed estimated average cost. A total allocation of \$0.7m is proposed for the decommissioning program.

Access Roads Scope Comments:

- an allocation of \$0.4m has been proposed for fix on fail access road works.
- Post rain events, sections of access roads will require renewal, reinstatement or grading.

iv. Corridor Fencing and Security

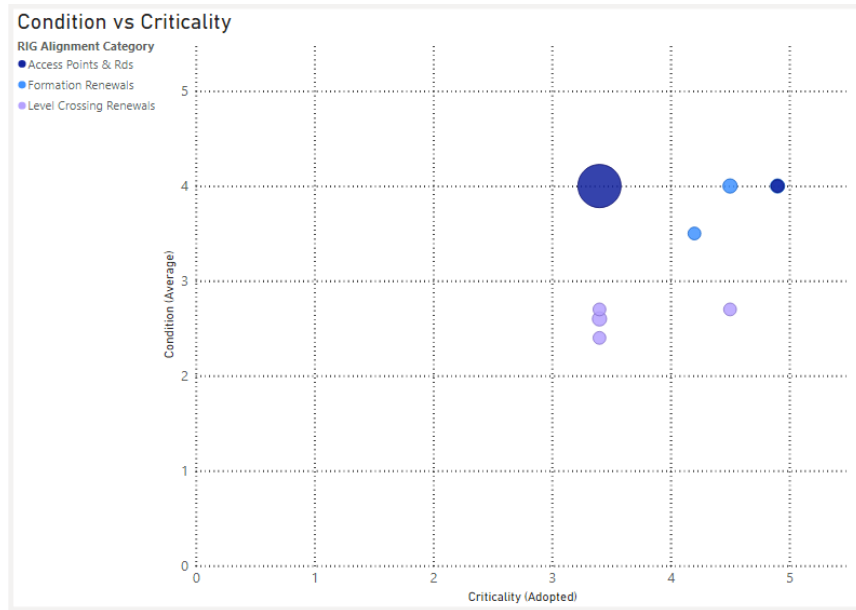
There is 1,576Km of fencing in the Blackwater System. An allocation for fix on fail fencing has been made in the FY23 program of \$0.4M. Consistent with previous years, this will be allocated to address failed fencing in locations as identified by the local delivery teams or via Aurizon Network's Community Engagement team in consultation with neighbouring land holders.

Civil Renewals FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Civil renewals against asset condition and location/ operational criticality.

- Formation scope has a condition rating of 3.5 and above with renewals planned.
- The identified access points to be removed have a condition rating of 4 given they are unformed and unsigned.

Figure 25 Civil Renewals – FY23 Scope Priority Ratings – Blackwater



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability

Civil Renewals FY23 Program - Options Considered

The proposed FY23 Civil Assets scope has an average condition rating of 3.6. Not actioning these assets will increase the risk of asset failure leading to a requirement for an unplanned rectification. Level crossing renewals are selected due to asset condition and safety improvement opportunities.

Not addressing formation requirements will result in additional track resurfacing requirements to maintain track alignment and avoid temporary speed or operating restrictions.

Level crossing and corridor access points are safety related upgrades to maintain the safety of Aurizon staff and the public.

Table 47 Civil Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Formation renewals treat formation sections that have failed and are causing track alignment issues leading to speed restrictions and the need to complete resurfacing works. Completing the scope at these locations addresses the underlying formation issue avoiding future operational delays.	Low	Completing the scope will maintain the assets performance across these asset classes. Formation failure is a root cause defect which is treated by speed restrictions and resurfacing. Renewing the formation will remove the need to apply a speed restriction or increased resurfacing activities at the renewed site.
Defer some of the proposed scope	Deferral of identified scope could result in failure that requires unplanned rectification and added delay. Deferral of formation works will result in additional track resurfacing activity at these sites to restore track geometry and associated operational delays.	Medium	Failure to renew aged assets can lead to unplanned failure and speed restrictions.
Do not complete proposed scope	Not completing the scope will result in unplanned outages when these assets	High	Failure to renew the formation can lead to unplanned failure and speed restriction.

Option	Description	Risk of Asset Failure	Impact
	fail or require an extended period to rectify from faults.		
Options in the delivery of Formation Works			
Formation – Lime Slurry Injection	Aurizon Network has in the past used the injection of lime slurry that hardens to fill voids that were identified in the formation with some success.	Medium	Lime slurry injection only treats the visible issues, given the issues are mostly not visible it has only a limited effect in the short term. The more efficient process is to re-life the asset by removal and rebuild.

Level crossing renewals and upgrades are proposed to maintain or increase the safety of the road rail interfaces at level crossings. Failure to complete the proposed scope will either retain a poor road condition or fail to increase the passive or active protection at these sites to the required condition.

Control Systems Assets

Control Systems Renewal Program

In FY23, Aurizon Network proposes to undertake \$21.8m of Control Systems Renewals or enhancements in the Blackwater System. The table below summarises the scope and budget for each relevant renewal item.

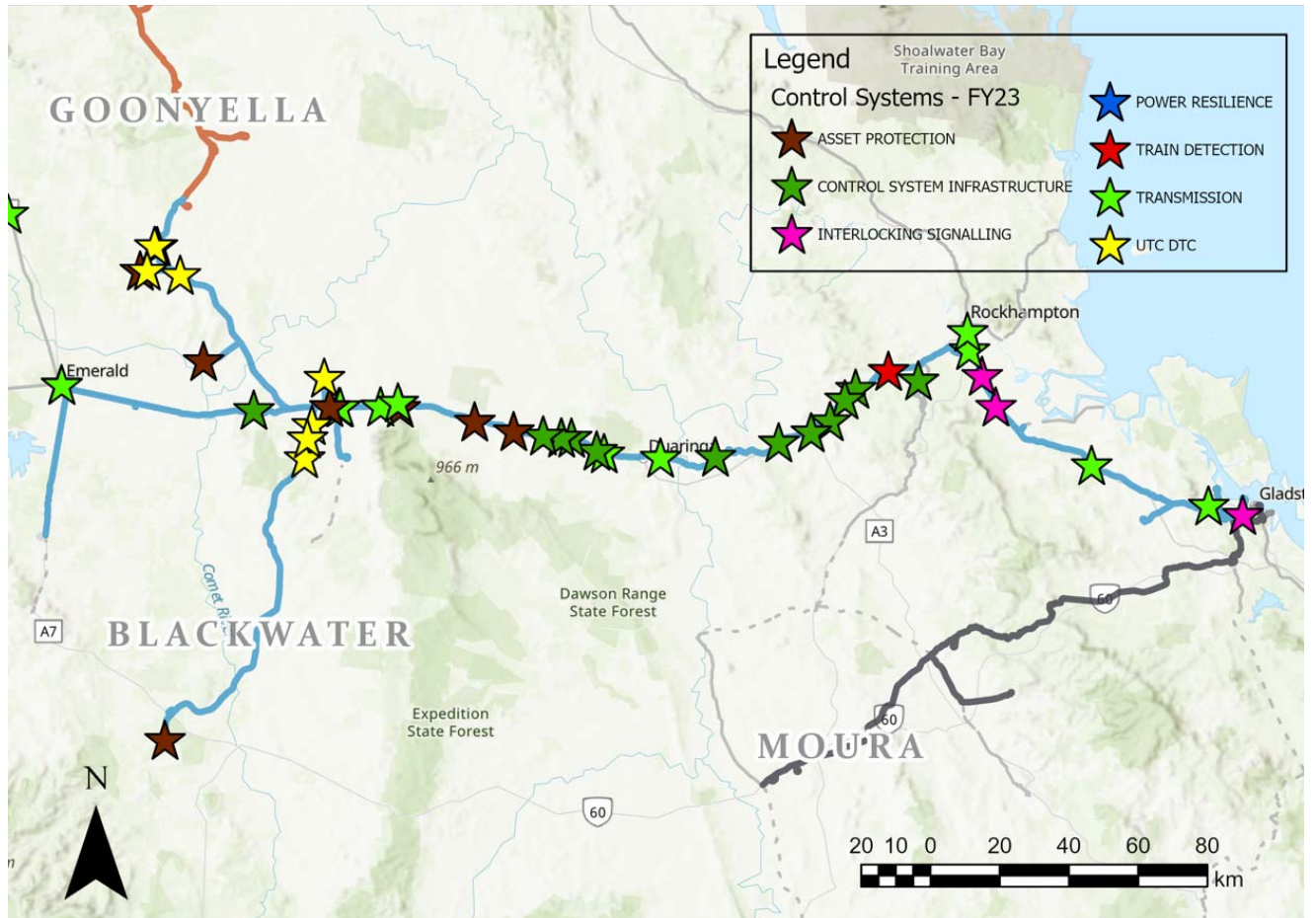
Table 48 FY23 Control Systems Renewal Program - Blackwater

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Safeworking Systems – Asset Protection	10.0	Sites	5.4	Renewal or establishment of asset protection systems to monitor the live interface between train and track assets, to mitigate the high consequence risks of track damage, derailment and dewirement.
ii. Safeworking Systems – Interlockings	2.0	Sites	2.5	Progressive replacement of end of service life signalling interlockings which ensure the safe separation of trains. This manages the risk of collision and derailment from unidentified failure, and of long-term system disruption associated with lead time to replace a condemned asset. The program includes the long lead design of interlocking renewals scoped in future years.
iii. Safeworking Systems – Train Detection	1.0	Sites	2.4	Renewal of track circuits and replacement of aged track circuit sections with axle counters in geographical blocks based on interlocking boundaries (sites). Program includes long lead design for blocks of work in future years.
iv. Safeworking Systems – Minor			1.9	Ongoing renewal of lower valued assets forming part of the system, to maintain average asset condition.
v. Power Resilience		Sites	0.04	Uninterrupted power supplies and battery pack renewals.
vi. Telecommunications Assets	48.3	Km	4.3	Optic fibre renewal.
vii. Transmission & Data Renewal	26.0	Sites	2.8	TETRA Radio upgrades, Radome radio dish covers, back-up power supplies.
viii. UTC/DTC Systems Upgrades	8.0	Sites	1.3	Digital telemetry upgrades for the train control system.

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
ix. Other Control Systems Renewals		Units	1.1	Design costs associated with CSEE Track circuits to Axle counters & Interlockings.
TOTAL			21.8	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

Figure 26 FY23 Control Systems Renewal Locations - Blackwater



i. Safeworking Systems - Asset Protection Renewals

The location and extent of these works for FY23 are outlined in the following table.

Table 49 FY23 Safeworking System Scope - Blackwater

Scope	Location	Qty	Unit
HBD/HWD RENEWAL	BLUFF	1	SITE
HBD/HWD RENEWAL	DUARINGA	1	SITE
HBD/HWD RENEWAL	MARMOR	1	SITE
HBD/HWD RENEWAL	SAGITTARIUS	1	SITE

HBD/HWD	RENEWAL	UMOLO	1	SITE
LX PROTECTION SYSTEM	RENEWAL	ADURAD ROAD	1	SITE
LX PROTECTION SYSTEM	RENEWAL	DINGO	1	SITE
WEIGHBRIDGE	RENEWAL	ENSHAM	1	SITE
WEIGHBRIDGE	RENEWAL	GORDONSTONE	1	SITE
WEIGHBRIDGE	RENEWAL	ROLLESTON MINE	1	SITE

Scope comments:

- Hot Bearing Detectors/ Hot Wheel Detectors are asset protection devices that detect abnormal temperatures in wheel bearings and wheels. Increased temperature is a pre-condition of bearing failure or brake lock. Seized wheels can create flat spots on wheels leading to high impact forces on the rail resulting in rail damage or potential rail breaks leading to derailment risk. Hot Bearing Detectors/ Hot Wheel Detectors are located throughout the coal systems at strategic locations. The final site for Hot Bearing Detectors will be determined in the design phase.
- The Hot Bearing Detector/ Hot Wheel Detector units to be renewed in Blackwater are old style STC (Southern Technologies Corporation) based Hot Bearing Detector Systems. These are technically obsolete equipment in that the server infrastructure that holds temperature data is on a non-supported operating system.
- The weighbridges to be replaced at Ensham, Gordonstone and Rolleston are National Instruments RM5.5 Version which are obsolete with minimum spares available. The weigher renewal will maintain and improve availability and reliability and provide train overload measurement at these sites. These sites will be renewed to a 2D weigher with 4 transducers which provide required accuracy and some redundancy for transducer failure. A high likelihood of a cost increase has been identified due to civil track works associated with weigher accuracy, which will be refined during the design and planning process.

ii. **Safeworking Systems - Interlocking Upgrades**

There are 83 interlockings in the Blackwater system. The FY23 Interlocking renewal program is a mix of renewal of aged sites and planning and design for future year renewals. The location and extent of these works for FY23 are outlined in the following table.

Table 50 FY23 Interlocking Scope - Blackwater

Scope		Location	Qty	Unit
RENEWAL	CALLEMONDAH STRATEGY	CALLEMONDAH	1	SITE
RENEWAL	RELAY INTERLOCKING UPGRADE	ARCHER	1	SITE

Scope comments Callemondah:

- The future interlocking renewal required in the Callemondah Yard is being planned with the required turnout renewals in the same location with a view to coordinate works and, where possible, minimise the track outage requirements. Note the completion of some tasks at the same time will not be possible due to the sequencing of turnout removal, formation works, turnout install, overhead alignment then signalling changes. These elements are planned to de-risk works to within required closures times. Some staging works will need to occur.
- This critical and complex interlocking is beyond service life. Cabling between the interlocking and field equipment is regularly failing, and the condition of some cables has required re-routing of control functions over alternate paths by local cables. Power supplies supporting signalling are also beyond service life.
- Replacement of the interlocking in one stage is beyond possession constraints for this yard.

- A multi-year strategy has been developed and forecast into outer years to stage the replacement of the interlocking, cabling and power supplies using modern networked interlockings. The majority will be delivered within the possession constraints for this yard.
- The proposed FY23 allocation will fund the detailed design that will lead to the preferred staged renewal plan. Initial design phases of the project were delivered in the FY22 Asset Renewal Program.

Scope comments Archer:

- This interlocking was significantly altered in 1994 during the duplication of the track section in this area. A relay-based interlocking is reliant on the safe and reliable operation of electro-mechanical relays which have an operational life, depending on usage of between 20 to 40 years.
- When a relay fails it is typically replaced with a spare. The relay components of these units are no longer supported by the vendor and critical spares are reducing.
- A replacement with a processor-based interlocking (PBI) minimises closure time needed to commission the interlocking on site and provides a cost effective renewal. Combining with Power System renewal and monitoring features of processor-based interlockings improves remote diagnosis and availability of interlocking.
- The replacement of Archer interlocking is part of a programme of replacing relay interlockings with processor-based interlockings on the NCL. Adjacent stations Marmor and Raglan will be completed in FY22 with Midgee planned for FY24.
- The design for the Archer Interlocking was delivered in the FY22 Asset Renewal Program.

iii. Safeworking Systems - Train Detection Renewals

The location and extent of these works for FY23 are outlined in the following table.

Table 51 FY23 Train Detection Scope - Blackwater

Scope	Location	Location	Qty
RENEWAL	CSEE TO AXLE COUNTER	TRYPHINIA	1

Scope comments:

- The FY23 renewals are the removal of aged track circuits and the installation of axle counters. This will reduce the population count of devices and the overall failure rate of the signalling system.
 “Track Circuits” are electronic devices that were installed in the 1980’s and are now starting to fail at an increased rate. They place a current between rails that detects the presence of a train. The maximum range of each individual track circuit is approximately 700m creating a large population on the network.
 “Axle counters” are devices that count wheels into and out of a section to prove it is clear for a signalled train path. Axle counters leverage modern processor based interlockings and the operational data communications Network.
- Train detection at Tryphinia is primarily obsolete CSEE track circuits. In-house spares provide the only means of maintaining the remaining CSEE installations. A rolling programme of CSEE track circuit removals maintains sufficient levels of these spares.
- A multi-year program commenced in 2017 to replace these track circuits on the NCL (now substantially complete). Large sections of track circuits west of Rocklands now need to be renewed in the coming years.
- The design for FY23 replacement Axle Counters at Tryphinia was completed in the FY22 Asset Renewal Program.

iv. Safeworking Systems – Minor

The FY23 program is mainly around asset protection assets installed to provide real time measurement of rollingstock and railway interface to identify rollingstock that are operating out of normal operations.

Table 52 FY23 Safeworking System Minor Works - Blackwater

Scope	Description	Qty	Unit
DIAGNOSTIC COMPUTERS	Computer hardware located in Trackside signalling equipment rooms. This is the general renewal of PCs in these huts	6	UNIT
INTERLOCKING	Design Midgee	1	UNIT
INTERLOCKING	Design and Order Callemondah Stage 1D	1	UNIT
INTERLOCKING	Planning Stages Callemondah Stage1E, 1F, Stage 2A	3	UNIT
IAMPS	Integrated Asset Monitoring and Protection System - consolidates alarms from multiple systems to present to UTC. Scope is various minor updates	1	SYSTEM

v. Power Resilience

This scope is required to improve the general power resilience across the Blackwater System. Mains power is required to operate the electric switching and components housed in the track side equipment rooms. This asset family includes emergency power systems to keep the vital train control, signalling and telecommunications operating if the local power supply is interrupted.

Table 53 FY23 Power Resilience Scope - Blackwater

Scope	Location	Location	Qty
PLANNING	REPLACE RELAY BASED ALTERNATOR CONTROL PANNEL	BLACKWATER	1 SITE
PLANNING	REPLACE BATTERIES IN BATTERY BANK	ROCKLANDS	10 BATTERIES

vi. Telecommunications Assets Renewals

During FY21, Aurizon Network commenced an Optic Fibre renewal program across the Blackwater System. This program is continuing into FY23.

The renewal program seeks to renew life expired 6 core fibre optic cable installed in 1980's with modern 24 core optic fibre. This modernisation also supports the increasing data network security and capacity requirements between field and control centre systems, and for monitoring asset condition in real time.

In FY23, Aurizon Network proposes to renew 48.3Km of optic fire at a cost of \$4.3m. The location and extent of these works for FY23 are outlined in the following table.

Table 54 FY23 Telecommunications Scope - Blackwater

Start Station	Start KM	End KM	Distance (metres)
DINGO TSC TO DINGO CER	133.285	141.326	8,041
GOGANGO CER TO GRANTLEIGH FSS	61.234	63.804	2,570
GRANTLEIGH FSS	63.15	66.150	3,000
SPRING CK AT TO WESTWOOD SER	40.575	47.736	7,161
TRYPHINIA ATE TO TRYPHINIA CER	125.714	128.419	2,705

Start Station	Start KM	End KM	Distance (metres)
TRYPHINIA CER TO DINGO TSC	128.419	133.285	4,866
WALLAROO TSC	119.823	125.714	5,891
WESTWOOD TSC TO WINDAH AM	49.36	55.093	5,733
WINDAH AM	57.65	61.234	3,584
WINDAH AT TO WINDAH SER	55.093	56.194	1,101
WYCARBAH SER TO SPRING CK AT	36.765	40.424	3,659
TOTAL			48,311

Scope comment:

- The 48.3 kilometres of optic fibre to be replaced in this program equates to 6.0% of the total kilometres of optic fibre in the Blackwater System (approx. 800Km).

vii. **Transmission & Data Network Renewals**

Transmission & Data Networks consist of:

- Control Systems Infrastructure – the physical buildings, towers and equipment rooms that support the Control Systems assets.
- Data Network – the infrastructure and electronics required to provide the data network across the CQCN.
- Transmission – digital and microwave radio systems.

In FY23, Aurizon Network proposes to undertake \$2.8m of asset renewals in the Blackwater System for Transmission & Data Network renewals. The location and extent of these works for FY23 are outlined in the following tables.

Control Systems Infrastructure

Table 55 Control Systems Infrastructure Scope - Blackwater

	Scope		Qty	Unit	Location
1	DEHYDRATOR	RENEWAL	1	SITE	TABLE MOUNTAIN
2	GENERATOR	RENEWAL	1	SITE	EMERALD
3	TELE BATTERY	RENEWAL	8	SITES	BLACKWATER MWR
4	TOWER MINOR	RENEWAL	5	SITES	VARIOUS
5	TOWER MAJOR	RENEWAL	1	SITE	BLUFF

Scope comments:

- Scope items 1 & 2 are to improve the air conditioning at these locations. Signal equipment rooms and signal interlockings are required to be kept at a certain temperature range. As such many of the buildings that house signalling and telecommunications equipment require air conditioning.
- Scope Locations 3 through 10 is the renewal of specialist batteries utilised in remote sites as they offer higher energy density for longer lasting operation between charge. These batteries are a component on the microwave radio equipment
- The major tower renewal at Bluff is a refurbishment of the tower footings.

Data Network

Table 56 FY23 Data Network Scope - Blackwater

	Scope		Qty	Unit
1	ROUTERS SWITCHES FIREWALLS	RENEWAL	1	SYSTEM

Scope Comment:

- In FY23 an allocation of \$0.7m has been proposed to renew aged data routers that provide the connectivity between the field assets and the data network via the internet interface.

Transmission

Table 57 FY23 Transmission Renewal Scope - Blackwater

	Scope		Qty	Unit	Location
1	ACOM	RENEWAL	1	SITE	ROCKHAMPTON
2	NMS	RENEWAL	1	SYSTEM	BLACKWATER SYSTEM
3	POWER SUPPLY	RENEWAL	1	UNIT	BOONAL PSC 178.5KM
4	POWER SUPPLY	RENEWAL	1	SITE	TRYPHINIA
5	POWER SUPPLY	RENEWAL	1	UNIT	YARWUN ATS 545.2KM
6	REVLOC	RENEWAL	1	SITE	ROCKHAMPTON
7	SDH TO IP	RENEWAL	1	SYSTEM	BLACKWATER SYSTEM STATIONS
8	TETRA SYSTEM	RENEWAL	1	SITE	BLACKWATER SYSTEM STATIONS
9	TRANSMISSION – TETRA CYBER SECURITY UPGRADE	RENEWAL	1	SYSTEM	SYSTEMWIDE

Scope comments:

- The radio system primarily provides vital voice communications between Network Control Officers and Rail Traffic Crew throughout the CQCN. It also allows Rail Traffic Crew to communicate with Rail Transfer Facilities (RTF) and workers on the corridor. RTF have a TETRA Radio fitted and workers have TETRA radios in vehicles.
- The digital based Terrestrial Trunked Radio (TETRA) network has been in operation since late 2019. It will eventually replace the analogue train control radio system, which is more than 20 years old, occupies radio frequencies that need to be handed back to the federal government and has a condition rating of 4.

viii. UTC/DTC Systems Renewals

In FY23, Aurizon Network proposes to undertake \$1.3m of asset renewals in the Blackwater System train control systems. This includes in-field digital modernisation of the life expired analogue telemetry that receives the control message via the train control system and safety and application enhancements to the Universal Train Control (UTC) system. These upgrades are scope prioritised by the train control team to improve the safety functions of UTC or to reduce potential scheduling and process errors.

The location and extent of these works for FY23 are outlined in the following table.

Table 58 FY23 UTC/DTC Scope - Blackwater

Scope		Location	Qty	Unit
DIGITAL TELEMETRY	RENEWAL	GREGORY MINE	1	SITE
DIGITAL TELEMETRY	RENEWAL	KINROLA	1	SITE
DIGITAL TELEMETRY	RENEWAL	YAN YAN	1	SITE
DIGITAL TELEMETRY	RENEWAL	TIKARDI	1	SITE
DIGITAL TELEMETRY	RENEWAL	BOORGOON	1	SITE
DIGITAL TELEMETRY	RENEWAL	CURRAGH	1	SITE
DIGITAL TELEMETRY	RENEWAL	GORDONSTONE	1	SITE
UTC CODE AND SAFEWORKING	RENEWAL	BLACKWATER SYSTEM STATIONS	1	SYSTEM

ix. Other Control Systems Renewals

In FY23, design of sites for future renewal across train detection and signal interlockings is captured as Control Systems Other. These design works completed in FY23 will be installed in FY24. In FY23 the following designs are to be progressed:

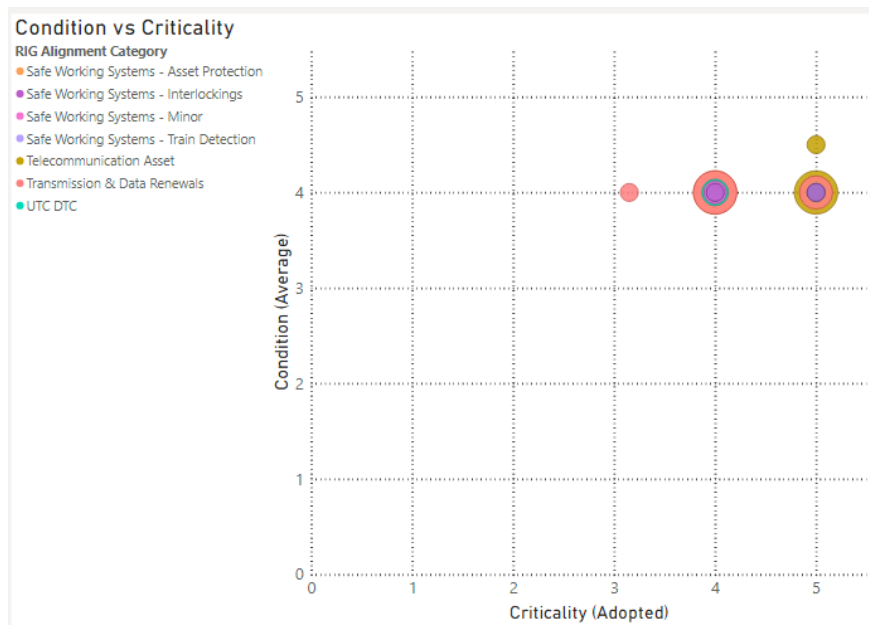
Table 59 FY23 Other Control Systems Renewals Scope - Blackwater

Scope		Location	Qty	Unit
CSEE TO AXLE COUNTER	DESIGN	WARREN	1	STATION

Control Systems Assets - FY23 Scope Asset Condition and Criticality Assignment

The following graphic plots the Control Systems renewals against asset condition and location/ operational criticality. As can be seen all scope items, except 1 UTC package are listed as condition rating 4. This reflects the age of assets targeted for renewal in FY23. Control Systems assets are mostly electronic, so renewal is a trigger of support, spare parts or software obsolescence. As such condition is more a matter of asset age against design life rather than a physical demonstration of wear.

Figure 27 Control Systems Assets – FY23 Scope Priority Ratings - Blackwater



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic

Control Systems Assets FY23 Program - Options Considered

All the proposed renewal scope for Blackwater Control Systems in FY23 is condition rating 4 or above and critical to system operations.

For the proposed FY23 Control Systems renewals, the renewal driver is predominantly age of the assets and technological obsolescence. The assets identified for renewal are at the end of their useable lives and in some instances operating beyond design life. Systems are unsupported by the original vendor and spares to maintain the systems are rare.

As a result, the options considered are centred around the speed of renewal or the technology choice to replace.

Table 60 Control System Program Options

Option	Description	Risk of Asset Failure	Impact
Plan scope over a multi-year program, managing asset performance risk	Planning objective is to maintain or reduce network service delays relative to current levels. The proposed scope can be completed within planned possession constraints.	Low	The proposed scope nominally targets this level of obsolescence risk. Other options are considered only when other factors (opportunities or costs) associated with the practicability of program implementation outweigh the capacity benefit associated with this renewal objective.
Defer some or all of the proposed scope, taking asset performance risk	Deferral may increase the near-term risk of unplanned disruption due to increasing failure frequency, or delay to return to service after failure. A future acceleration of renewal to redress the deficit may require an increase in the number or duration of possessions.	Medium	This option is considered for assets where asset performance remains satisfactory, and where spares inventory can be sustained through a recover and reuse strategy to ensure return to service upon failure. It is used to reduce the demand for track possessions to within target levels in the

Option	Description	Risk of Asset Failure	Impact
			planned year, or to moderate demand for finite execution resources.
Accelerate scope, to eliminate obsolescence risk	While the availability of assets may improve, any significant acceleration may require an increase in track possession beyond the annual budget, eroding annual throughput.	Low	This option is typically considered when there is an efficiency associated with the bundling of renewals within a geographical location, or to remove a category of equipment from a maintenance district (possibly supporting deferral of renewal in another district through replenishing of obsolete spares). It may also be used where a capacity impact is observed from a previous deferral of renewals.
Modernisation	Reduce delays due to failures through deployment of resilient systems and architectures using modern technologies	Low	In conjunction with the scheduling of asset renewals, alternative modern technologies and resilient system architectures are considered to ensure advantages of networked digital assets.
Alternative Fibre Optic Cable installation	Options: OPGW (Optical Ground Wire) fibre optic cable, installed in lieu of the traction earth wire. Air Dielectric Self Supporting (ADSS) fibre installed on traction masts.	Medium	These options would be more expensive to install and maintain given interaction with OHLE, however is considered in certain circumstances where appropriate.
Digital Microwave Radio	As a replacement for fibre optic cable, it introduces a significant capacity constraint, and increases exposure to cyclone and storm events due to equipment exposed on structures.	High	Digital Microwave Radio provides limited capacity between 2 points. It is a highly precise focal beam technology requiring substantial tower structures (height and strength) to sustain connection. Microwave Digital Radio is not considered sufficient for baseline capacity requirements.
5G mobile data network	Not practicable	N/A	5G options were not deemed appropriate as the 5G network is not commercially available for use in the CQCN.

Electrical Assets

Electrical Renewal Program

Several of Aurizon Network's power systems assets are nearing the end of their design life in the coming financial years. Aurizon Network is progressing its analysis to better understand options with respect to future power systems renewal requirements. As this develops, Aurizon Network will engage with the RIG in relation to those options.

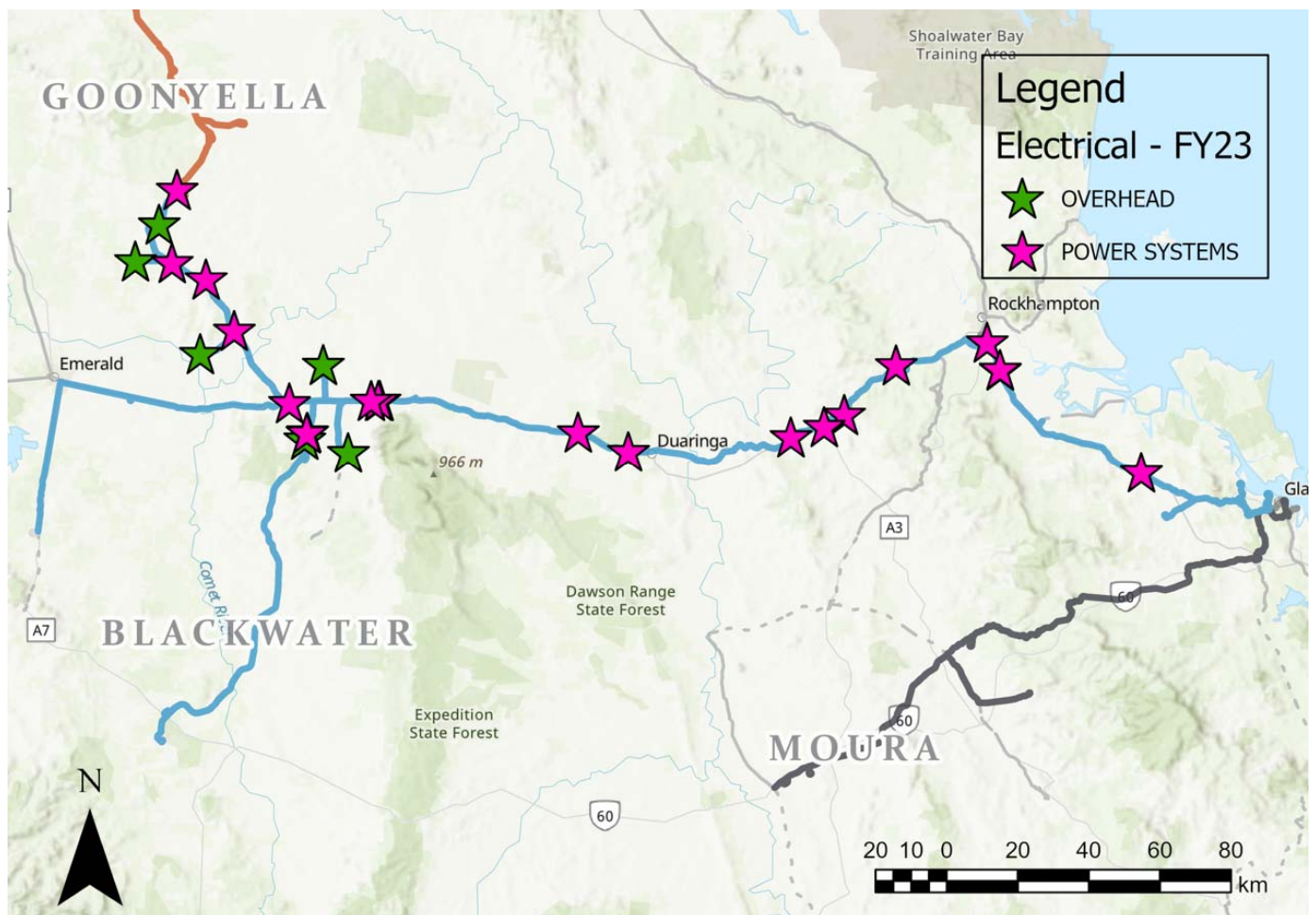
In FY23 Aurizon Network proposes to undertake \$5.6m of Electrical Renewals or enhancements in the Blackwater System. Table 61 summarises the scope and budget for each relevant renewal item.

Table 61 FY23 Electrical Renewal Program - Blackwater

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Overhead Line Equipment Renewals	16.0	Sites	2.7	Overhead Line Equipment (OHLE) consists of all overhead wiring and support structures of the Aurizon Network's electrified system which transmit the power from the points of connection to the electric locos.
ii. Power Systems Renewals	44.0	Units	2.3	The traction power systems assets (e.g., autotransformers and motorised isolators) manage the transmission and distribution of power from the electricity grid to the electric locomotives.
iii. Traction Substation Renewal (Concept)			0.5	Aurizon Network's traction substations enable a connection to the transmission grid, provide switching capability and high voltage protection systems.
TOTAL			5.6	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

Figure 28 FY23 Electrical Renewal Sites - Blackwater



i. Overhead Line Equipment (OHLE) Asset Renewals

The proposed scope for OHLE renewals in FY23 is a \$2.7m investment across three scope items.

Table 62 FY23 Overhead Line Equipment Scope - Blackwater

Scope	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
Overhead Reactive Works		Fix on Fail	1.0	Allocation to fix on fail for componentry renewals
Overhead feeder wire and Clearance Improvement Renewal	3.0	Units	1.1	Increasing the clearance of the OHLE at several sites to bring back to current standard to minimise faults primarily due to wildlife and/or to minimise safety hazards.
Termination Portals	13.0	Units	0.6	Renewal of termination structures which support the overhead line on each side of mine loadouts.
TOTAL			2.7	

Scope comments:

- **Overhead Reactive Works** - The \$1m allocation to overhead reactive works is consistent with prior years expenditure for overhead component renewals.
 - Scope consists of renewing overhead line components including insulators, clamps and steelwork fittings.
- **Overhead clearance improvement** – increasing the distance between the overhead wire equipment and the rail infrastructure at selected locations.
 - In 2020, Aurizon Network reported a dangerous electrical event at Edungalba siding after the live feeder wire was accidentally earthed.
 - Following this incident, a review of similar arrangements in the network was undertaken. Potential sites were identified for rectification to remove these hazards. Rectification works are now part of an ongoing feeder wire clearance improvement program which will address these hazards across the network. The program is currently planned out to FY27.
- **Termination Portal Renewals** - renewal of key components of termination portals at selected mine sites that have advanced corrosion evident.
 - Component renewal not full structure renewal
 - A program for renewal of all termination portals is required through to FY26

ii. Power Systems Renewals

The proposed scope for Power Systems renewals in FY23 is a \$2.3m investment as per the following table.

Table 63 FY23 Power System Scope - Blackwater

Scope	Qty	Unit	Value (\$m)	Description
Autotransformer Renewal	2.0	Units	0.9	Renewal of aged Autotransformers that are operating beyond design life, including site renewal.
Current Detectors	2.0	Units	0.03	To narrow the area of investigation required when an electrical trip occurs and reduce response times.
Earthing & Bonding	6.0	Site	0.3	Renewal of key elements to ensure the ongoing integrity of the traction power return current circuit, and to mitigate unsafe earth potential rises when faults occur.
Fault Locator install	11.0	Site	0.2	These units are co-located with autotransformers and work together to accurately locate traction faults. This enables maintenance crews to be quickly deployed to the faulted

Scope	Qty	Unit	Value (\$m)	Description
				site, make repairs, and return the network to normal operations.
Motorised Isolator Renewal	14.0	Sites	0.6	Electrical switching assets that can be remotely operated by the Electric Control Operator.
Power Supply Cubicle (PSC) Battery Renewal	4.0	Sites	0.1	Backup DC power supply.
Protection Relays Renewal	4.0	Sites	0.2	Renewal of protection relays which disconnect the HV power supply when faults are detected.
TOTAL			2.3	

Scope comments:

- Autotransformer Renewal** - Over the past few years, Aurizon Network has observed that Tyree autotransformers installed in the mid 1980s can fail in service without any advanced warning, despite showing healthy oil test results. This increases the risk of a bow wave of future renewals due to the aging transformer fleet. Aurizon Network is addressing this risk by implementing a new Autotransformer Renewal Strategy which takes account of condition and known failure modes.
 - Renewal includes installation of bund walling where required which is an environmental protection requirement to contain any oil spill for autotransformer failure.
 - Autotransformer suppliers require a long lead time to manufacture materials. As a result, it may be necessary to place orders in FY23 for autotransformers which will be installed in future years. Early payment milestones may be achieved within FY23.
- Current Detectors** – devices which measure current to detect faults within electrical sections. Current detectors enable maintenance staff to locate faults in multi-track areas.
- Earthing & Bonding** – renewal and upgrade of electrical earthing and bonding at selected sites
- Fault Locators** - installation of new fault locators on the Bauhinia Branch. Fault locators allow for maintenance staff to effectively identify the location of a fault along the length of an electrical section reducing fault identification and remedy time.
- Motorised Isolators (MI's)** – MI's allow the Electrical Control Operator to remotely isolate track sections via the SCADA system by opening electrical circuits. This program is a renewal of MI's that were installed as part of the mainline electrification project in the 1980's.

iii. Traction Substation Renewals

In FY23 Aurizon Network is proposing an allocation of \$0.5m to further develop the design requirements, estimated costs and timeframes required for the renewal of the 8 Air-Insulated Switchgear (AIS) traction substations which will reach the end of their nominal service life in the next 5 to 10 years.

The project presents an opportunity for Aurizon Network and its customers to consider the reliability requirements of the electrified rail corridors, and possible trade-offs between network resilience, renewal expenditure and ongoing maintenance costs.

The selected "Generation 1" Air Insulated Switchgear (AIS) traction substations will reach the end of their 40-year design life in the next 5 years. These substations were constructed in the mid-1980s, and while short-term life

extension may be possible at some sites with increased asset management attention, these assets require renewal over the next decade to maintain reliability, safety and compliance with modern standards. The renewal of the 1980's substation assets is the first major renewal of the electrical traction system since its installation.

The work to date has involved a specialist consultant assisting in developing a range of substation renewal treatment options and associated estimated costs for each of the substations approaching end of life. The engineering solution for each substation is expected to be identified towards the end of FY22, with options baselined and further design development to be completed during FY23. Undertaking this early design phase is an important element to inform the decision making process. Aurizon will present the outputs and the possible investment options to the RIG, with the view of involving the RIG in the investment approach into future years.

As is consistent with treatment of design costs with other assets, these costs will form part of the cost base of the final assets.

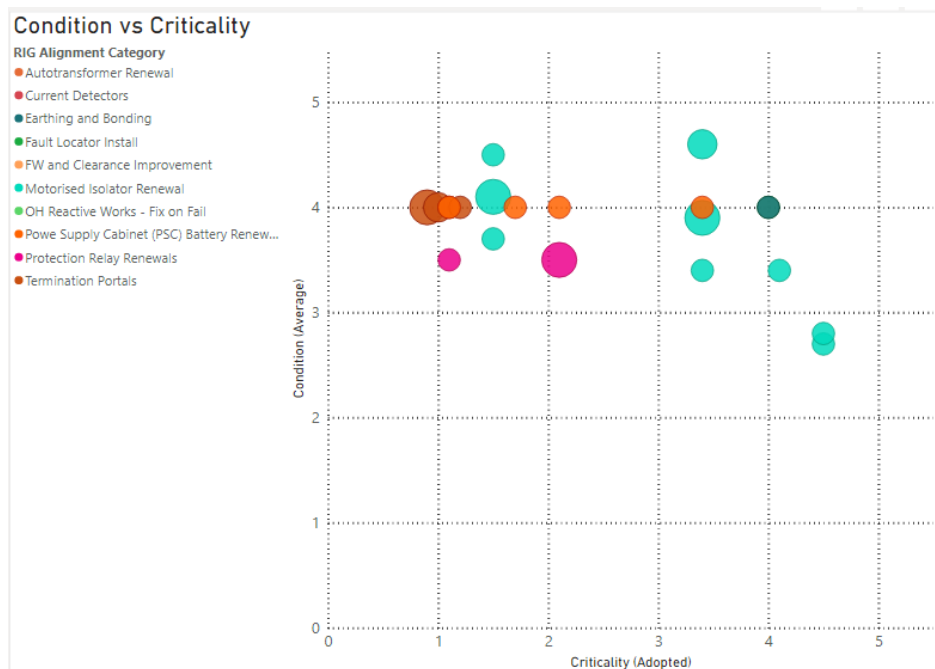
A high-level forecast of future investment requirements for this program is included in Chapter 9.1.

Electrical Assets - FY23 Scope Asset Condition and Criticality Assignment

The following graphic plots the Electrical renewals against asset condition and location/ operational criticality. Figure 29 indicates that:

- There are a large population of scope items around criticality 1.5 with a condition rating of greater than 3. Although these renewal scope items have lower criticality scores, they are important assets in the traction network and must be renewed as they are reaching end of life.
- Some renewals scope is designated as "Strategic" and not shown on the graph below. Strategic renewals are typically undertaken to improve safety or operations (e.g., feeder wire clearance improvements), or where there is a significant multi-year investment strategy being pursued (e.g., the Autotransformer Renewal Strategy).

Figure 29 Electrical Assets – FY23 Scope Priority Ratings - Blackwater



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic

Electrical Assets FY23 Program - Options Considered

The average condition rating of the proposed FY23 Electrical renewal scope in Blackwater is 3.9.

For the proposed FY23 renewals the renewal driver is predominantly age of the assets, importance to electrical safety and component renewals to maintain the operations of the electrical infrastructure and avoid faults that by their nature introduce significant delay into the supply chain.

As a result, the options considered are centred around the speed of renewal or the technology choice to replace.

Table 64 Electrical Asset Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Minor impact as works are completed in the shadow of other renewal and maintenance activities or in feeder stations that can be de-energised whilst still retaining throughput due to the N-1 resilience built into the system.	Low	The renewal or upgrade will maintain reliability and availability levels and extend the asset's life. It will also maintain electrical safety risks at acceptable levels. The OHLE component renewal will change out defective or degraded electrical components and reduce the risk of dewirements that have a significant impact on electrical safety and system availability.
Defer some of the proposed scope	Deferral of end of life components could result in failure that requires unplanned rectification and reduced network availability.	Medium	Failure to renew worn components can lead to unplanned failure and expose the network to unacceptable electrical safety and compliance risk
Do not complete proposed scope	Failure to replace end of life components could result in failure that requires unplanned rectification and reduced network availability.	Moderate	Failure to renew worn components can lead to unplanned failure and expose the network to unacceptable electrical safety and compliance risk.

Technology Projects

Technology Projects

As detailed in Chapter 3 of this FY23 Final Draft Proposal, Aurizon Network is progressing several technology projects to better understand, analyse, and identify scope across the CQCN assets. These projects improve Aurizon Network's ability to make data driven decisions regarding the management of the rail assets on behalf of the customers, stakeholders and safety regulators.

In FY23, Aurizon Network intends to progress a number of these initiatives and will seek support from the RIG to invest in these systems to enhance the maintenance and renewal programs for the Central Queensland Coal Network.

Two items are proposed to be progressed in FY23:

- ATIS – Automated Track Inspection system (ATIS) is a combination of autonomous measurement devices that provide frequent measurement of track and overhead geometry, pantograph interface and forward facing track vision. ATIS will provide Aurizon Network with increased understanding of track and overhead alignment, moving decisions of rail and overhead alignment management from qualitative decisions to quantitative data driven assessments. Currently Aurizon Network is finalising the trial of the Wire Geometry

Measurement system (WGMS) and the Pantograph Collision Detection System (PCDS) in the Blackwater and Goonyella systems ahead of presenting the business case for investment. This business case will be discussed with the RIG, seeking customer support in Q3 FY22.

- As the standardisation of the OneSAP system is completed across Aurizon Network some system functionality gaps may become evident requiring investment in SAP modules or system architecture changes. No allowance has been included in the FY23 Final Draft Proposal. If an investment is required, then Aurizon Network will engage with the RIG on the required level and timing of investment.

Goonyella System



6. Goonyella System

This chapter presents Aurizon Network's Draft Maintenance and Renewal Strategy and Budget for the Goonyella System during FY23. In line with 7A.11.3 of UT5, this section will be subject to vote by the relevant Goonyella End Users.

Aurizon Network's FY23 Final Draft Proposal for the Goonyella System provides for:

- **A Direct Maintenance Cost Allowance (excluding ballast undercutting plant depreciation) of \$60.2m**
This represents an increase of \$1.9m compared to Aurizon Network's current FY22 full year maintenance forecast and an increase of \$2.2m compared to the FY22 Approved Maintenance Strategy and Budget.
- **A Renewals Allowance of \$122.4m**
This represents an increase of \$9.5m compared to Aurizon Network's current FY22 full year renewals forecast and an increase of \$1.6m compared to the FY22 Approved Renewals Strategy and Budget.

6.1 Goonyella System - Characteristics and Corridor Strategy

The Goonyella System is Aurizon Network's largest Coal System by volume. It services coal mines in the central and northern Bowen Basin, carrying product to the ports at Dalrymple Bay and Hay Point. The Goonyella System includes approximately 1,006Km of electrified track.

Maintenance and renewal activities in the Goonyella System are primarily delivered from depots located in Jilalan and Moranbah, with mobile mechanised plant based in Yukan and Rockhampton.

Aurizon Network's depots are strategically located to enable incident response times within approximately two and a half hours, depending on whether significant travel is required within the rail corridor, such as between South Walker Creek and Hail Creek. Mechanised plant (e.g., resurfacing) is typically able to respond to an urgent defect (e.g., a buckle or geometry defect) in the Goonyella System within 1 day.

Figure 30 Depot Locations – Goonyella System



Aurizon Network has considered asset conditions specific to this Coal System when developing the FY23 Final Draft Proposal, particularly in relation to:

- **Civil Assets** – The civil assets in the Goonyella System see the highest tonnage of the four Coal Systems and the highest train density. The Great Dividing Range crossing at Black Mountain is a significant rail crossing with high grades and tight curves resulting in significant train dynamics and inertia forces applied to the rail, sleeper and formation assets. Given the steepness of the terrain and the fact that the area can

record high rainfall in short periods, there is a significant network of drains, culverts and spillways to assist water shed from the mountainous areas, aiming to minimise impact on rail operations. Due to the concentration of train movements, the Goonyella System has the highest volume of tonnage-based maintenance and renewal activities

- **Control Systems Assets** – A significant amount of the Control Systems assets in the Goonyella System are original 1980's infrastructure from the initial installation. These assets are nearing or beyond their nominal service life in particular signal interlockings. The radio system across Goonyella was upgraded in recent years to a digital based Terrestrial Trunked Radio (TETRA) system. Train positioning is achieved through a mix of track circuited track sections and axle counter sections. A program to modernise the optic fibre in Goonyella commenced in FY22 and continues in FY23.
- **Electrical Assets** – The Electrical assets were largely installed during the mid-1980's Main Line Electrification Project. A significant proportion of the assets are approaching the end of their 30-40 year design life. The assets nearest the ports see significant corrosion due to the coastal environment. A focus of FY23 is the planning for the renewal of original installed power substation assets as well as lifting the reliability and ability to recover from defects around the Goonyella ports area.

Corridor Strategy:

- The Goonyella System is a purpose-built Coal System and has seen significant expansions both in terms of extensions and section duplications. There is a mix of asset condition given age and use.
- The Goonyella system is highly utilised and as such the maintenance focus seeks to minimise the capacity impact of unplanned outages due to infrastructure failures. Where possible the strategy is to rectify faults in a planned manner ahead of faults becoming a service disrupting failure.
- The arrangement of the Black Mountain range crossing requires highly strengthened assets including track structure to operate under the train load and intensity, but also significant drainage structures to move water away from the railway in rain events.
- The system is predominately serviced by electric traction, so feeder stations are located closer together in Goonyella than in Blackwater, and the impact of an outage is magnified in the system with little ability to substitute rollingstock during electrical outages.
- Trains move predominantly east towards the ports at Dalrymple Bay, but with trains originating in the Goonyella system also rail north to Abbott Point via Newlands or south to Gladstone via Blackwater, so loaded trains operate in both directions in the western areas.

6.2 Goonyella System - Integrated Closure Plan

Aurizon Network has engaged with the RIG and other stakeholders to better understand their requirements and has taken the following into consideration when developing the FY23 Integrated Closure Plan:

Specific Goonyella Supply Chain considerations:

- **Port operating mode and mine stockpile capacity:**
 - Careful consideration of closure lengths to minimise starving cargo assembly ports. Failure to do so would result in loss of loading capability, berth vacancies and increased demurrage costs.
 - Alignment with major in-loading outages to mitigate higher impact asset activity and locations, e.g., extended single line asset activity.
- **Closure timing:**
 - Avoid peak demand periods and closure conflicts with adjacent corridors.
 - Integrated system closures being planned in consultation with ports at nominal 6-weekly intervals.
 - December and June are avoided to provide the opportunity to maximise railings for the end of calendar and financial year respectively.

Table 61 below outlines the proposed Goonyella System integrated closure hours for FY23, including integrated system and branch line closures.

Table 65 Planned integrated closures and branch closures– Goonyella System

FY23 Integrated System Closures													
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Hours	36	60	0	60	36	0	36	36	36	0	60	0	360
FY23 Integrated Branch Line Closures													
Location	Gregory (nth)			Gregory (nth)				Blair Athol					
Hours	60	0	0	0	60	0	0	0	60	0	0	0	180

In addition to the integrated system and branch line closures (outlined in Table 62) single line maintenance activities will be planned during the year (as required by the asset) and will have regard to seeking to deliver Committed Capacity, and that outages are coordinated with other Supply Chain Participants wherever reasonably possible with a view to maximising throughput.

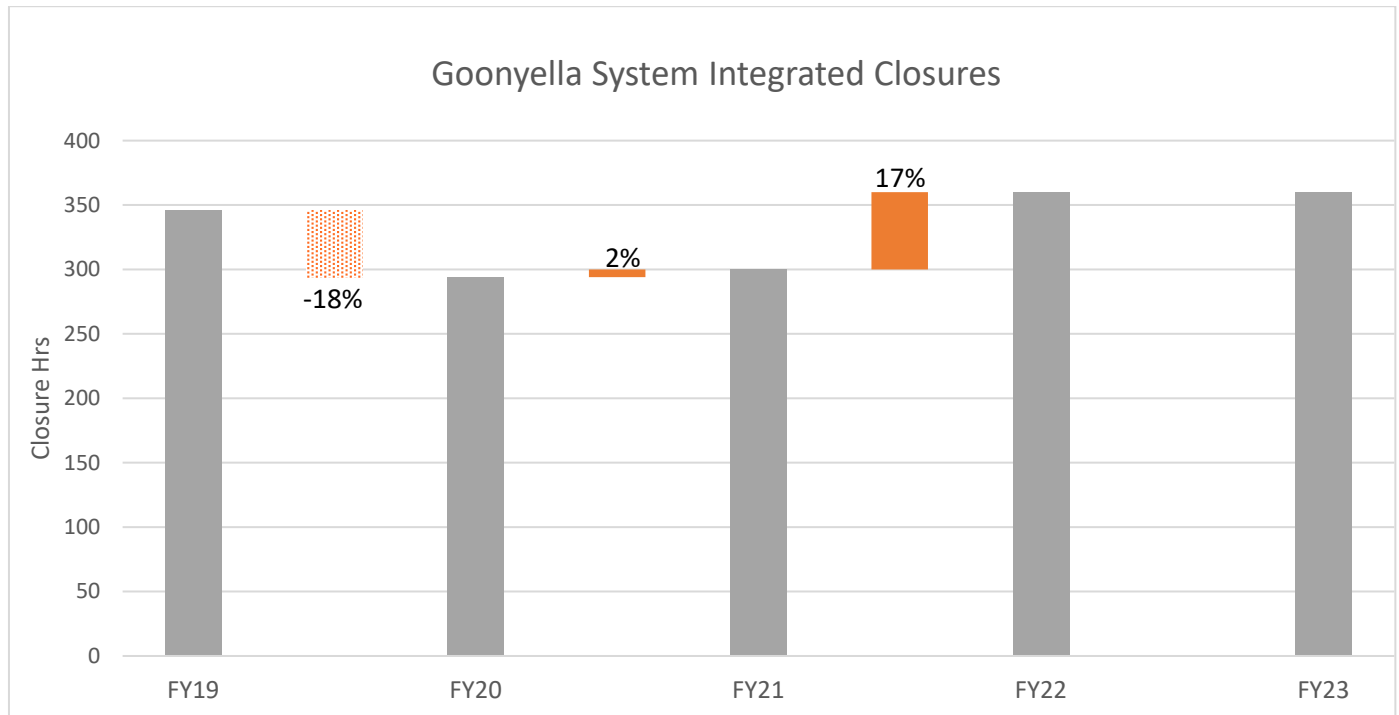
The following asset activities have determined the duration of the planned integrated closures and access requirements in the Goonyella System during FY23:

Table 66 Critical Scope in the Goonyella System

Planned Delivery (hrs)	Asset	Location
120	Track Upgrade	Bolingbroke (67.07 – 74.80Km)
60	Ballast Cleaning	Mindi Down Rd (110.175 – 116.920Km)
60	Culvert Renewal	Yukan (28.230Km & 28.350Km)
108	Bridge Bearing Replacement	Nebo Creek

Figure 31 below illustrates the historical Goonyella integrated system closure hours in comparison to the FY23 Final Draft Proposal.

Figure 31 Trend of Integrated Closure Hours from FY19 to FY23 - Goonyella System



6.3 Goonyella System - FY23 Maintenance Strategy and Budget

Aurizon Network has developed its Draft Maintenance Strategy and Budget for the Goonyella System having regard to all relevant matters outlined in clause 7A.11 of UT5, including the Maintenance Objectives. Aurizon Network considers its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of Goonyella System Rail Infrastructure and seeking to deliver Committed Capacity.

6.3.1 Summary of Historic, Forecast & FY23 Maintenance Strategy and Budget

Aurizon Network’s FY23 Final Draft Maintenance Strategy and Budget for the Goonyella System provides for a Direct Maintenance Cost Allowance of \$60.2m (excluding ballast undercutting plant depreciation) which is:

- \$2.2m higher than the FY22 Approved Maintenance Strategy and Budget; and
- \$1.9m higher than Aurizon Network’s current FY22 full-year forecast.

Figure 32 below provides a summary of historic direct maintenance costs as well as the proposed direct maintenance cost allowance in respect of FY23. To ensure comparability with prior periods, the direct maintenance costs shown in the chart below exclude depreciation on ballast undercutting plant.

Figure 32 Goonyella System Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

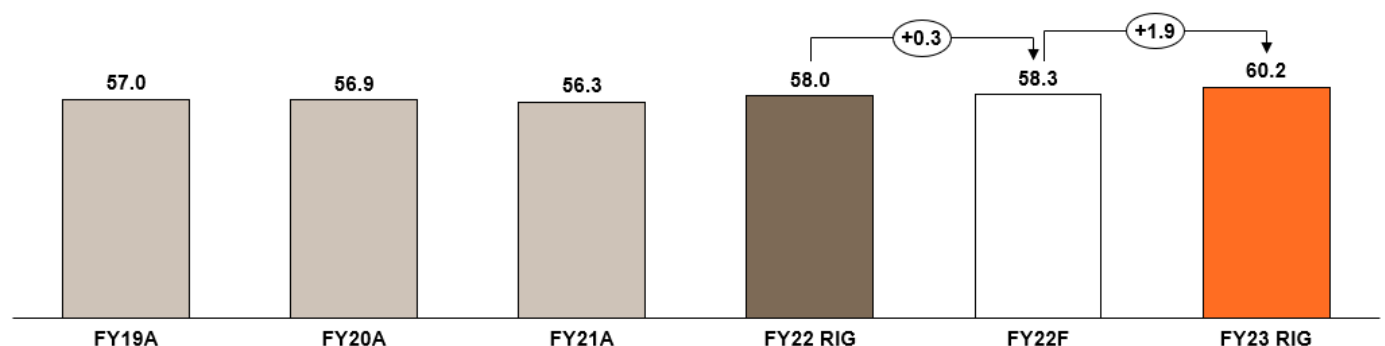
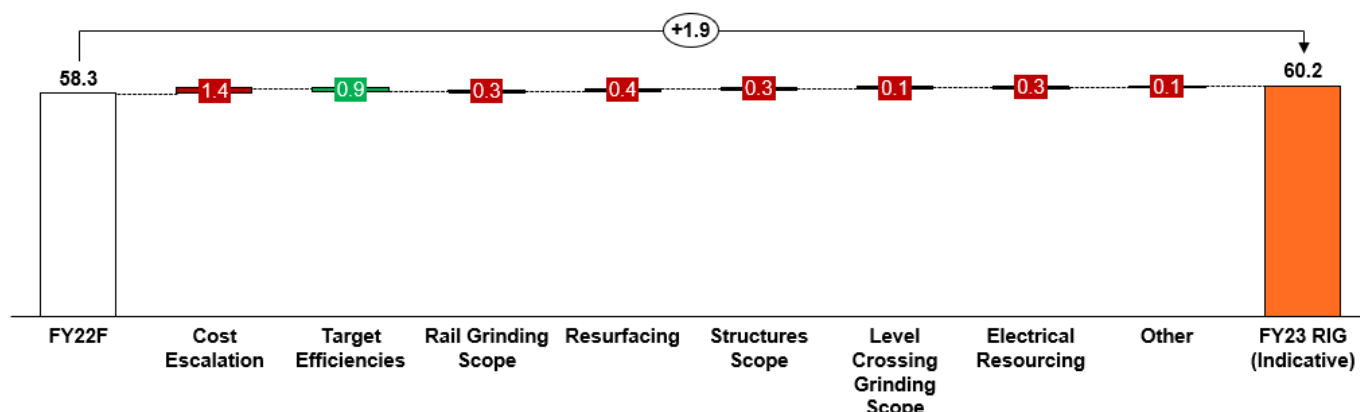


Figure 33 Goonyella System Direct Maintenance Cost Movement (excluding ballast undercutting plant depreciation)



As noted in the Quarterly Report for Q1 FY22, the current forecast for FY22 direct maintenance costs excluding ballast undercutting plant depreciation is \$58.3m (as at 30 September 2021). The increase in forecast spend against the FY22 Approved Maintenance Strategy and Budget is primarily driven by increases in Signalling & Telecommunications (\$0.1m), Structures and Facilities (\$0.1m) and Other General Maintenance (\$0.1m).

The revised forecast takes account of actual conditions and run rate costs from FY21 and Q1 FY22. None of the individual item variances is greater than the indicative materiality thresholds set in UT5. The FY22 forecast is subject to review and will be updated at the end of Q2 FY22.

The proposed direct maintenance cost allowance for FY23 (excluding ballast undercutting plant depreciation) is \$60.2m, \$1.9m higher than the current FY22 direct maintenance cost forecast, which has been used as the basis for developing the FY23 Final Draft Proposal. This increase represents the net impact of assumed cost escalations and scope changes (+\$2.8m) offset by target efficiencies (-\$0.9m).

An overview of the methodology used to establish the FY23 maintenance cost budget is provided in Chapter 13. Chapter 6.3.2 below provides a summary of the maintenance scope and budget proposed for the Goonyella System in FY23 for each maintenance item.

6.3.2 FY23 Maintenance Strategy and Budget

Maintenance Approach

As detailed in Chapter 11.2, Aurizon Network’s Asset Management approach is based on achieving the appropriate level of asset availability at the most efficient cost of ownership, through the entire asset life cycle, which will best meet customer requirements for each Coal System.

Aurizon Network’s Asset Maintenance and Renewal Policy is to maintain the condition and availability of the network consistent with previous performance. The scope and closure requirements in different systems is influenced by demand, track arrangement, operating parameters, traction mode and signalling and communications systems.

The Goonyella System is highly utilised. Aurizon Network’s maintenance approach for the system seeks to hold the asset condition steady and minimise the capacity effect of unplanned outages due to infrastructure failures and appropriately manage the requirement for Temporary Speed Restrictions.

Goonyella is the largest system by volume and by train density with some sections seeing a train every 21 minutes. The high tonnage and concentration of train movements results in a maintenance and renewal mix very similar to the Blackwater system that has longer haul lengths and aged infrastructure. The mix of maintenance to renewal costs for Goonyella can be seen in the table below.

Table 67 FY23 Proposal – Goonyella System Maintenance & Capital spend % split

System	FY23 Renewals and Maintenance Cost (\$m)	% Maintenance	% Capital
Newlands	\$35.4	36%	64%
Goonyella	\$182.6	33%	67%
Blackwater	\$189.7	34%	66%
Moura	\$28.6	45%	55%

The planned and preventative maintenance activities and inspections, as well as the planned mechanised production scope, are derived in line with the intervention periods as detailed in the Asset Maintenance & Renewal Policy. This Policy determines the inspection regime and period based on asset type condition and locations.

The proposed FY23 maintenance scope and budget for the Goonyella System is outlined in Table 76. Please note that the totals presented in the tables below may not add due to rounding.

Table 68 FY23 Proposal – Goonyella System Maintenance

Maintenance Item	Scope Units	FY22 Forecast Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
Resurfacing			9.3		9.9
- Mainline	Km	956	7.4	956	7.8
- Turnout	Site	189	1.9	189	2.1
Rail Grinding			8.5		9.1
- Mainline	Km	█	6.9	█	7.2
- Turnout	Site	█	1.7	█	1.8
- Level Crossings	Track LX		-	█	0.1
General Track Maintenance			16.3		16.4
- General Track	Activity		14.8		14.9
- Track Recording	Km	1,809	0.9	1,809	0.9
- Ultrasonic Testing Car	Km	5,216	0.6	5,729	0.6
Signalling and Telecoms			9.8		10.0
- Signalling Corrective	Activity		2.2		2.9
- Signalling Preventative	Inspection		4.6		4.2
- Telecoms Corrective	Activity		0.3		0.3
- Telecoms Preventative	Inspection		2.7		2.6
Electrical			6.1		6.2
- OHLE Corrective	Activity		1.8		2.3
- OHLE Preventative	Inspection		2.7		2.4
- Traction Substation Corrective	Activity		0.4		0.2
- Traction Substation Preventative	Inspection		1.2		1.2

Maintenance Item	Scope Units	FY22 Forecast Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
Structures and Facilities			1.8		2.0
Trackside Systems			1.7		1.7
Other Civil Maintenance			2.6		2.6
Other General Maintenance			2.3		2.4
- Asset Management & Inventory			1.5		1.5
- On Call			0.8		0.8
- RM900 Storage & Maintenance			-		0.1
Sub-Total			58.3		60.2
Ballast Undercutting Plant Depreciation			2.6		2.5
Total Direct Maintenance Costs			60.9		62.7
Non-coal allocation			(0.0)		(0.1)
Total			60.9		62.6

For the Goonyella System:

- **Direct Maintenance Costs** (excluding ballast undercutting plant depreciation) are budgeted to increase by \$1.9m from the current FY22 forecast to \$60.2m in FY23. The movement in cost between periods reflects the net impact of cost escalation and scope changes (\$2.8m) partially offset by estimated target efficiencies (\$0.9m). Key movements in RIG maintenance categories are summarised below.
 - **Resurfacing (+\$0.6m)** – this increase primarily reflects cyclic maintenance costs. Resurfacing plant has varying annual maintenance cycles such that costs of maintaining the equipment will vary year on year for the life of the plant.
 - **Rail Grinding (+\$0.6m)** – this increase primarily reflects an increase in mainline and turnout grinding scope. The draft budget also includes an allowance for the introduction of a preventative level crossing rail grinding program.
 - **General Track Maintenance (+\$0.1m)** – this category represents approximately one quarter of overall maintenance costs in the Goonyella System. Cost increase primarily reflects cost escalation.
 - **Ultrasonic Testing Car (\$0.0m)** - Variance in scope compared to FY22 is attributable to an extra run that is required due to timing and tonnages on the main line.

Since FY21, Aurizon Network has made improvements to better align the requirement for ultrasonic testing (every 10MGT) with actual traffic movement rather than assumptions of traffic flow across the railway. Resetting intervals on (primarily) unloaded track has resulted in a reduced annual program. In addition, the ultrasonic test car is able to test up to 120km per day (dependent on sectional length and access planning), 75% more than in FY18. This is by enhancing the ultrasonic test car to be able carry more water for testing. Where the shift block durations (number of consecutive testing days) have been less than optimal to align with train access priorities, the shift count compared to a stable scope requirement will result in variations in costs from year to year

- **Signalling and Telecoms (+\$0.2m)** – this increase primarily reflects cost escalation and an increase in trainee apprentice resources in the Control Systems teams.
- **Electrical (+\$0.1m)** – this increase primarily reflects cost escalation.
- **Structures & Facilities (+0.2m)** - this increase primarily reflects the cost of concrete repairs (\$0.7m) including installation of concrete line inverts, blast and paint protection on corrugated metal pipes, crack injection, spalling, patching and wall repairs. The higher concrete repair costs are partially offset by lower structures inspection costs due to the cyclical nature of inspections (\$0.5m).
- **Other General Maintenance (+\$0.1m)** – this increase reflects cost escalation as well as storage and maintenance costs for the BCM.
- **Ballast Undercutting Plant Depreciation (-\$0.1m)** – ballast undercutting plant depreciation is forecast to decrease primarily due to a reduction in the number of days that the ballast undercutting plant is expected to be operating in the Goonyella system in FY23.
- **Non-Coal allocation** – this adjustment reflects an allocation of costs to non-coal services and is calculated by applying an estimate of the non-coal proportion of total system GTKs to total system maintenance costs (excluding electrical spend and ballast undercutting plant depreciation).

In aggregate, these changes result in an increase in direct maintenance costs of **\$1.7m** from **\$60.9m** in FY22F to **\$62.6m** in FY23.

- The scope of planned corrective and reactive maintenance tasks is heavily dependent on the faults identified via the planned inspection programs. Consequently, scope for these activities cannot be defined. Aurizon Network has assumed that in FY23 the Coal System will see a similar level of faults that require planned corrective or immediate response as in prior years.
- For the Goonyella System, the following activities will be considered “items” for the purpose of UT5, clause 7A.11.5(f)(ii)(B)(2) - Resurfacing, Rail Grinding, General Track Maintenance, ‘Signalling and Telecoms’ and Electrical. The remaining activities, including ‘Structures and Facilities’, Trackside Systems, Other Civil Maintenance and Other General Maintenance are to be considered as an aggregated single item.

Set out in the chart below is a summary of historic, forecast and budgeted direct maintenance costs by maintenance category. To ensure comparability between periods, the direct maintenance costs presented in the chart exclude depreciation on ballast undercutting plant.

Figure 34 Goonyella System - Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

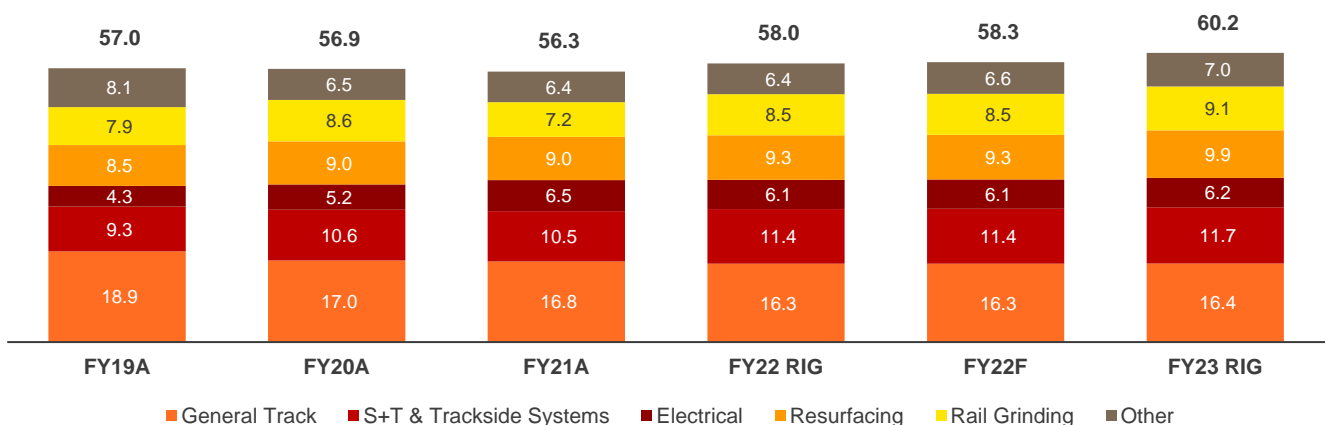
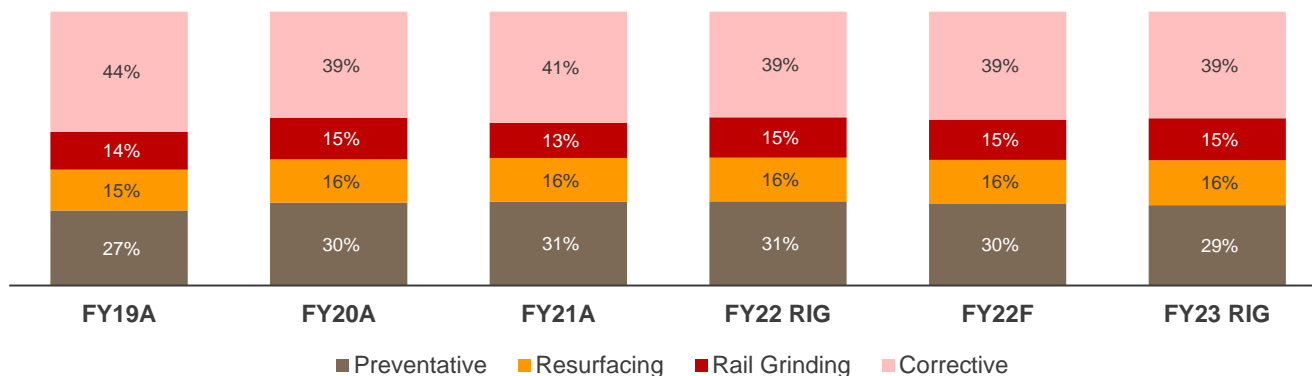


Figure 35 below illustrates the proportion of preventative and corrective maintenance expense in the Goonyella System over time. The cost of both Rail Grinding and Resurfacing maintenance activities have been categorised as preventative in nature. Approximately 61% of the Goonyella System maintenance spend in FY23 is expected to be

preventative in nature, which is higher relative to the smaller systems and comparative to the Blackwater system. It is broadly in line with FY20 and FY21 and reflects the focus on minimising unplanned outages in this System.

Figure 35 Goonyella System – Preventative / Corrective Maintenance Spend Composition



Further information in relation to the costing methodology used by Aurizon Network in the development of the Draft Proposal is outlined in Chapter 13. Additional detail in relation to the make-up of costs for each maintenance activity has also been provided to the RIG Expert Advisor.

6.3.3 Alternative maintenance options considered

Aurizon Network notes that there are several options available as to how and when asset renewal and maintenance is performed. When implemented, each option may have an associated flow on impact to other Supply Chain Participants. Aurizon Network’s access planning process endeavours to optimise impacts through appropriate access planning. Aurizon Network welcomes further discussions to explore alternative options.

As detailed in Chapter 12.2, Aurizon Network applies several different approaches with regards to maintaining the Rail Infrastructure. These approaches lead to the application of the maintenance task across the system. A summary of alternate considerations is detailed in Table 69 below. Aurizon Network welcomes the opportunity to work with Customers and other Supply Chain Participants to further explore alternate maintenance approaches.

Table 69 Maintenance Considerations

Activity	Description	Alternative maintenance option
Mainline & Turnout Resurfacing	Track settlement occurs in heavy haul railway conditions, presenting as track geometry defects that can result in derailments if not maintained effectively. Track resurfacing is an essential maintenance activity in railways to maintain safe track geometry for rolling stock. Track geometry defects can be symptomatic of an underlying defect, which is creating excessive or rapid track settlement. Multiple resurfacing interventions to maintain safety is a key consideration when determining whether ballast cleaning and formation renewal work is required. Resurfacing activities are currently delivered in a way that provides	<ol style="list-style-type: none"> Higher Production / Lower Cost / High Short-term Access Impact Option, provides: <ul style="list-style-type: none"> Larger blocks of uninterrupted access planned before trains are pathed Focuses on plant productivity and cost minimisation Negatively impacts access providing less flexibility to schedule between train services Potential to increased response time to TSR’s due to a longer planning horizon Maintenance targets more easily achieved Lower Production / Higher Cost / Low Short-term Access Impact Option, provides: <ul style="list-style-type: none"> Smaller blocks of access planned between trains Focus on capacity

Activity	Description	Alternative maintenance option
	operational flexibility with these activities currently scheduled after customer train orders. Planned works are delivered in the shadow of other maintenance activities and/or where customer demand permits. Resurfacing scope is both preventative and corrective based on the method of identification.	<ul style="list-style-type: none"> • Able to take advantage of periods of low demand (or advantageous access due to incidents) to increase production • Harder to meet maintenance targets • Closures utilised to target TSR's <p>Aurizon Network currently utilises option 2 in the Goonyella system as it delivers the most appropriate outcomes for the supply chain.</p>
Rail Grinding	<p>Rail grinding is a critical maintenance activity to reduce rail breaks and extend the life of rail.</p> <p>The rail grinding approach through the CQCN seeks to control surface initiated rail defects under a preventative regime. Intervention thresholds are based on throughput tonnage which are translated into a time-based frequency to allow long term planning. These frequencies are dictated by the 'tightness' of the curve as rail defects are directly correlated to the dynamic curving forces of trains.</p> <p>Rail grinding is also undertaken in a reactive way to remedy identified rail defects which are initiated from high traction locomotives or other unpredictable mechanisms.</p>	<ol style="list-style-type: none"> 1. Preventative grinding strategy with a small amount of corrective allowance 2. Corrective rail grinding strategy - A corrective rail grinding strategy would involve allowing rail surface defects to propagate to a severe condition, before reactively programming the rail grinder to perform deep rail grinding to remove the severe defect. This approach would reduce the rail grinding scope, however, significantly increases the risk that surface defects grow into the rail causing rail breaks. This approach would also restrict long term planning leading to disruption in the network for unplanned maintenance. Corrective rail grinding also reduces the rail asset life as more rail is removed during rail grinding to remove surface defects and cracks. Corrective rail grinding strategies are adopted in other rail networks that are lower throughput with plenty of maintenance windows or where the demand is seasonal. <p>Aurizon Network recommends a best practise preventative rail grinding program to ensure high availability and reliability of the rail asset</p> 3. On a face grinding (not recommended) – starting at a location and grinding rail in a continuous run for the length of a track within the System. <p>While this approach will maximise production rates, it will result in a reduction in rail life because grinding would be completed across entire track sections, even where it is not required.</p> <p>Aurizon Network recommends that its current approach to rail grinding remains appropriate. A reduction from the proposed scope will see an increase in rail defects leading to speed restrictions and an increase in rail replacements due to rail defects causing failures.</p>
General Track	The current inspection approach for General Track is a mix of the Track Recording Car, Ultrasonic Test Car, High Rail Vehicle inspection, walking inspections and non-destructive hand testing as detailed in the Asset Maintenance & Renewal Policy.	<ol style="list-style-type: none"> 1. Reduce Inspection Frequencies - Reduce inspection frequencies and revert to additional fix on fail methodology. A move to reduce the frequency of inspections would require consultation and approval from the Rail Safety Regulator. <p>This option is not recommended and would likely lead to an increase in unplanned delays and increased cost to rectify in an unplanned manner.</p> 2. Operational Intervention - To reduce the impact of high priority defects, Aurizon Network can apply

Activity	Description	Alternative maintenance option
Control Systems	<p>Maintenance is based on defined time-based inspections of equipment items (e.g., points, level crossings) and of equipment enclosures and power supplies.</p> <p>The frequency of inspection varies between equipment types and is based on failure modes and criticality.</p> <p>Frequency and tasks are reviewed annually for effectiveness based on observed asset condition, fault performance, and impact on rail services.</p>	<p>temporary restrictions to manage risks e.g., Temporary Authorised Non-Conformance, Temporary Speed Restrictions, Axle Load Restrictions or rerouting loaded and empty trains. These interventions can be localised to the defect to keep the rail line open whilst working with the above rail operators to find a least impact time to rectify the defect. Whilst this keeps the rail line open, this will potentially impact operational performance and could result in unplanned closures if the defect changes.</p> <p>Aurizon Network currently utilises option 2 in the Goonyella system as it delivers the most appropriate outcomes for the supply chain.</p> <p>Aurizon Network is currently trialling ATIS, an alternative option to the Track Recording Car outlined in Chapter 3.3. The results of this trial and possible effect on the frequency of general track inspections will be discussed with the RIG in due course.</p> <ol style="list-style-type: none"> 1. Maintain only on failure – not recommended and would likely lead to an acceleration of faults which will reduce the reliability of the systems which in turn reduces the capacity of the railway. 2. Planned frequency (current approach): recommended. The current planned frequencies are reviewed on an annual basis to align the required inspections to the condition of the assets. 3. Increased inspection frequency and/or accelerated replace and refurbish to reduce the likelihood of service affecting failures: this is considered annually in conjunction with maintenance check sheet review. Frequencies and activities are adjusted where it is believed that the in-service performance will be materially improved. Any change to the inspection frequencies requires consultation and approval from the Rail Safety Regulator.

Activity	Description	Alternative maintenance option
OHLE and Power Systems	<p>The Electrical Safety Act in Queensland requires that a Prescribed Entity, such as Aurizon Network, ensures that the asset is operated in a way that is electrically safe. This includes managing the high voltage electrical assets through effective maintenance and renewals activities.</p> <p>Maintenance is predominantly based on defined time-based inspections of equipment items (e.g., overhead lines, transformers, isolators, etc).</p> <p>The frequency of inspection varies between equipment types and is based on failure modes and criticality.</p> <p>Frequency and tasks are reviewed for effectiveness based on observed asset condition, fault performance, and impact on rail services.</p> <p>The maintenance frequency is defined in the Asset Maintenance and Renewal Policy, and forms part of the RIM accreditation.</p>	<ol style="list-style-type: none"> 1. Maintain only on failure – not recommended: expect to see an acceleration of faults as asset condition drifts from an acceptable performance level. Move to a fix on fail approach would lead to more component failures and dewirements, potentially resulting in a notification of a dangerous electrical event to the Electrical Safety regulator. 2. Planned frequency (current approach): recommended. The current planned frequencies are reviewed on an annual basis to align the required inspections to the condition of the assets. 3. Increased inspection frequency and/or accelerated replacement and refurbishment to reduce the incidence of service affecting failures: this is considered in conjunction with maintenance process review. Frequencies and activities are adjusted where it is believed that the in-service performance, including safety outcomes, will be materially improved. Any change to the inspection frequencies requires consultation and approval from the Rail Safety Regulator.

6.4 Goonyella System - FY23 Renewals Strategy and Budget

Aurizon Network has developed its Draft Renewals Strategy and Budget for the Goonyella System having regard to all relevant matters outlined in clause 7A.11 of UT5. Aurizon Network considers its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of Goonyella System Rail Infrastructure and seeking to deliver Committed Capacity.

6.4.1 Supply Chain Benefits of the Renewal Program

In addition to an optimised cost outcome, Aurizon Network's renewal program for the Goonyella System seeks to provide the following benefits for the supply chain.

Table 70 Supply Chain Benefits of the Renewal Program

Renewal Activity	Benefit Type	Description
Permanent Way	Asset reliability	Reduce network delays associated with unplanned asset activity. Asset components such as rail, sleepers and turnouts have a low likelihood of failure in a new state and require minimal maintenance once renewed.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition.
Ballast Cleaning	Asset reliability	Reduce network delays due to asset failure associated with track geometry defects and mudholes linked to poor ballast condition, due to coal fouling.

Renewal Activity	Benefit Type	Description
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses. Proactive ballast condition management mitigates TSR's caused by poor ballast condition.
	Safety	Improve the wet weather resilience of track (reduced unplanned defects which need to be responded to in a reactive manner). Reduces train derailment risk by managing asset condition.
Civil Assets	Asset reliability	Reduce network delays associated with asset failure and lifting renewed sections to the current required tonnages.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition. Removal of redundant assets reduces the risk of rail staff accessing the rail corridor and members of the public accessing no longer required live crossings.
Transmission and Data Networks	Asset reliability	Given these assets do not wear but rather age to a point where they are no longer supported renewal ahead of failure is required to retain asset reliability.
	Throughput	Renewal and system improvements to best move trains through the system in an efficient and safe way.
	Safety	Ensuring the critical signalling and train control systems are robust and effective in the separation of trains. Providing clear communications functionality across the CQCN systems.
Electrical Assets	Asset reliability	These are typically long-run assets which will eventually fail due to age-related defects and/or environmental factors. Renewal decisions are typically made based on failure risk or safety.
	Throughput	Traction power systems have built-in redundancy and typically allow normal throughput to continue in the event of an outage of one major piece of plant. By contrast, a single dewirement on the overhead line system will impact both electric and diesel services.
	Safety	Many of the High Voltage traction assets have inherent safety functions (e.g., protection and earthing systems). As a "Prescribed Electricity Entity" under the Electrical Safety Act 2002, Aurizon Network has clearly defined obligations to maintain an electrically safe system. This includes a mandatory annual Safety Management System audit by a qualified external auditor to review safety systems and infrastructure integrity.

6.4.2 Summary of FY23 Renewals Strategy and Budget

Aurizon Network's FY23 Final Draft Renewals Strategy & Budget for the Goonyella system provides for a Capital Renewals requirement of \$122.4m which is:

- \$1.6m higher than the FY22 approved Maintenance Strategy & Budget; and
- \$9.5m higher than Aurizon Network's current FY22 full year forecast

A summary of the FY23 renewals budget for the Goonyella System is outlined in Table 71. Please note that the totals presented in the tables below may not add due to rounding.

Table 71 FY23 Proposal – Goonyella System Renewals

Renewals Item (\$m)	Assets Include:	FY22 Approved Budget	FY22 Full Year Forecast	FY23 Draft Budget
Civil Assets		88.8	85.9	88.8
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	37.4	33.3	36.3
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	36.5	36.5	35.9
Structures	<i>Culverts, Bridges</i>	5.4	5.3	7.3
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	9.6	10.8	9.3
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>	21.1	16.6	22.3
Electrical Assets	<i>Overhead Line Equipment and Power Systems</i>	7.4	9.1	11.3
Technology Projects		3.5	1.3	--
Total		120.8	112.9	122.4

The FY22 full year forecast variance to the FY22 Approved Strategy and Budget is primarily driven by optical fibre replacement in the Control Systems renewals. The main driver of this cost variance is a revised schedule of the sites to be completed in FY22. The revised schedule has minimised mobilisation / demobilisation for the execution of the works and leverages the success in FY21 of alternate methodologies based on site conditions. Permanent Way assets are forecast lower than budget through a combination of scope reduction and anticipated cost efficiencies.

The detail of this change to the FY22 program and all variances in FY22 will be detailed as part of the Quarterly RIG reporting process.

Table 72 FY23 Proposal – Goonyella System Renewals as a % of Total System Assets

Renewals Item	Assets Include:	Total system Assets	FY22 RIG Approved Scope	FY23 Proposed Scope	FY23 scope % Total System Assets
Civil Assets					
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	<ul style="list-style-type: none"> • 2,036Km rail • 1,018Km sleepers • 1,018Km track • 399 turnouts 	<ul style="list-style-type: none"> • 26.8Km rail • 1.2Km sleepers • 15.2Km track upgrade • 3 turnouts 	<ul style="list-style-type: none"> • 35.0Km rail • 7.4Km sleepers • 13.0Km track upgrade • 0 turnouts 	<ul style="list-style-type: none"> • 1.7% • 0.8% • 1.3% • -
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	<ul style="list-style-type: none"> • 1,018Km Mainline • 399 Turnouts • 103 bridges 	<ul style="list-style-type: none"> • 65.2Km Mainline • 23 Turnouts • 4 bridges 	<ul style="list-style-type: none"> • 61.0Km Mainline • 24 Turnouts • 6 bridges 	<ul style="list-style-type: none"> • 6.0% • 5.7% • 5.8%
Structures	<i>Culverts, Bridges</i>	<ul style="list-style-type: none"> • 103 bridges • 1,169 culverts 	<ul style="list-style-type: none"> • 0 bridges • 8 culverts 	<ul style="list-style-type: none"> • 1 bridge • 7 culverts 	<ul style="list-style-type: none"> • 0.6% • 0.9%

Renewals Item	Assets Include:	Total system Assets	FY22 RIG Approved Scope	FY23 Proposed Scope	FY23 scope % Total System Assets
Civil Renewals	Formation, Level Crossings, Access Points	<ul style="list-style-type: none"> 1,018Km formation 277 level crossings 	<ul style="list-style-type: none"> 1.3Km formation 3 level crossings 	<ul style="list-style-type: none"> 2.4Km formation 1 level crossing 	<ul style="list-style-type: none"> 0.2% 0.4%
Control Systems Assets	Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission		<ul style="list-style-type: none"> 55 Sites 92.8Km Optic Fibre 	<ul style="list-style-type: none"> 54 Sites 117.0Km Optic Fibre 	
Electrical Assets	Overhead Line Equipment, Feeder Stations, Autotransformers, SCADA system		<ul style="list-style-type: none"> 10 Sites 51 Units 	<ul style="list-style-type: none"> 22 Sites 31 Units 29 Structures 	

Note:

- Control Systems count of assets is a collective of sites, nodes, cable routes, communications assets and systems and is included to indicate level of work comparable to prior year. Detail of actual scope is provided later in this section.
- Electrical count of assets is a collective of sites, earthing and bonding, current detection, insulator renewal, transformer renewal, protection relay replacement etc. Detail of actual scope is provided later in this section.

6.4.3 Details of the FY23 Renewals Strategy and Budget

This section provides detailed information in relation to the individual scope items selected for renewal in FY23, along with the rationale for those selections and alternative options considered.

Aurizon Network notes that the prioritisation of renewals scope is based on currently available information and that this prioritisation may change over the period prior to execution (of up to 18 months) because of environmental factors, relative degradation rates or other considerations. Changes to the proposed scope will be dealt with through the reporting and change management processes as appropriate.

In the preparation of the FY23 proposal, Aurizon Network conducted a likelihood of change review to determine scope that may incur project change to either cost or delivery, time to complete or location change. Further detail of this review is detailed at Chapter 12.1.7 of Part B and change drivers against individual scope items are included in this section.

Through the likelihood of change review, it was identified that of the 315 scope items proposed in Goonyella in FY23, 8% had a high likelihood of change, 17% had a moderate likelihood of change and 75% of the program is expected to have no change to either site cost, scope creep or works duration. An overview of this information by asset class can be seen in Table 73 below.

Table 73 FY23 Likelihood of Change – Goonyella

Asset Class	Total scope items	Items with High Likelihood of change	% of scope with High Likelihood of change
Civil	162	12	7%
Control Systems	82	4	5%
Electrical	71	8	11%
TOTAL	315	24	8%

The percentage of scope change relative to total scope is higher in the Goonyella Electrical program in FY23 as final designs and learnings from the FY22 installation program of Power System Protection Relays have yet to be finalised. The final design will be completed ahead of FY23, any changes will be reported through the change management processes and the RIG quarterly reporting.

Civil Assets – Permanent Way

Permanent Way Renewal Program

In FY23, Aurizon Network proposes to undertake \$36.3m of permanent way renewals in the Goonyella System. Table 74 below summarises the scope and budget for each relevant renewal item.

Table 74 FY23 Permanent Way Renewals - Goonyella

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Rail Renewal	35.0	Rail Km	12.1	Equates to 1.7% of track Km in the Goonyella System.
ii. Sleeper Renewal	10,885	Sleepers	6.2	Equates to 0.8% of track Km in the Goonyella System.
iii. Track Upgrade	13.0	Track Km	13.6	6 Track Upgrades planned and assigned to planned closures which is 1.3% of the track assets.
iv. Turnout Components		Fix on Fail	3.0	FY23 proposed cost based on historical fix on fail scope.
v. Turnout Designs			0.3	Designs for locations to be renewed in future years
vi. Permanent Way Other		Fix on Fail	1.0	Glued Insulated Joints (GIJ's) & Rail Lubrication installation and fix on fail scope.
TOTAL			36.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Rail Renewal

The FY23 rail renewal program for the Goonyella System will see rail renewals carried out at 17 sites that are either at or near their wear limit or have seen tonnages that indicate near term failure due to rail fatigue. The location and extent of these works for FY23 are outlined in Table 75.

Table 75 FY23 Rail Renewal Program - Goonyella

Ref	Track Section		Start Km	Finish Km	Length (Km)
1	BLACK MOUNTAIN	BLACK MOUNTAIN	42.857	43.613	0.972
2	BLACK MOUNTAIN	BLACK MOUNTAIN	34.756	36.019	1.296
3	BLACK MOUNTAIN	HATFIELD	47.490	48.530	2.080
4	BLACK MOUNTAIN	HATFIELD	44.518	45.058	1.080
5	BLACK MOUNTAIN	HATFIELD	41.391	41.906	0.864
6	BOLINGBROKE	BALOOK	62.623	63.001	0.756
7	BOLINGBROKE	BALOOK	70.199	73.150	5.902
8	BOLINGBROKE	BALOOK	68.901	69.283	0.764

Ref	Track Section		Start Km	Finish Km	Length (Km)
9	BRAESIDE	MINDI	109.220	111.110	3.780
10	HATFIELD	BOLINGBROKE	49.927	50.263	0.648
11	HATFIELD	BOLINGBROKE	52.876	54.000	2.248
12	HATFIELD COMMON LOOP	HATFIELD COMMON LOOP	49.323	49.809	0.972
13	HAY POINT	DALRYMPLE BAY	11.618	12.321	1.404
14	JILALAN	YUKAN	21.955	23.190	1.728
15	YUKAN	BLACK MOUNTAIN	36.371	39.178	5.616
16	YUKAN	BLACK MOUNTAIN	36.793	39.108	4.63
17	YUKAN	BLACK MOUNTAIN	39.390	39.500	0.220
TOTAL					34.960

Scope comments:

In the development of the rail renewal scope, site walkouts are undertaken to confirm start and end markers and identify any site-specific issues that need consideration in the planning phase. The proposed scope has had site walk outs completed, as such the likelihood of change is low.

- 8 of the 17 sites are on Black Mountain. This track section has a series of moderate and tight radius curves and high train density. Rail in curves wears the fastest due to the friction from the wheel rail interface and the wheel contacting more of the rail head as it steers through curves. The density of traffic means that a rail in a tight radius curve in Goonyella has an average life of 5 years, whereas rail in the same configuration and of the same quality in the Moura system lasts on average 33 years due to the much lower tonnages of that system.
- The scope at locations 6, 7, 8, 9, 11, & 13 are being driven by rail fatigue. All other sites are driven by rail wear.
- The rail renewal at site 6 includes new rail through an occupational crossing and will also include rubber flangeways to provide a better road / rail crossing interface.

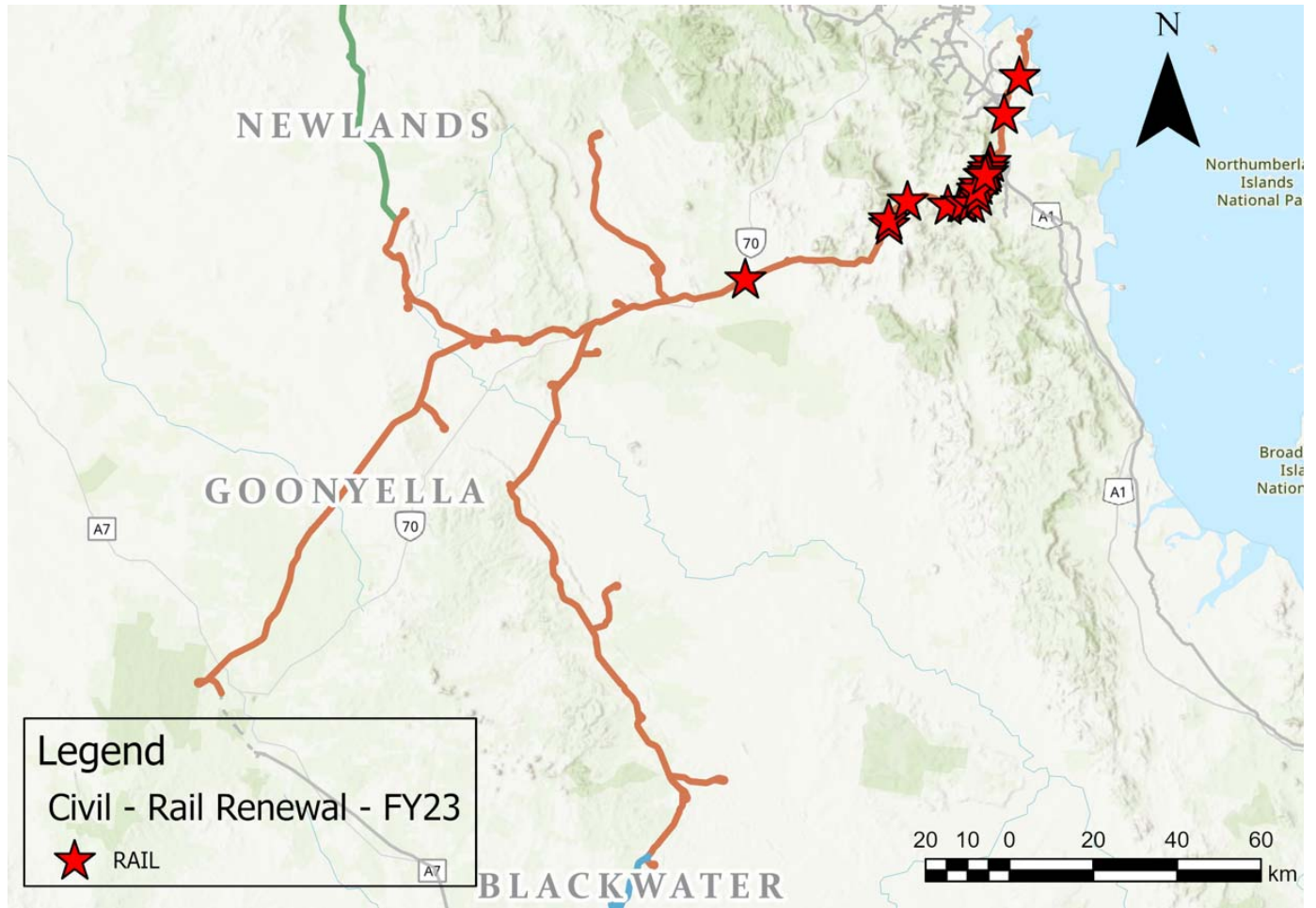
An additional total of 26.1Km of rail will be renewed as part of the FY23 Track Upgrade scope taking the total rail to be renewed Goonyella in FY23 to 61.06Km, this represents 3.0% of the total rail in the Goonyella system.

"Rail fatigue" refers to the failure mechanism due to an increase in rail defects which are caused through millions of wheels cycling over the rail (analogous to continuous bending of a paperclip). Rail fatigue generally only manifests itself in straight track where the rail has been in service for significant periods of time.

"Rail wear" is the progressive loss of steel in the rail head caused by the very high lateral forces within curved track under train operations and preventative grinding. The rail wears to the point where it is not sufficiently strong enough to sustain the heavy axle loads and generally only manifests itself in curved track. The sharper (i.e., tighter) the curve, the higher the wear rate.

Aurizon Network's planned unit length of rail is typically 108m, as this is the nominal longest length of rail that can be transported around the rail network. In certain circumstances lesser lengths can be used.

Figure 36 Rail Renewal Sites Goonyella FY23



ii. Sleeper Renewals

A total of 10,885 sleepers are programmed for renewal in the FY23. The location and extent of these works for FY23 are outlined in the following table.

Table 76 FY23 Sleeper Renewal Program - Goonyella

Ref	Track Section	Start Km	Finish Km	Sleepers
1	BALOOK WANDOO	82.380	85.932	5,185
2	BRAESIDE MINDI	107.868	108.680	1,185
3	JILALAN JILALAN	21.070	21.971	1,315
4	JILALAN JILALAN	19.670	20.840	1,722
5	JILALAN JILALAN	19.670	19.824	225
6	WAITARA BRAESIDE	106.872	107.73	1,253
TOTAL				10,885

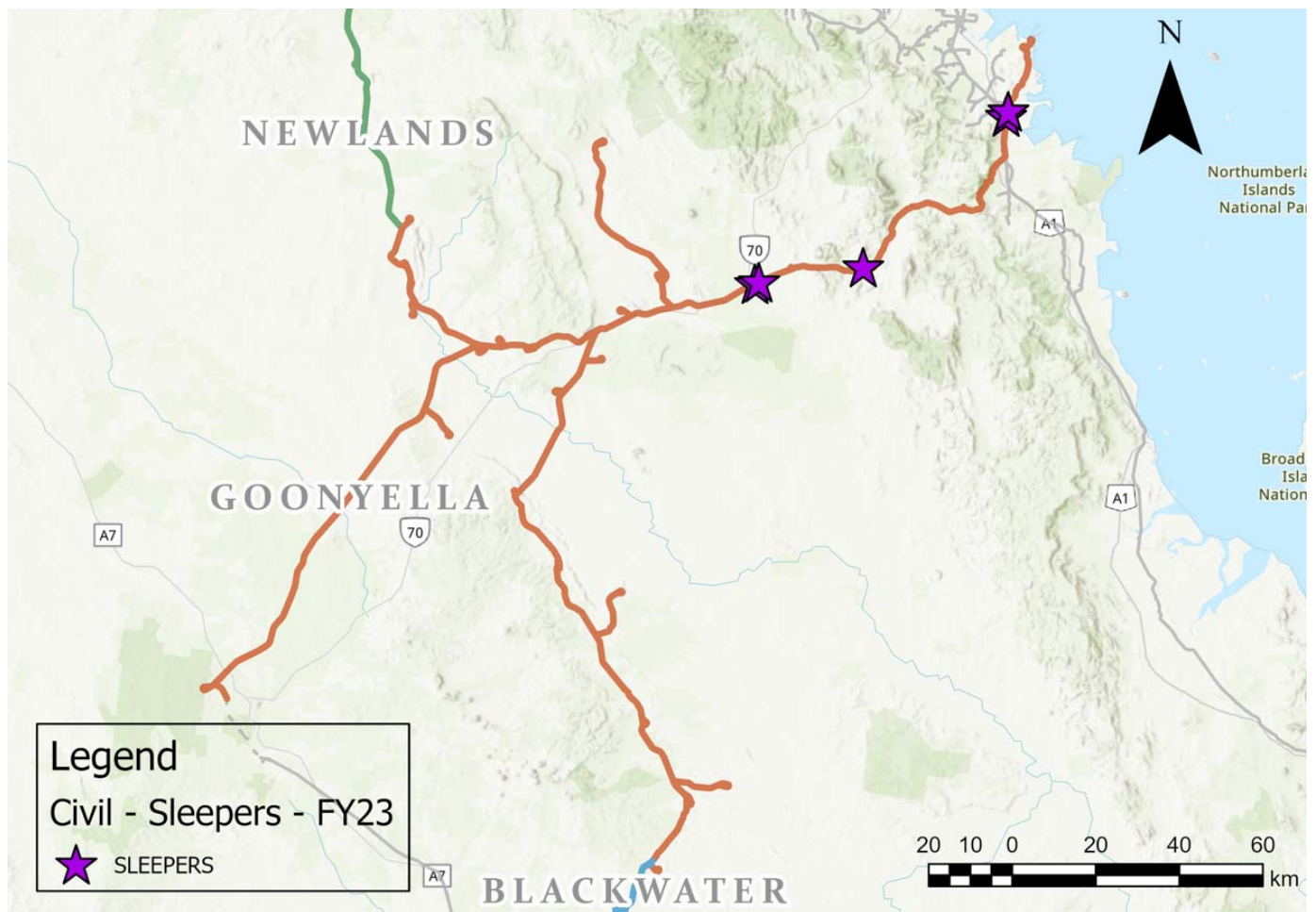
Scope comments:

- Site 1 – Removal of 22 tonne axle load fist clip sleepers installed in the 1990's. This section meets a track upgrade completed in FY20 from the 81.733Km to 82.380Km.

- Sites 2 & 6 – Replacement of aged fist clip sleepers that are losing rail holding capability due to corrosion and failure of holding pins. The renewal of fist clip sleepers has been an ongoing asset renewal program since 2015.
- Sites 3, 4 & 5 – Renewal of degraded timber sleepers in yard roads. Possession footprint is not finalised and is waiting on clarification of construction methodology. Due to being yard track there will not be a direct impact to mainline capacity. These sites were previously in FY22 but due to scope creep and resulting cost increase have been deferred into FY23.

An additional total of 13Kkm of sleepers (17,732 sleepers) will be renewed as part of the FY23 Track Upgrade scope taking the total sleepers to be renewed Goonyella in FY23 to 20.46Kkm, which represents 2.1% of the total track in the Goonyella system.

Figure 37 Sleeper Renewal Sites Goonyella FY23



iii. Track Upgrades

A total of 13.0 kilometres has been identified for track upgrade in the FY23. The location and extent of these works for FY23 are outlined in the following table.

Table 77 FY23 Track Upgrade Program - Goonyella

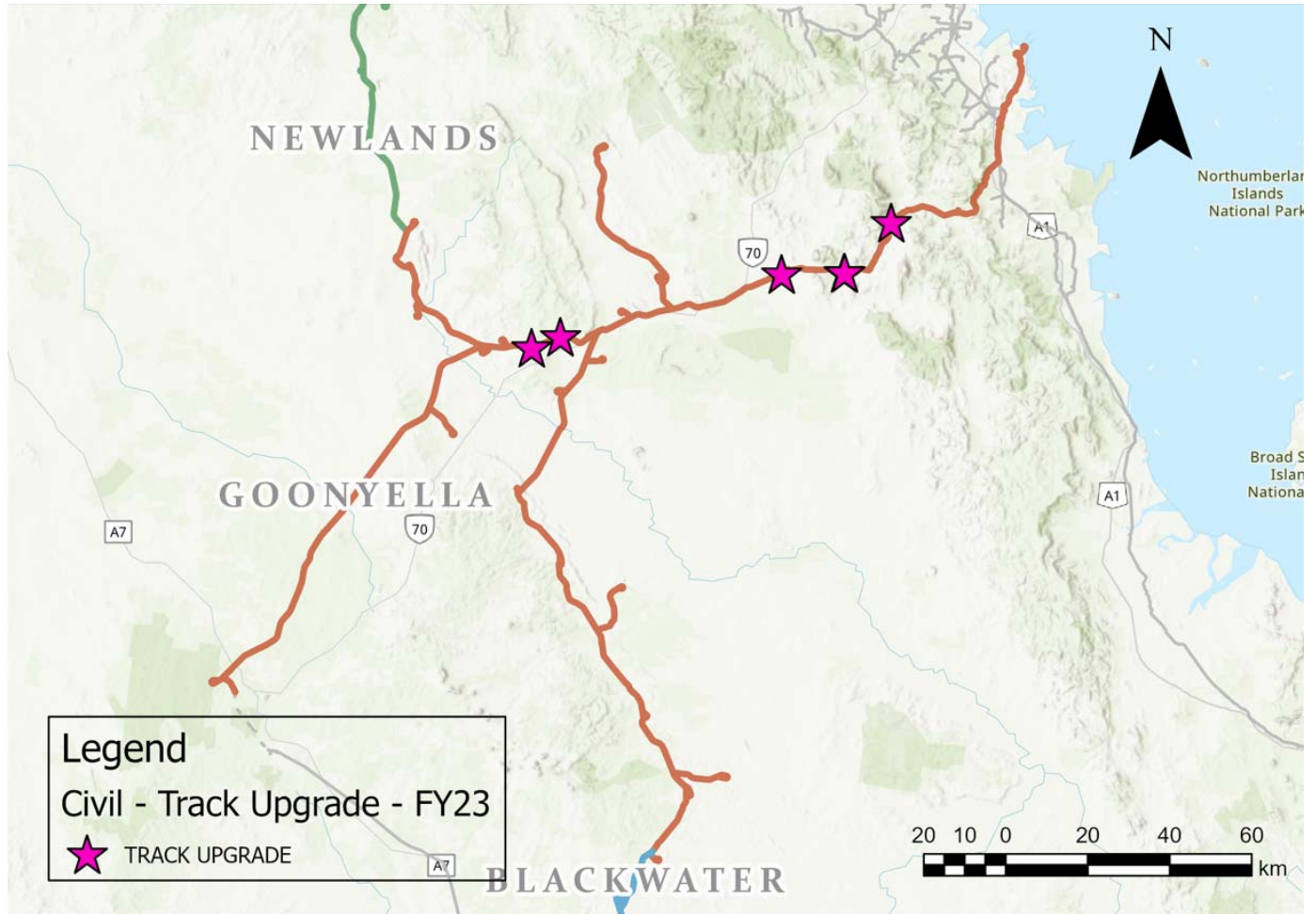
Ref	Track Section	Start Km	Finish Km	Length (Km)	Sleepers
1	BOLINGBROKE BALOOK	67.072	74.798	7.726	10,319
2	BROADLEA CARBOROUGH DOWNS JCT	155.988	158.231	2.237	3,275
3	BROADLEA MALLAWA	163.119	163.833	0.714	1,043

Ref	Track Section		Start Km	Finish Km	Length (Km)	Sleepers
4	WAITARA	BRAESIDE	100.815	102.558	1.743	2,295
5	WANDOO	WAITARA	86.170	86.640	0.470	687
6	WANDOO	WANDOO	86.006	86.115	0.109	113
TOTAL					12.999	17,732

Scope comments:

- Site 1 - This scope is for the full replacement of 1983 standard carbon rail and fatigued fist sleepers between 67.07Km – 74.80Km. Scope consists of six 800m radius curves connected by small sections of tangents (straights). This track carries mostly unloaded trains.
 - The delivery of this site in one continuous scope generates significant cost efficiencies utilising high production Track Laying Machine. There is a 37% reduction in cost compared to the standard track upgrade unit rate (\$10.6M).
- Site 2 – This site has a combination of worn rail and rail that will reach fatigue limits in the near future (standard carbon rail steel installed in 1994).
- Site 3 – This site has worn rail on fist sleepers that will be integrated with a formation renewal.
- Site 4 – Track upgrade to new rail and sleepers following multiple rail defects removed in this section via plug rail inserts over the last 10 years resulting in an excessive number of welds in the section.
- Sites 5 & 6 – These sites will be completed together. The full section is 86.006Km to 86.640Km. It has been split into two scope items as there is a turnout in the middle of the site from the 86.115 to the 86.170 (15m section).

Figure 38 Track Upgrade Renewal Sites Goonyella FY23



iv. Turnout Components

Component renewal is a standard asset management practice which allows Aurizon Network to maximise the assets useful life. Component replacements typically include switch and stock replacement or vee/crossing replacement.

In FY23, Aurizon Network has included an amount of \$3.0m for Turnout Component scope in the Goonyella System.

v. **Turnout Design**

The FY23 Turnout Design program has a forecast budget of \$0.3m to design turnouts at 5 locations for delivery in FY24 as per the following table

Table 78 FY23 Turnout Design Program - Goonyella

Ref	Station	Points	Location (Km point)	Planned Delivery
1	Wandoo	WO12A/B	86.058	FY25
2	Waitara	WA10C	100.310	FY25
3	Waitara	WA12A	100.520	FY25
4	Waitara	WA 7A/B	98.037	FY25
5	Waitara	WA9A	98.168	FY25

To manage the likelihood of change risk with regards to turnouts no turnout renewals are programmed for FY23 in Goonyella. The decision was made to hold off renewals until site designs were fully completed to avoid possible changes. Turnout designs are one of the most complex asses to design as they involve all three disciplines. Civil for the rail and formation alignment, Electrical to match the wire location of the turnout arrangements and control systems who manage the turnout motors rodding and signal interlockings.

vi. **Permanent Way Other**

- **Glued Insulated Joints**

An amount of \$0.3m for the renewal of defective Glued Insulated Joints (GIJ) has been included in the proposed FY23 scope of works. Renewal of 4-hole GIJ's to 6-hole GIJ's to improve robustness, resilience and mitigate rail failure points from aged joints. In track sections that utilise axle counters, GIJ are redundant so will be removed prior to failure and renewed with a rail weld.

- **Rail Lubrication**

There are 57 lubricator units in the Goonyella System. In FY23, 5 sites will have the existing 16 port grease applicators upgraded to 48 port applicators. This will deliver the grease to the rail in small portions over a larger area and facilitate better wheel pick up, this will limit wastage and grease splatter. Lubricators deploy grease that is picked up by the train wheels and distributed through curves to reduce friction aiding wheel and rail wear and to reduce wheel squeal noise.

An allocation of \$0.04m has also been made for fix on fail requirements for mobile lubrication units.

- **Rail Fix on Fail**

An allocation of \$0.3m has been made for fix on fail requirements for short rail replacement. This small amount of funding cover reactive rail replacements that are not predictable and are over 27 metres long. Typical rail defects in this category are rail burns left by locomotives or rail foot strikes from dragging equipment.

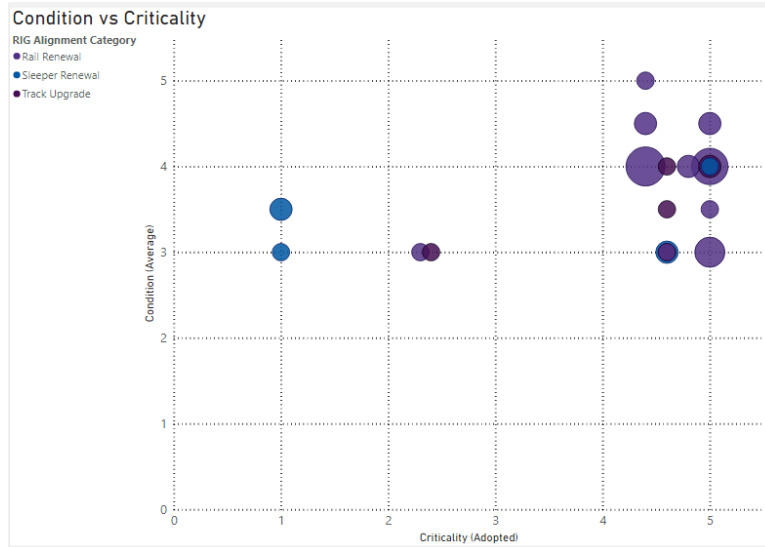
- **Slab Track**

An allocation of \$0.3m has been identified for the management of those unplanned defects that occur within slab track (i.e., the rail and fasteners are encased in concrete). Where a rail break occurs within slab track, to enable the permanent remedy, it is likely that an extended section of concrete needs to be removed, corroded plates, fasteners and the rail replaced, and the concrete reinstated. This work would otherwise inflate a rail renewal unit rate. This allocation enables the management of defects and improves the accuracy of delivered unit rates and cost forecasting.

Permanent Way FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the permanent way renewals against asset condition and location/ operational criticality. As can be seen all planned FY23 renewals are either advanced in wear or degradation and/ or located in track sections identified as critical to maximising throughput.

Figure 39 Permanent Way – FY23 Scope Priority Ratings – Goonyella



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and
- The size of the bubble represents the number of sites / tasks.

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Permanent Way FY23 Options Considered

In FY23, the permanent way assets identified for renewal have an average condition rating 4.0 which is at the point of renewal identified in the Asset Maintenance and Renewal Policy.

The assets in this class degrade in condition based on usage and wear, as such a decision to defer or not do the renewal does not stop the wearing of the asset and the further degradation of condition. Deferral or removal of this scope increases the risk of the asset failing requiring an unplanned rectification. As outlined in Part B, the approach to renewals is to affect an asset renewal ahead of an asset failure to minimise the disruption to the network, reduce the mix of reactive works and maintain system throughput.

Table 79 Permanent Way Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	This scope is typically completed within existing integrated closures. Turnout components and removals are not complete renewals and can be carried out in the shadow of other activities within integrated closures	Low	The renewal or upgrade will provide enhanced system reliability through the avoidance of unplanned outages and re-life the renewed assets. Component renewal will extend the life of assets. Removal of surplus or redundant assets will reduce the associated maintenance costs for inspection and service of assets.
Defer some of the proposed scope	Deferral of worn components could result in asset failure that requires unplanned rectification and added delay. Given these works are often completed in the shadow of other major tasks or	Medium	Deferral of the renewal of worn components can lead to unplanned failure and will need to be renewed in a future year. This option will incur additional ongoing maintenance costs.

Option	Description	Risk of Asset Failure	Impact
	<p>between trains there would be little increase in throughput.</p> <p>Where there is a capacity impact and deferred works are moved to the next available period any capacity gain through deferral is potentially eroded by having to complete the scope later.</p>		
Do not complete proposed scope	<p>Worn components that are not replaced will eventually result in failure, unplanned rectification and delays.</p> <p>The benefit of any short-term access reduction is likely to be offset by the impact of future unplanned closures in the event of asset failure.</p>	Medium to High	<p>Failure to renew worn components will lead to unplanned failure.</p> <p>This option will incur additional ongoing maintenance costs.</p>

Options for the delivery of Permanent Way renewals

Always replace both rails	<p>Limited impact on throughput as time taken to replace both rails is minimal within the closure required.</p> <p>Replacing both rails would negate the need to go back to the same site in a future year to replace the other rail.</p> <p>The lower rail in a curve generally wears at a slightly higher rate given the loads are increased on the lower rail due to imperfect balance of speed and cant. That is, trains are travelling at slower speeds than that which the track is canted for. Current practice is to renew the rail closest to the wear limit and assess the other rail to determine its remaining life.</p>		<p>Replacing both rails will have the effect of replacing some rail prematurely in that rail would be replaced that had remaining life.</p> <p>There is an opportunity to cascade this rail to yards and low speed locations but would require freight charges to reposition the rail.</p>
Complete track upgrade instead of individual rail or sleeper replacement	<p>Sleepers and rail have differing deterioration rates and expected lives hence why they are currently treated as separate assets.</p> <p>Current practice is to assess the need for sleeper or rail replacement at the same site during the planning phase and where applicable bring required rail and required sleeper upgrade together as a Track Upgrade.</p>		<p>Always replacing sleepers will result in sleepers being replaced prematurely.</p> <p>Sleeper life is typically far more than rail life. As such, rail replacement is generally the predominant trigger for track upgrade.</p> <p>This will have the effect of an increase in short-term cost with longer-term efficiencies brought about through single mobilisation and reduced track access.</p>

Ballast Cleaning & Renewals

Ballast Cleaning Renewal Program

In FY23, Aurizon Network proposes to undertake \$35.9m of Ballast Cleaning in the Goonyella System. Table 80 below summarises the scope and budget for each relevant renewal item.

Table 80 FY23 Ballast Cleaning Program

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Mainline Undercutting	61.0	Track Km	29.5	Scope delivery for FY23 assumes the use of both the high production BCM and excavator undercutter.
ii. Turnout Undercutting	24.0	Units	3.4	Section undercutting utilising on track excavators fitted with an undercutting bar.
iii. Bridge Rollout	670	Metres	2.4	Geotechnical studies of bridge ends to be completed to finalise design of works limits.
iv. Ground Penetrating Radar (GPR)			0.6	To determine fouling across the network to inform future scope location planning.
TOTAL			35.9	

The remainder of this section provides further details of the specific scope that Aurizon Network intends on delivering during the period.

i. Mainline Undercutting

The proposed FY23 mainline undercutting program will see 61.0Km of scope delivered for a forecast cost of \$29.5m in aggregate. The scope will be delivered using the BCM (C01) and excavator undercutter (C14).

Table 81 Mainline Undercutting - Goonyella

Scope	FY23 Scope	Scope Unit	FY23 Budget (\$m)
BCM - C01	52.0	Track Km	24.1
Mainline Excavator Undercutting - C14	9.0	Track Km	5.4
TOTAL	61.0		29.5

The location and extent of these works for FY23 are outlined in the following table.

Table 82 FY23 Mainline Undercutting Scope - Goonyella

	Track Section		Start KM	Finish KM	Length (KM)	Scope
1	BLACK MOUNTAIN	HATFIELD	42.600	45.354	2.755	MAINLINE UNDERCUTTING
2	BLAIR ATHOL	BLAIR ATHOL	108.300	110.400	2.099	MAINLINE UNDERCUTTING
3	BOLINGBROKE	BALOOK	64.480	65.908	1.426	MAINLINE UNDERCUTTING
4	BOLINGBROKE	BALOOK	65.950	67.300	1.353	MAINLINE UNDERCUTTING
5	BRAESIDE	MINDI	110.175	116.920	6.743	MAINLINE UNDERCUTTING
6	COPPABELLA	COPPABELLA	1.050	3.847	2.755	MAINLINE UNDERCUTTING
7	DALY BAY BLOOPS	DALY BAY BLOOPS	0.330	1.587	1.257	MAINLINE UNDERCUTTING
8	DALY BAY BLOOPS	DALY BAY BLOOPS	0.620	3.400	1.778	MAINLINE UNDERCUTTING
9	GERMAN CREEK	OAKY CREEK	132.054	135.539	3.481	MAINLINE UNDERCUTTING
10	GERMAN CREEK	OAKY CREEK	136.300	137.012	0.715	MAINLINE UNDERCUTTING
11	HATFIELD	BOLINGBROKE	50.600	52.580	1.917	MAINLINE UNDERCUTTING
12	HATFIELD	BOLINGBROKE	55.925	56.925	1.001	MAINLINE UNDERCUTTING
13	HATFIELD	HATFIELD	47.497	48.700	1.204	MAINLINE UNDERCUTTING

	Track Section		Start KM	Finish KM	Length (KM)	Scope
14	HAY POINT	HAY POINT	0.050	3.033	2.999	MAINLINE UNDERCUTTING
15	INGSDON	INGSDON	10.985	12.400	1.426	MAINLINE UNDERCUTTING
16	INGSDON	INGSDON	11.300	12.500	1.231	MAINLINE UNDERCUTTING
17	JILALAN	JILALAN	17.636	19.970	2.331	MAINLINE UNDERCUTTING
18	JILALAN	JILALAN	20.260	22.488	2.230	MAINLINE UNDERCUTTING
19	JILALAN	YUKAN	25.462	27.635	2.176	MAINLINE UNDERCUTTING
20	MIDDLEMOUNT JCT	BUNDOORA	125.581	127.324	1.745	MAINLINE UNDERCUTTING
21	MINDI	SOUTH WALKER	123.047	125.757	2.718	MAINLINE UNDERCUTTING
22	PEAK DOWNS	PEAK DOWNS	43.655	45.684	2.042	MAINLINE UNDERCUTTING
23	YUKAN	BLACK MOUNTAIN	32.599	33.200	0.604	MAINLINE UNDERCUTTING
24	YUKAN	BLACK MOUNTAIN	30.200	32.264	2.056	MAINLINE UNDERCUTTING
25	YUKAN-BLACK MTN	YUKAN-BLACK MTN	33.200	35.140	1.944	MAINLINE UNDERCUTTING
26	BALOOK	WANDOO	80.450	80.650	0.200	EXCAVATOR UNDERCUTTING
27	BALOOK	WANDOO	81.605	81.900	0.295	EXCAVATOR UNDERCUTTING
28	BROADLEA	CARBOROUGH DOWNS	160.400	161.100	0.698	EXCAVATOR UNDERCUTTING
29	CARBOROUGH DOWNS	BURTON JUNCTION	162.850	163.100	0.250	EXCAVATOR UNDERCUTTING
30	DALRYMPLE BAY	DALRYMPLE BAY	0.050	0.300	0.250	EXCAVATOR UNDERCUTTING
31	DALRYMPLE BAY	DALRYMPLE BAY	0.050	0.300	0.250	EXCAVATOR UNDERCUTTING
32	DALY BAY LOOPS	DALY BAY LOOPS	0.330	0.590	0.260	EXCAVATOR UNDERCUTTING
33	HATFIELD	BOLINGBROKE	59.400	59.730	0.330	EXCAVATOR UNDERCUTTING
34	INGSDON	INGSDON	10.985	11.240	0.235	EXCAVATOR UNDERCUTTING
35	MINDI-STH WALKER JCT	MINDI-STH WALKER JCT	124.515	124.950	0.435	EXCAVATOR UNDERCUTTING
36	TOOTOOLAH	MACARTHUR JCT	136.700	136.950	0.250	EXCAVATOR UNDERCUTTING
37	TOOTOOLAH	MACARTHUR JCT	137.100	137.216	0.116	EXCAVATOR UNDERCUTTING
38	WANDOO	WAITARA	97.650	98.050	0.409	EXCAVATOR UNDERCUTTING
39	MAINLINE ADJACENT TO 5 TURNOUTS				0.631	EXCAVATOR UNDERCUTTING
40	UNALLOCATED SCOPE				4.376	METHOD TBC BASED ON SITE REQUIREMENTS
TOTAL					60.971	

The scope of ballast cleaning is based on the identification of track sections with fouling above the Acceptable Fouling Limit (AFL). The AFL is expressed as a percentage of void contamination (PVC). At a level of over 38% PVC fouling, the ballast draining properties are diminished and the wet weather performance of track is impaired.

Aurizon Network utilises Ground Penetrating Radar (GPR) to determine the level of fouling. The review and analysis of the FY22 GPR run data is currently ongoing. These results will be used along with local condition data from field teams to determine scope for FY24 ballast renewals.

Through the likelihood of change review in the development of the FY23 proposed scope, it was noted that site specific test pit digs had not been completed at the sites identified for Mainline Undercutting. As such the fouling rate and return rates of ballast are based on the average rates. Prior to works these test pits are dug to better understand the fouling rate on site. A higher fouling rate will result in a less efficient return rate and the possibility that not the full scope can be achieved in the allotted time.

Scope Comments:

- Mainline excavator undercutting (C14) adjacent to 5 turnouts are short ballast replacements, ranging between 25 and 50 metres, on the lead into and out of the planned turnout undercuts. Due to the dynamic forces applied by trains, these locations have an accelerated fouling rate. Historically, Aurizon Network has taken the opportunity to undercut these locations with the excavator during turnout undercuts. In the FY23 Final Draft Proposal, Aurizon Network is presenting this scope as excavator undercutting (C14) for transparency. The unallocated allowance for excavator undercutting (C14) has been reduced by the equivalent amount.
- An unallocated scope of 4.376Km has been added to the FY23 program. This is to react to sites that require ballast cleaning as sites degrade ahead of expectations or present with little notice. In prior years the planned scope was changed to accommodate the fix on fail sites. In FY23 the plan for the identified sites is planned into closures and will not be disrupted in the event of a fix on fail scope site presenting. The methods of undercutting will be determined on a site by site basis but is likely to be excavator undercutting as the BCM will be on planned works across the CQCN and can't be readily deployed to fix on fail sites. Additionally, the fix on fail sites are traditionally shorter than is economic for the BCM to be deployed.
- The 60.971 kilometres of ballast being cleaned in the mainline undercutting program equates to 6.0% of the total ballast in the Goonyella System (1,018Km).

The current mainline scope is based upon data up until the 2020 GPR run and the historical performance of the Goonyella system. In 2021, a further GPR run was completed and provides for a further data set to compare against, to determine the rate of coal fouling throughout the CQCN. It is expected that the results of this GPR run will be presented to the Ballast Working Group in the third quarter of FY22.

In FY22, Aurizon Network, along with members of the Rail Industry Group and rollingstock operators, have established the Ballast Working Group to investigate, quantify and implement options for mitigating coal entering the ballast. The Ballast Working Group also continues to discuss the efficient delivery of the current ballast cleaning task across the CQCN.

ii. Turnout Undercutting

24 turnouts are proposed to be undercut via the excavator undercutters in FY23. The location and extent of these works for FY23 are outlined in the following table. One turnout has been allocated for reactive turnout undercutting; this strategy is to protect the planned scope as historically scope change has been managed through deferring planned works. This is due to the level of unpredictability of turnout ballast performance at the current planning horizon.

The location and extent of these works for FY23 are outlined in the following table.

Table 83 FY23 Turnout Undercutting Scope - Goonyella

Turnout Location	Km Point
BALOOK	74.479
BLACK MOUNTAIN	40.797
BLACK MOUNTAIN	40.896
BLACK MOUNTAIN	40.918
COPPABELLA	143.919
COPPABELLA	144.495
DALRYMPLE BAY	7.975
DALRYMPLE BAY	8.068
HATFIELD	47.443
JILALAN	17.567
JILALAN	17.341
JILALAN	19.931
JILALAN	20.274
JILALAN	22.636
PEAK DOWNS	43.597
PEAK DOWNS	43.650
SARAJI	67.535
SOUTH WALKER	127.400
TOOTOOLAH	132.711
WAITARA	106.427
WANDOO	86.037
YUKAN	29.298
YUKAN	27.783
Reactive Turnout	-

As part of the likelihood of change review in the development of the FY23 proposed scope it was noted that additional sites may come into consideration due to condition changing at sites currently planned for future years above what can be accommodated with the reactive turnout sits allowance. These changes, if they eventuate, will be presented to the RIG as part of the quarterly reporting process.

iii. Bridge Rollout

The proposed FY23 program for bridge rollouts in the Goonyella System is 6 bridges for a total of 670 metres. The location and extent of these works for FY23 are outlined in the following table. The forecast cost to deliver this scope is \$2.4m.

Table 84 FY23 Bridge Rollout Scope - Goonyella

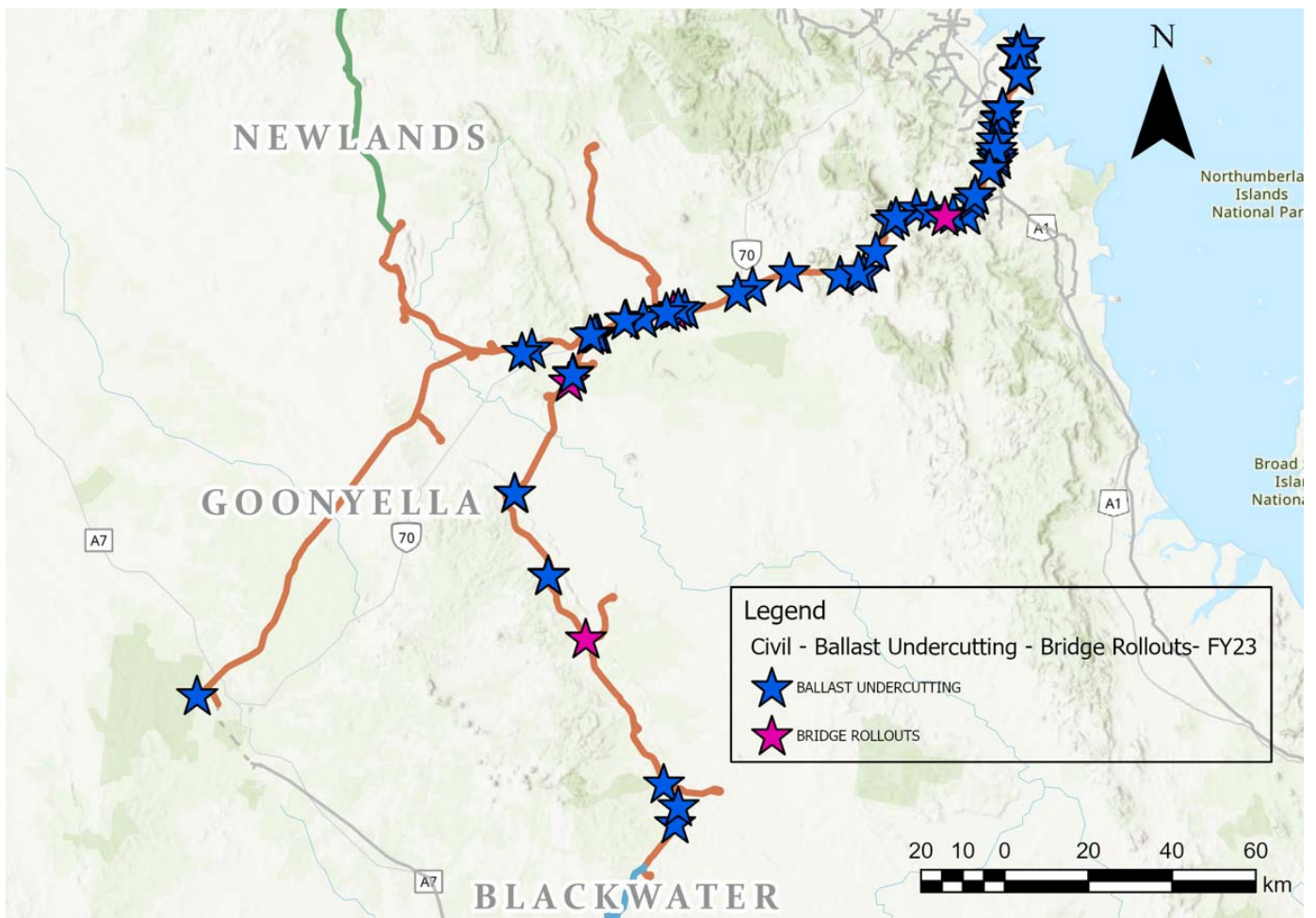
Waterway	Start Km	End Km	Length (metres)
BRIDGE 0.300KM ARRIVAL RD 2	0.280	0.350	70
BRIDGE 0.300KM ARRIVAL RD 3	0.330	0.260	70

Waterway	Start Km	End Km	Length (metres)
Bridge 125.790Km UP MISW Bee Creek	125.710	125.860	150
Bridge 13.310Km INMJ North Creek	13.255	13.355	100
Bridge 52.570Km UP HDBO Bolingbroke	52.450	52.640	190
Bridge 85.630Km SILV Downs Creek	85.590	85.680	90
TOTAL			670

Scope Comment:

- Geotechnical studies of bridge ends are to be completed prior to the commencement of FY23 to finalise design of work. This may result in additional formation renewal or strengthening at bridge ends.
- Each of the above bridges will also have curb raising included to increase the ballast carrying capacity of the bridges. This will increase the period between bridge rollout requirements as the fouling rate will decrease given the deeper ballast.
- At all locations, except for the Bolingbroke Creek location (52.570), the rail will also be renewed as part of the Bridge rollout scope. The Bolingbroke Creek bridge was last rolled out in 2015 and the rail is still in a suitable condition and can be reused.

Figure 40 Ballast Cleaning & Bridge Rollout Sites Goonyella FY23



iv. Ground Penetrating Radar

To further the refinement of ballast cleaning scope, Aurizon Network seeks to perform an additional GPR survey in FY23. This will be the 6th run of its type (with prior surveys conducted in 2014, 2016, 2018, 2020 & 2021) and will allow Aurizon Network to not only identify sites that require cleaning, but to also trend locations over the period to understand degradation rates with a view to predict future renewal requirements and locations.

The costs of the GPR survey have been allocated between systems in proportion to the GPR survey kilometres planned in each Coal System. This results in a cost allocation to the Goonyella System of \$0.6m.

The proposed FY23 GPR survey will be targeting all electrified Mainline track within the CQCN (i.e., trunk routes, branch lines and spurs - the track carrying increased risk due to higher line speeds and throughput) and select yard track that is high-frequency and/ or critically located. The intent is to enable a data-driven assessment of the overall condition of the ballast using a risk-based approach to determine future undercutting requirements.

Aurizon Network considers it necessary to continue to collect GPR data (including in recently undercut sections) to assess and understand the System and localised change in ballast condition over time. In particular, the inclusion of recently undercut sections enables an understanding of the overall fouling status of each System; excluding these sections would result in a negatively skewed view of the fouling status. Similarly, if recently undercut sections were not surveyed, the time between successive datasets would increase from ~24 months to ~48 months and become less valuable in the context of the undercutting scope development and subsequent planning. This would compromise Aurizon Network's ability to manage its ballast asset over the long-term.

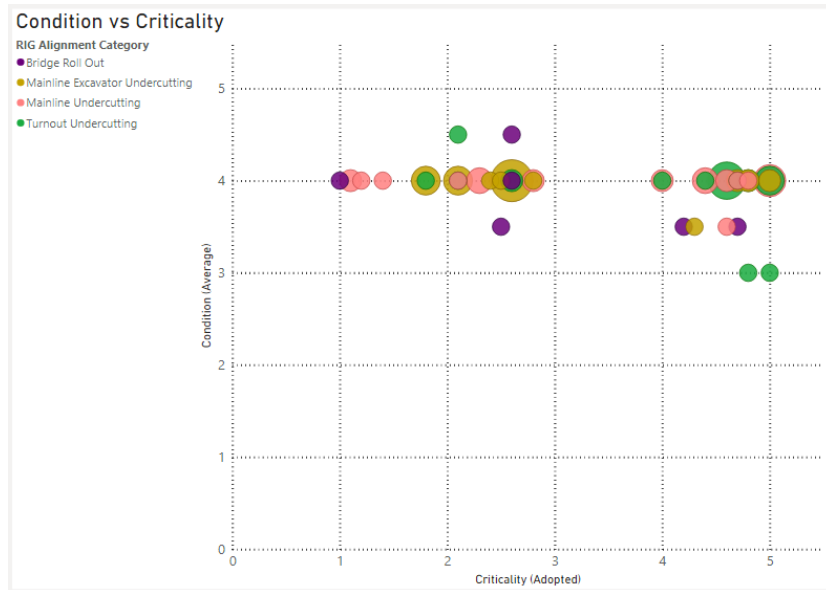
In any event, the on-track vehicle collecting GPR survey data would otherwise need to traverse the recently undercut sections and therefore, no throughput benefit is gained (nor loss suffered) through 'missing' localised and recently undercut sections. Aurizon Network would not expect any cost savings because of omitting these sections.

Ballast Cleaning FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Ballast renewals against asset condition and location/ operational criticality.

- All identified scope has a current condition of 3 or above; and
- Remaining scope relates to ballast sections with advanced fouling at less critical track section. These will further degrade without intervention.

Figure 41 Ballast Cleaning – FY23 Scope Priority Ratings – Goonyella



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Ballast Cleaning FY23 Program - Options Considered

Failure to remove fouling from the ballast results in drainage issues that affect formation condition resulting in track alignment defects. These defects manifest as temporary speed restrictions until a track resurfacing or track tamping is conducted as part of the General Maintenance activity. Therefore, the options of deferring or not completing ballast cleaning works on identified locations, increases the risk of these track alignment defects propagating.

Other options are available in the delivery of the undercutting process and are assessed for the cost of doing the alternate activity and the time required to complete against the long term asset condition benefits.

Table 85 Ballast Cleaning Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Proposed scope is taken into the system-wide planning process to balance scope system throughput with scope requirements.	Low	All identified scope has a current condition of 3 or above with advanced fouling and will degrade further without intervention. The Risk of Asset Failure categorisation is somewhat subjective but has been assessed based on the proposed and planned scope and available data at the time of preparation. The cleaning of each site as per the proposed plan will remove the most fouled locations whilst balancing production rates and track time of the BCM against throughput capacity demand.
Defer some of the proposed scope	Deferral of works will push requirement into future years with ballast condition becoming more fouled in deferred locations. Some throughput would be returned to the supply chain, where ballast cleaning is the critical scope for possessions, but this would be eroded by operational restrictions and unplanned delays caused by degraded ballast condition	Medium	Locations identified for cleaning are already at a high level of fouling. Deferral will see condition worsen and may require a full ballast replacement rather than an undercut and screen. The condition could worsen through the development of mud-holes and compromised track geometry, leading to speed restrictions.

Option	Description	Risk of Asset Failure	Impact
Do not complete proposed scope	Not completing the scope will see the ballast continue to foul and the associated impacts increase. This will lead to unplanned outages and delays that will reduce system capacity at the planned renewal sites	Medium	Locations identified for cleaning are already at a high level of fouling. Not completing the works will see condition worsen and may require a full ballast replacement rather than an undercut and screen.
Options for the delivery of Ballast Cleaning			
Move to 100% ballast replacement	This option would result in a slightly higher production rate of the mainline undercutter as ballast would no longer be and returned. It would require additional ballast at undercut sites with additional ballast train (work train) hauls to deliver or stockpile the ballast.		<p>Mainline undercutter consist includes several ballast spoil wagons but these would be filled quickly, and the rest of the ballast would be ejected to track side to be stockpiled for future removal. The increase in ballast spoil management is not accounted for in the ballast cleaning unit rates, and therefore would cause an increase in cost.</p> <p>Failing to remove spoil from the corridor or stockpiling adjacent to the track can create drainage, access and maintenance issues.</p>
Slabtrack all bridges to reduce Bridge ballast replacement	<p>Slabtrack design and installation is both expensive and time consuming to execute. It will however eliminate the need to renew ballast on bridge decks and has positive capacity benefits in the long-term due to reduced renewal and maintenance activity.</p> <p>Aurizon Network has installed Slab Track on the Cooling channel bridge in Gladstone and continues to look at this as an option for other critical bridges.</p>		If the bridge and/or slabtrack infrastructure is structurally damaged through derailment or bridge strike (e.g., from an over-height vehicle), the ability to recover from such an event is heavily compromised and would require new reconstruction techniques and stocks of large inventory items (e.g., slab track panels or bridge girders)
Shoulder Cleaning	Shoulder cleaning would provide, in the short-term reduced throughput impact to execute work (i.e., higher production in a given time) and in the medium-term risk to throughput due to potential TSRs from ballast fouling immediately beneath track.		Shoulder cleaning has been shown to provide short-term benefits however the intervention thresholds are very narrow, intervening too soon may result in benefits not being realised, whilst intervening too late will result in wasted effort and loss of capacity due to the need to execute a full undercut and the likely imposition of TSR's to manage the short-term geometry degradation.
Cleaning of turnouts using a Vacuum Truck	Vacuuming of turnouts is appropriate in certain areas. It remains a slow process and in areas of high fouling is used to manage the otherwise high likelihood that components will be unable to be inspected and unplanned failure rates will increase.		<p>Vacuuming of turnouts does not address the underlying level of fouling and will not negate the need to undercut ballast in turnouts but rather ensure that components are able to be inspected and remain lubricated and functional.</p> <p>Aurizon Network is aware of Plasser's and other vacuum-based technologies which include on-track vacuum machines, with the ability to remove all fouled ballast, and off-track vacuum trucks which do not have this capability and, therefore, can only manage surface contamination. Aurizon Network does make use of off-track vacuum-trucks to manage heavy surface fouling at critical locations.</p>

Option	Description	Risk of Asset Failure	Impact
			<p>Enquires in relation to this technology identified that a bespoke on-track machine would likely need to be designed and manufactured for Aurizon Network's narrow gauge railway, requiring investment in new plant. Aurizon Network also understands that the production rates of vacuum machines are lower than excavator undercutters. On-track machines will also face constraints such as the ability to store the necessary spoil.</p> <p>Essentially, use of such a machine would result in increased cost (investment in new plant either Network-owned, Leased or Contracted Machines and Labour) for a negligible change in production rate relative to the existing excavator undercutter approach.</p>

Civil Assets - Structures Renewals

Structures Renewal Program

The Goonyella System has a total of 103 Bridges and 1,169 Culverts which are designed to allow the natural flow of water through the rail network. Aurizon Network proposes to undertake \$7.3m of structures renewal works in FY23. Table 86 below summarises the scope and budget for each relevant renewal item.

Table 86 Structures Renewals – Goonyella System

Description	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Bridges	1.0	Sites	2.3	Equates to <1% of bridges in Goonyella.
ii. Culvert Renewal	7.0	Sites	4.9	Equates to <1% of culverts in Goonyella
iii. Culvert Design	5.0	Sites	0.2	Release of design packages for identified sites to be renewed in future years
TOTAL			7.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Bridges

As detailed in the table above, one bridge at the 109.820Km is proposed to have some renewal activities carried out in FY23. This is not a full bridge replacement, rather the renewal of deteriorated bridge bearing pads with have exceeded their 40 year design life and have been identified during inspection to be in poor condition.

Table 87 Bridge Renewals – Goonyella

Location	Start Km
Bridge 109.820 Mindi - Nebo Creek	109.820

Scope comments:

- 100% of Goonyella loaded traffic traverses this bridge. The bridge was constructed in 1970 with the bridge bearing pads having a nominal 40 year life.
- There has been movement of the bearing pads since 2018.
- The poor condition of the bearing pads puts the super structure and substructure at risk, if the bearing pads fail then the headstock and pier will have direct concrete on concrete contact increasing the degradation rate of both elements of the bridge super structure.
- The method to renew the bearing pads is to jack lift the bridge deck in situ using a series of hydraulic jacks, remove the aged pads, insert new pads and then lower the bridge.

In the Goonyella System, over 85% of bridges are ranked as condition rating 2.5 or less. The limited number of structures above 2.5 have defects of varying condition which are being monitored through routine inspections and once the defects are at a stage of requiring renewal like the one planned for FY23, they are put into a program of work for a renewal activity. No bridges are presenting for renewal requirements in FY24, as such there is no design activities related to bridge works in FY24 for the Goonyella system.

ii. Culvert Renewals

The culverts used in the railway are typical of concrete culverts and corrugated metal pipes used in civil construction and Maintenance in other heavy civil uses (roads, mines, airport runways etc). Given this, the design activity for culvert renewals is outsourced to design houses with demonstrated experience in site specific design matching standard units to local conditions to achieve the required hydrology functionality.

7 culverts in the Goonyella system are proposed for renewal in FY23. Specific locations are outlined in the following table.

Table 88 FY23 Culvert Renewal Scope Locations - Goonyella

	Culvert Renewal Location		Km Point
1	Culvert 67.940Km	BOLINGBROKE-BALOOK	67.940
2	Culvert 158.090Km	BROADLEA	158.090
3	Culvert 20.940Km	JILALAN	20.940
4	Culvert 24.270Km	JILALAN-YUKAN	24.270
5	Culvert 32.070Km	WINCHESTER	32.070
6	Culvert 28.230Km	YUKAN	28.230
7	Culvert 28.350Km	YUKAN	28.350

Of the sites identified:

- Location 1 - existing pipes cracking and showing deformity, scope is to insert small pipe to sleeve existing and grout fill gaps.
- Location 2 – this is a bank of 3 culverts. 1 culvert was badly silted, once cleaned it was discovered to be collapsed and was grout filled to reduce top and line risk from further failure. Scope is to remove all 3 existing culverts and renew with new. The other 2 culverts are showing advanced wear and failure to conduct these works now carried risk of asset failure requiring unplanned renewal at fail point. Grout filling also increases flood damage risk as hydrology is reduced.
- Location 3 – this is a 200m long corrugated metal pipe that provides drainage across 4 tracks at Jilalan. The scope is to concrete line the existing pipe that currently has severe corrosion and delamination of the

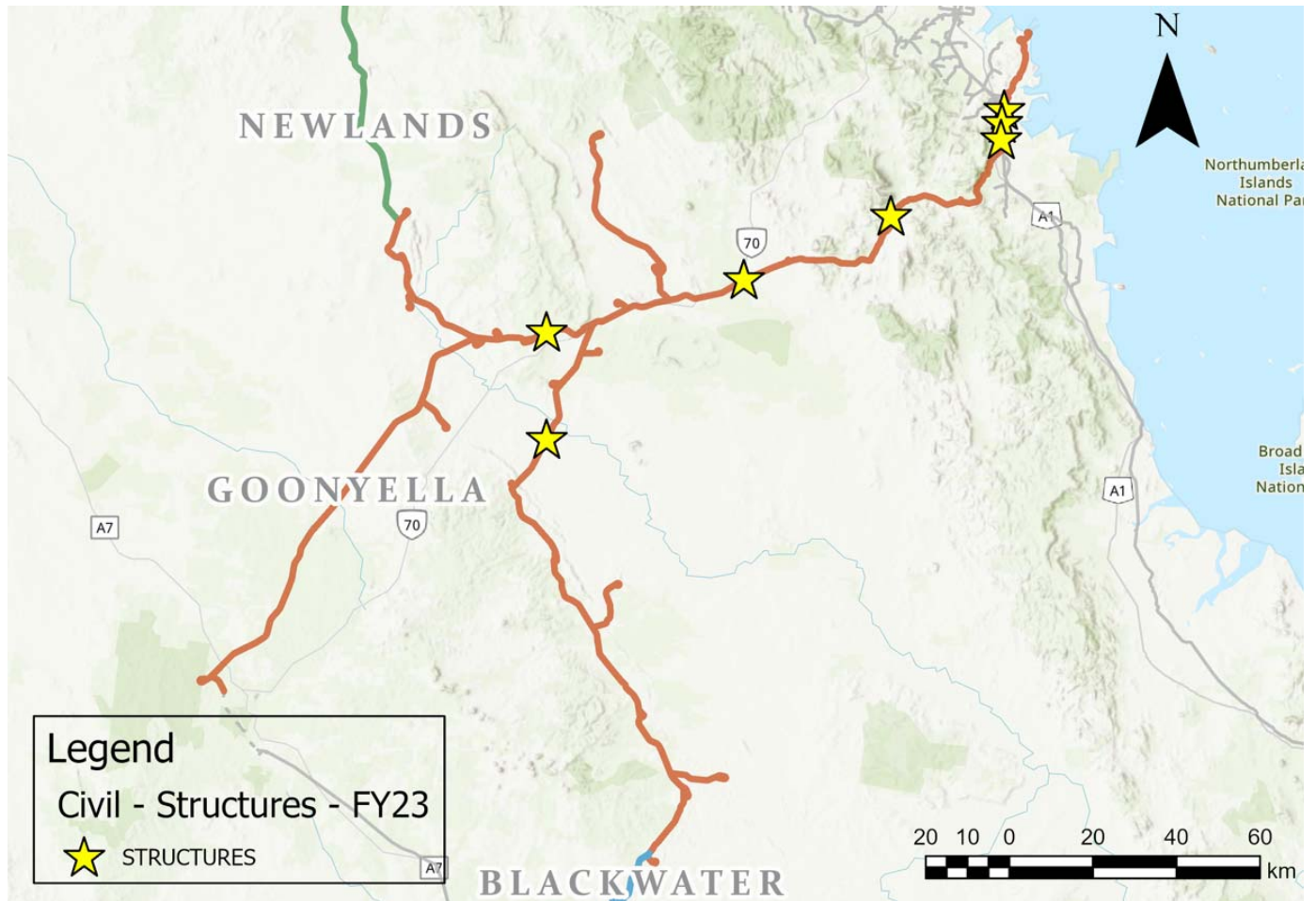
steelwork. Concrete lining will ensure the ongoing structural integrity of this pipe, although there is a high likelihood of change to the estimated costs once the tender has been issued and evaluated.

- Location 4 – scope at this location is to remove the failing concrete box culvert and replace with new 2 1800x900 culverts. This location is adjacent to the North Coast Line so the closure to conduct this work has required a coordination with Queensland Rail to align closures of their track at the same time.
- Location 5 – the culvert is on duplicated track section, scope is to replace the culvert cells on the loaded track side as they have advanced cracking, they are at risk of failing resulting in alignment defect and increased derailment risk.
- Locations 6 & 7 - Both of these sites have been monitored closely over the last 2-4 years due to their existing very poor condition. Both culverts are pumping under train services which increases the deterioration rate of the asset.
 - 28.230Km - To be replaced with 4 1200x900 Reinforced Concrete Box Culvert (RCBC) to improve flood immunity and inspect ability with 900 height.
 - 28.350Km - to be replaced with 3 1200x600 RCBC 20.45m Long
 - Coordination of closures with Queensland Rail track has resulted in delays to these sites from previous financial years. Some smaller pipes have been inserted and gaps requiring to be grouted in to hold the asset until the new renewal date proposed in FY23.

The 7 culverts renewed in this program equates to 0.9% of the total culverts in the Goonyella System (1,169).

All sites have full design and were assessed as having a low likelihood of change during construction. The design also included hydrology assessments to ensure the works will improve or hold current flow requirements.

Figure 42 Structures Renewal Sites Goonyella FY23



iii. Culvert Design

Aurizon Network proposes to undertake culvert design works for 5 locations in the Goonyella System for future years construction. These locations are outlined in Table 89 below.

Table 89 FY23 Culvert Design Scope Location - Goonyella

	Culvert Design Location	Km Point	Design Being Developed
1	ARR RD PEAK DNS	45.360	Remove and replace with RCBC
2	CAVAL RIDGE JCT-VILLAFRANCA	27.890	Concrete lining
3	DALY JCT-PRAGUELANDS	10.000	Pipe in Pipe insert and grout
4	INGSDON-MILLENNIUM JCT	16.420	Remove and replace with RCBC
5	WAITARA	98.840	Remove and replace with RCBC

Scope Comments:

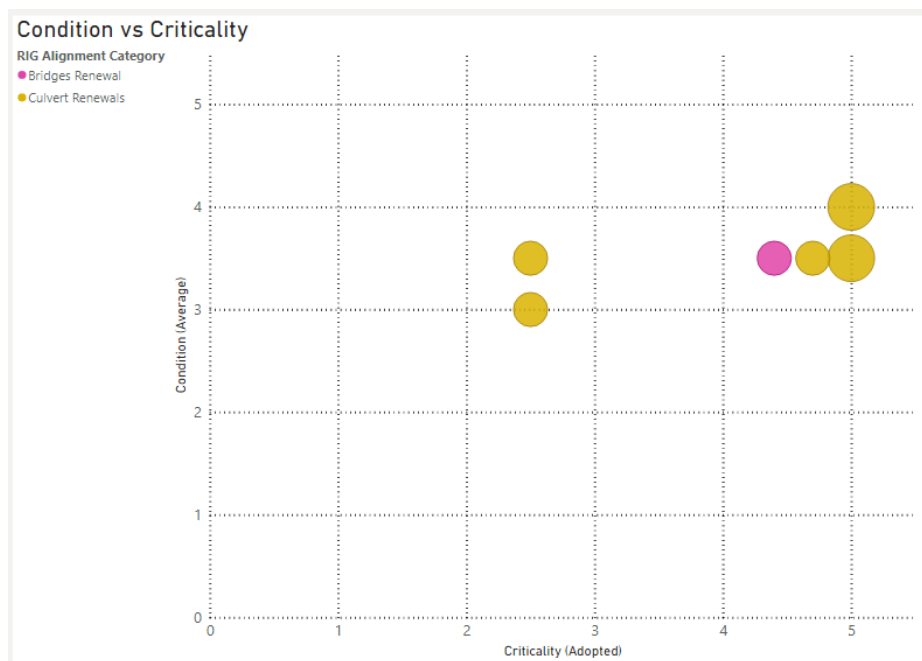
- The design works identified above are in preparation for delivery in FY24.

Structures FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Structures against asset condition and location/ operational criticality. As can be seen:

- 3 of the sites will impact the adjacent Queensland Rail track and have been programmed with Queensland Rail to be completed in FY23.
- The average condition for the FY23 program is 3.6.

Figure 43 Structures Renewals – FY23 Scope Priority Ratings – Goonyella



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Structures FY23 Program – Options Considered

The average condition rating of the proposed FY23 scope is 3.6. As such they are at or near a condition state that the next condition will be asset failure. As such deferral or not completing the scope introduces a higher risk of asset failure that would require an unplanned intervention to correct.

In developing the scope of structures renewal there are a range of options available to retain the drainage requirements of the structure. As evident in the Goonyella scope a number of these options have been progressed.

Culvert assets are managed so that they can continue to do the water flow management task they were designed for. As such the renewal treatment, size of culvert and number of culverts at each site is different. The culverts are looked at as individual assets and as part of the group of structures that manage water flow at different locations.

The renewal of culverts is to reduce the risks associated with track wash out, under mining and water egress over the rail and formation.

Table 90 Structures Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Renewing in a planned manner allows for optimal access planning and track occupancy for the required renewal works. Where applicable Aurizon Network sleeves pipe culverts so the renewal works can occur under traffic not requiring a possession.	Low	In order to renew a culvert or upgrade an element of the culvert, as is the scope in FY23, the culvert is required to be in good alignment, and not heavily deformed and out of shape. The planned renewals in FY23 are currently in a condition that the proposed scope is achievable. Culverts that present as a risk, either structurally or hydraulically, create impacts which include load and speed restrictions and a higher likelihood of track washouts respectively,
Defer some of the proposed scope	Deferral will push the renewal requirement to a future year and increase the risk of failure during the period of extension.	Medium	Deferral of renewal of worn components can lead to unplanned failure. Deferral can see further alignment degradation negating the opportunity for lining of pipes or element upgrades.
Do not complete proposed scope	Failure to renew planned scope will leave faulty structures that if not treated will fail in the near term and effect the alignment of the railway such that emergency possessions will be required to remedy or a TSR would be required until a renewal could be planned.	High	Failure to renew worn components will lead to unplanned failure and increase derailment risk related to track misalignment at defective structure sites. The loss of hydraulic capacity of the culvert during the wet season could cause the track to washout.

Civil Assets - Civil Renewals

Civil Assets Renewal Program

In FY23, Aurizon Network proposes to undertake \$9.3m in renewals for these assets. Table 91 below summarises the scope and budget for each relevant renewal item.

Table 91 Civil Assets Renewal Program – Goonyella System

Description	FY23 Scope	Scope Units	FY23 Budget (\$m)	Comments
i. Formation Renewal	2.4	Track Km	5.8	Equates to 0.23% of formation length
i. Formation Reactive		Fix on Fail	1.5	Fix on fail scope allocation to accommodate formation that fails in a yet to be known location
i. Formation & Civil Other			0.1	
ii. Level Crossing Renewals	1.0	Sites	0.8	Equates to 0.36% of level crossing sites
ii. Level Crossing Design	2.0	Design	0.1	Design of identified renewal sites to be completed in future years.
ii. Level Crossing Other		Fix on Fail	0.2	Fix on fail scope allocation to accommodate level crossing elements that fail or reduce the safety of

Description	FY23 Scope	Scope Units	FY23 Budget (\$m)	Comments
				the road rail interface, Level Crossing removals & minor signage upgrades.
iii. Access Roads & Points		Fix on Fail	0.4	Fix on fail allocation.
iv. Corridor Fencing & Security		Fix on Fail	0.4	Fix on fail allocation to reinstate required corridor fencing to sperate the rail corridor from neighbouring land.
TOTAL			9.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Formation

Formation Renewal - There is 1,018 kilometres of formation in the Goonyella System. In FY23 Aurizon Network proposes to complete 2.364Km of formation renewal. The location and extent of formation renewal works for FY23 are outlined in the following table.

Table 92 FY23 Formation Scope - Goonyella

Location		Start Km	End Km	Distance (Km's)
BROADLEA	MALLAWA	163.100	163.800	0.714
MINDI	SOUTH WALKER	124.100	124.400	0.300
PEAK DOWNS	HARROW	56.400	57.100	0.700
RED MOUNTAIN	RED MOUNTAIN	23.050	23.700	0.650
				2.364

Scope Comments:

- Location 1 – this location has seen several track alignments defects and track geometry issues associated with the formation condition. Based on geotechnical inspection it is estimated that 50% of the formation is unsuitable and as such scope will renew formation by rebuilding between 580mm and 1200mm below ballast base
- Location 2 – there is very fouled ballast located in this section and the track alignment fails post rain. A mudhole was removed at this location in FY21 and again in FY22. The scope is for a full rebuild in this location.
- Location 3 – this area has a history of highly expansive clay materials, with a high rate of formation shear failures when water is unable to drain away from track. Lime slurry pressure injection has been performed nearby from the 57Km to 62Km to strengthen the formation. This section has been under Temporary Speed Restriction, requiring reactive resurfacing. The geotechnical investigations have found weak existing capping layers and is expected to require replacement in some locations to remove weak subgrades. Previously, two smaller (less than 60 metres) reactive fix on fail formation activities have been performed within this site to mitigate the immediate risk of derailment.
- Location 4 – based on geotechnical inspection, it is estimated that 30% of the formation is unsuitable and as such scope will renew formation by rebuilding between 600mm and 900mm below ballast base.

Formation Fix on Fail - An allocation of \$1.5m has been made for fix on fail formation sites in the Goonyella System.

- Each site is identified through track geometry, confirmed by the local Track Inspection staff and thereafter validated by District Engineering.

- Scope and site estimates are developed, approved by District Engineering, and draw down from the fix on fail allocation.
- The FY23 allocation is consistent with the FY22 Approved Strategy and Budget allocation for fix on fail works.

Formation & Civil Other – An allocation of \$0.1m has been made:

- \$0.075 for design works related to ongoing slope stability works on the Black Mountain.
 - In FY22 significant slope stability works were undertaken. This work will continue in future years as the slope above the railway is strengthened. There were significant slips of the up slope as part of the rain event associated with Tropical Cyclone Debbie in 2017.
- \$0.030 for geotechnical designs to assist in the scoping of the FY24 formation renewal program. Geotechnical studies determine the state of the formation and provides an indicative understanding of required works.

ii. Level Crossings

There are 277 level crossings in the Goonyella System. In FY23 Aurizon Network Proposes a Level Crossing program that includes:

Level Crossing Renewals – Full upgrade of crossing track structure and/or active protection (flashing lights and boom gates) or incremental safety upgrades. The location and extent of these works for FY23 are outlined in the following table.

Table 93 Level Crossing Renewals - Goonyella

	Scope	Location	Km point
1	MAJOR RENEWAL	LX3247.16.585 Private Access Road	16.585

Scope Comments:

- The level crossing being renewed in this program equates to 0.36% of the total level crossings in the Goonyella System (277).
- The final design for this crossing is still in development, expected in Q4 FY22. In the likelihood of change review this site was identified as having a high likelihood of change once the final design is delivered. Any change will be communicated to the RIG via the quarterly RIG reporting process.

Level Crossings Fix on Fail - An allocation of \$0.2m has also been made for fix on fail or unplanned safety upgrades for level crossings in Goonyella.

Level Crossing Signage Upgrade - Crossings where signage does not meet Aurizon Network standards are to be upgraded. 1 crossing has been identified for a signage upgrade ion FY23.

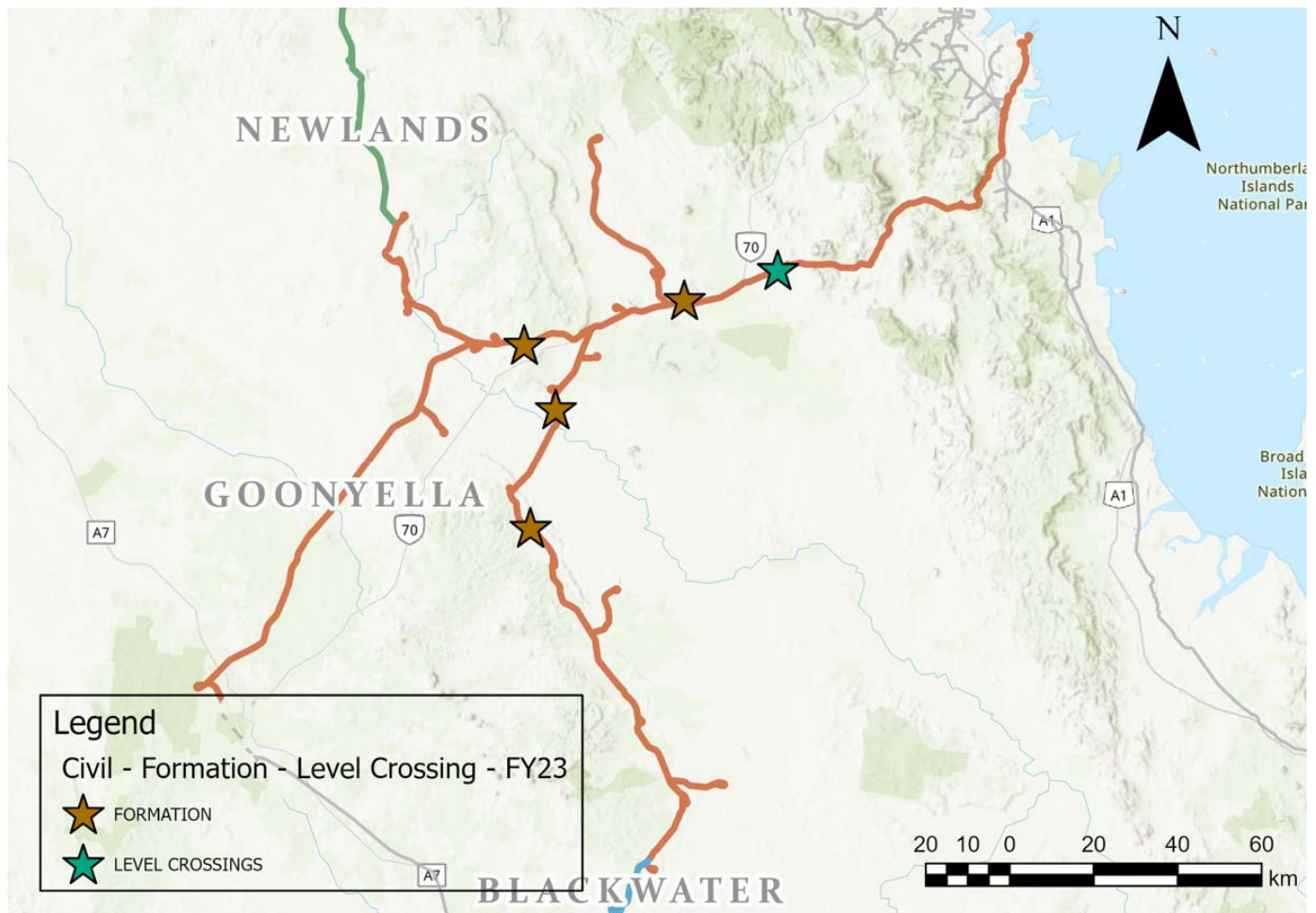
Level Crossing Design - Crossings with active protection require coordination into the localised signalling system and therefore require a level of design works. Additionally, the road condition and below road formation condition also needs to be assessed if the upgrade is for the road surface through a level crossing the designs are for delivery in future years

The location and extent of these works for FY23 are outlined in the following table.

Table 94 FY23 Level Crossing Design Scope - Goonyella

Location & Description		Km Point
1	LX03258 – BURTON DOWNS – BLOW RAIL GEOTECH ASSESSMENT AND DESIGN	168.488
2	LX05841 – MOUNT MCLAREN – ACTIVE	61.925

Figure 44 Formation and Level Crossing Renewal Sites Goonyella FY23



iii. Access Points and Access Roads

Corridor access points are locations where Train Crew and Aurizon Network workers and contract staff need to leave the public road network to access the rail corridor. These access points are turnoffs that intersect with public and private roads. “Drive to stay alive” is a critical safety commitment in the Aurizon business so the safe access to the public road system from the rail corridor is part of the treatment of this risk.

There are 1,585Km of rail access roads in the Goonyella system that provide passage along the rail corridor. They are utilised by maintenance and rail operations staff to access the rail corridor.

In Goonyella the railway and the road network are quite separate. As such entry points include turns at formed intersections and undefined turnoffs. These undefined or un-engineered turnoffs pose a significant risk. Aurizon Network has been working with local road authorities (DTMR & local Council) to better sign access points. A focus is

to progressively eliminate unsafe or high-risk access points and to better define and identify the controlled access points.

The Black Mountain rail section attracts the highest maintenance and renewal works of any location in the CQCN. This track section crosses the Great Dividing Range in a subtropical rainforest environment. The area sees frequent short but intensive rainfall events each wet season. Given the need to access the railway in this location as well as the weather patterns, an all-weather access road has been established.

Access Point & Access Road Scope Comments:

- An allocation of \$0.1m is proposed for fix on fail access point works in FY23
- An allocation of \$0.3m is proposed for fix on fail access road works in FY23

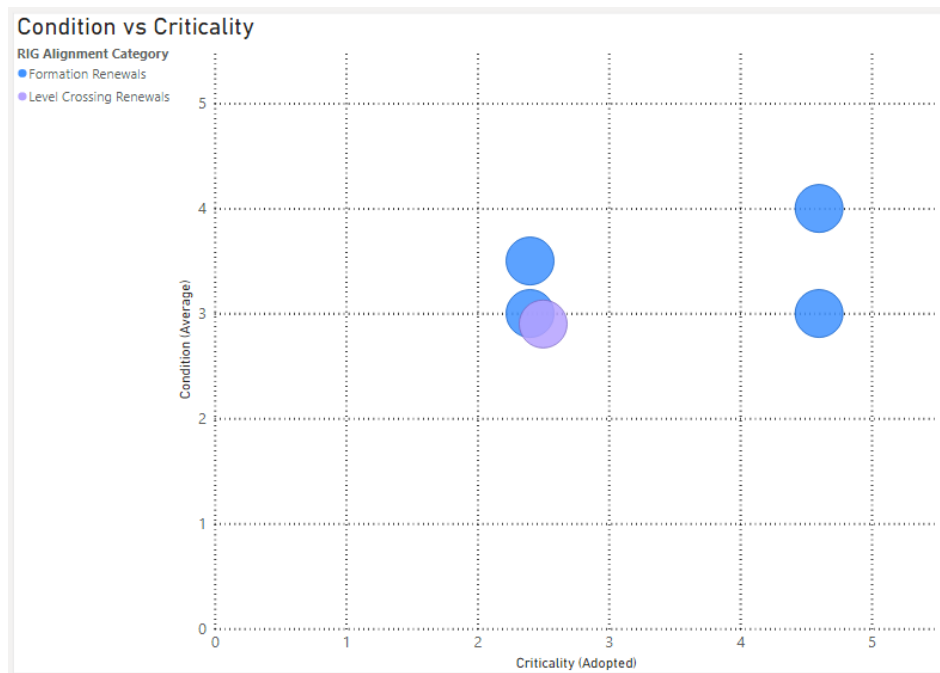
iv. Corridor Fencing and Security

The Goonyella System contains approximately 1,450Km of fencing. An allocation for fix on fail fencing has been made in the FY23 program of \$0.3m. Consistent with previous years, this will be allocated to address failed fencing in locations as identified by the local delivery teams or via Aurizon Network’s Community Engagement team in consultation with neighbouring land holders.

Civil Renewals FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the civil renewals against asset condition and location/ operational criticality. The formation scope is demonstrating a condition rating of 3.0 to 4.0.

Figure 45 Civil Renewals – FY23 Scope Priority Ratings - Goonyella



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Civil Renewals FY23 Program - Options Considered

All the proposed FY23 Civil Assets scope is condition rating 3 or above, other than level crossings. Not actioning these assets will increase the risk of asset failure leading to a requirement for an unplanned rectification. Level crossing renewals are selected due to asset condition and safety improvement opportunities.

Not addressing formation requirements will result in additional track resurfacing requirements to maintain track alignment and avoid temporary speed or operating restrictions.

Level crossing and corridor access points are safety related upgrades to maintain the safety of Aurizon staff and the public.

Table 95 Civil Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Formation renewals treat formation sections that have failed and are causing track alignment issues leading to speed restrictions and the need to complete resurfacing works. Completing the scope at these locations addresses the underlying formation issue avoiding future operational delays.	Low	Completing the scope will maintain the assets performance across these asset classes. Formation failure is a root cause defect which is treated by speed restrictions and resurfacing. Renewing the formation will remove the need to apply a speed restriction or increased resurfacing activities at the renewed site.
Defer some of the proposed scope	Deferral of identified scope could result in failure that requires unplanned rectification and added delay. Deferral of formation works will result in additional track resurfacing activity at these sites to restore track geometry and associated operational delays.	Medium	Failure to renew aged assets can lead to unplanned failure and speed restrictions.
Do not complete proposed scope	Not completing the scope will result in unplanned outages when these assets fail or require an extended period to rectify from faults.	High	Failure to renew the formation can lead to unplanned failure and speed restriction.

Options in the delivery of Formation Works

Formation – Lime Slurry Injection	Aurizon Network has in the past used the injection of lime slurry that hardens to fill voids that were identified in the formation with some success.	Medium	Lime slurry injection only treats the visible issues, given the issues are mostly not visible it has only a limited effect in the short term. The more efficient process is to re-life the asset by removal and rebuild.
-----------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------	--------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Level crossing renewals and upgrades are proposed to maintain or increase the safety of the road rail interfaces at level crossings. Failure to complete the proposed scope will either retain a poor road condition or fail to increase the passive or active protection at these sites to the required condition.

Control Systems Assets

Control Systems Renewal Program

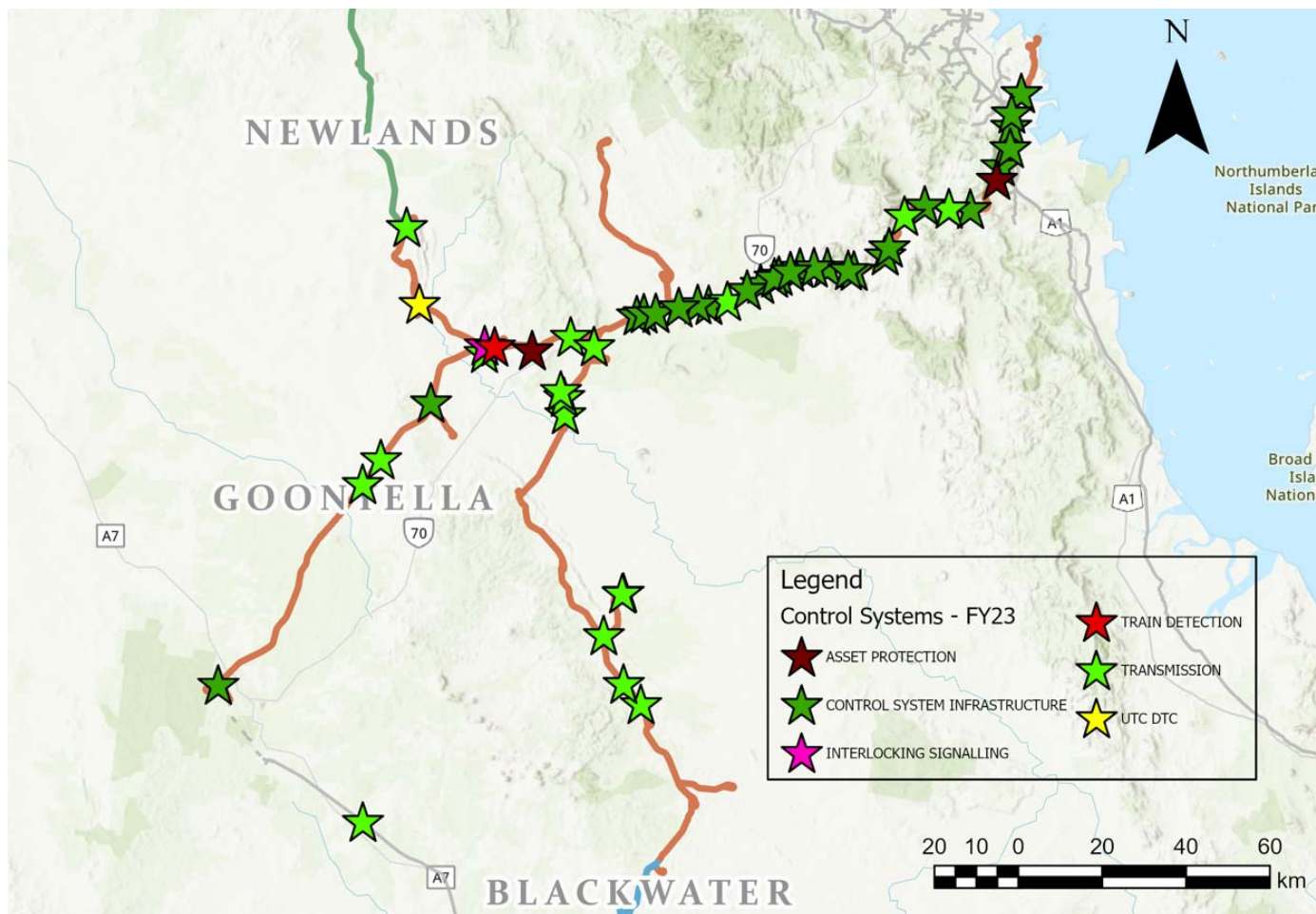
In FY23, Aurizon Network proposes to undertake \$22.3m of Control Systems replacement or renewals in the Goonyella System. Table 96 below summarises the scope and budget for each relevant renewal item.

Table 96 Control Systems Renewal Program – Goonyella

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Safeworking Systems – Asset Protection	4.0	Sites	2.5	Renewal or establishment of asset protection systems to monitor the live interface between train and track assets, to mitigate the high consequence risks of track damage, derailment and dewirement.
ii. Safeworking Systems – Train Detection	4.0	Sites	3.0	Renewal of track circuits and replacement of aged track circuit sections with axle counters in geographical blocks based on interlocking boundaries (sites).
iii. Safeworking Systems - Minor			1.3	Ongoing renewal of lower valued assets forming part of the system, to maintain average asset condition
iv. Power Resilience	10.0	Sites	0.6	Uninterrupted power supplies and battery pack renewals
v. Telecommunications Assets	117.0	Km	10.4	Optic fibre renewal
vi. Transmission & Data Renewal	34.0	Sites	3.0	TETRA Radio upgrades, Radome radio dish covers, Back-up power supplies
vii. UTC/DTC Systems Upgrades	2.0	Sites	1.0	Digital telemetry upgrades for the train control system
viii. Other Control Systems Renewals		Units	0.5	Design costs associated with Power Resilience & Interlockings
TOTAL			22.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

Figure 46 FY23 Control Systems Renewals – Goonyella



i. Safeworking Systems – Asset Protection Renewals

The location and extent of these works for FY23 are outlined in the following table.

Table 97 Asset Protection Renewals Scope - Goonyella

Scope	Detail	Qty	Location
GMS	RENEWAL	SYSTEM	BLACK MOUNTAIN
WEIGHBRIDGE	RENEWAL	SITE	CARBOROUGH DOWNS
WEIGHBRIDGE	RENEWAL	SITE	LAKE VERMONT
WEIGHBRIDGE	RENEWAL	UNIT	MILLENNIUM

Scope comments:

- The geotechnical measurement systems at Black Mountain comprise obsolete equipment and are becoming unreliable in operation. The geotechnical measurement system measures ground movement at specific locations. A ground slip is alarmed to Train Control that triggers a track inspection. A rock fall fence to detect large boulders that fall down the unstable face above the track level is also incorporated which triggers an alarm for a track inspection.
- The weighbridges to be replaced at Carborough Downs, Lake Vermont and Millennium are National Instruments RM5.5 Version which are obsolete with minimum spares available. The weigher renewal will maintain and improve availability and reliability and provide train overload measurement at these sites. These sites will be renewed to a 2D weigher with 4 transducers which provide required accuracy and some

redundancy for transducer failure. High likelihood of a cost increase due to civil track works associated with weigher accuracy, which will be refined during the design and planning process.

ii. Safeworking Systems - Train Detection Renewals

The location and extent of these works for FY23 are outlined in the following table.

Table 98 Train Detection Renewals Scope - Goonyella

Scope		Location	Qty	Unit
RENEWAL	AXLE COUNTER	WOTONGA	1	Station
RENEWAL	ML INT RX	OAKY CREEK to SARAJI	3	Station

Scope Comments:

- The FY23 renewals program relates to the removal of aged track circuits and installation of axle counters. This will reduce the population count of devices and the overall failure rate of the signalling system.

“Track Circuits” are electronic devices that were installed in the 1980’s and are now starting to fail at an increased rate. They place a current between rails that detects the presence of a train. The maximum of each individual track circuits is approximately 700m, creating a large population on the network.

“Axle counters” are devices that count wheels into and out of a section to prove it is clear for a signalled train path. Axle counters leverage modern processor based interlockings and the Operational Data Communications Network.

iii. Safeworking Systems – Minor

The FY23 program is minor asset protection assets installed to provide real time measurement of rollingstock and early works related to future year signal interlocking renewals.

Table 99 Minor Safeworking Systems Renewals - Goonyella

Scope	Description	Qty	Unit
IAMPS	Integrated Asset Monitoring and Protection System - consolidates alarms from multiple systems to present to UTC. Scope is various minor updates.	1	SYSTEM
DIAGNOSTIC COMPUTERS	Diagnostic Computers - computer hardware located in trackside signalling equipment rooms. This is the general renewal of PCs in these huts.	4	UNITS
REMOVE SERIAL LINK	Remove Serial Link – interlocking elements that are within a single station area but sufficiently separated require a communications link to exchange information. The technology that implements this communications link is obsolete and requires upgrade to a point to point data communications link.	1	UNIT

Relay to Processor Based Interlocking Renewal Goonyella -

- There are 20 relay-based interlockings in the Goonyella system. These have been in service for nearly 35 years and are near their renewal requirements. The proposed interlocking scope in Goonyella in FY23 is to start the design, procurement, and planning of future year interlocking.
- A relay-based interlocking is reliant on the safe and reliable operation of electro-mechanical relays which have an operational life, depending on usage of between 20 to 40 years.

- When a relay fails it is typically replaced with a spare. The relay components of these units are no longer supported by the vendor and critical spares are reducing.
- A replacement with a processor-based interlocking (PBI) minimises closure time need to commission the interlocking on site and provides a cost effective renewal. Combining with Power System renewal and monitoring feature of processor-based interlockings improve remote diagnosis and availability of interlocking.

Location	Scope	Planned Renewal
Balook	Early works planning and concept design	FY24
Balook	Design interlocking renewal, develop commissioning plan and order long lead items	FY24
Wandoo	Design interlocking renewal and develop commissioning plan	FY24
Braeside	Early works planning and concept design	FY25
Mindi	Early works planning and concept design	FY26

Prior to the development of the FY24 draft MRSB, Aurizon Network will discuss with the RIG the proposed multi year renewal plan of the aged interlocking population in the Goonyella System. This will also include discussion on the procurement options and strategy.

iv. **Power Resilience**

This scope is required to improve the general power resilience across the Goonyella System. Mains power is required to operate the electric switching and components housed in the track side equipment rooms. This asset family includes emergency power systems to keep the vital train control, signalling and telecommunications operating if the local power supply is interrupted. In FY23, \$0.6m is proposed for this asset class to deliver scope as outlined in the table below.

Table 100 Power Resilience Scope - Goonyella

Scope	Description	Quantity	Unit
UPS	Uninterruptible Power Supply – maintains continuous power during power outage. Scope is to replace existing expired units.	6	UNIT
GENSET IMPROVEMENTS	Upgrade standby generators to improve starting reliability. Renewal at Lake Vermont, Harrow, Stephens, Isaac Plains, Mallawa and Ingsdon	4	STATION

Note:

The FY23 Draft Proposal included scope for 6 UPS and 4 GENSET renewals. In the FY23 Final Draft, the scope quantities have been updated to 4 UPS and 6 GENSET renewals with no change to costs.

v. **Telecommunications Assets Renewals**

During FY21, Aurizon Network commenced an Optic Fibre renewal program across the Goonyella System. This program is proposed to continue into FY23.

The renewal program seeks to renew the existing 6 core optic fibre with 24 core optic fibre. This added capacity is also required to facilitate the increased data requirements from the field to central control centres and for recording asset condition in real time.

If FY23 Aurizon Network propose to renew 117Km of optic fire at a cost of \$10.4m. The location and extent of these works for FY23 are outlined in Table 101.

Table 101 Telecommunications Asset Scope - Goonyella

	Location	Start KM	End KM	Distance
1	BALOOK AT TO WANDOO SER	76.780	85.920	9.140
2	BALOOK SER TO BALOOK AT	71.248	76.780	5.530
3	BOLINGBROKE ATW TO BALOOK TSC	65.930	71.248	5.320
4	BOLINGBROKE FSS TO B'BROKE SER	54.900	60.620	5.720
5	BOLINGBROKE SER TO B'BROKE ATW	60.620	65.930	5.310
6	BRAESIDE MIE TO BRAESIDE SER	104.300	107.700	3.400
7	BRAESIDE TSC TO BRAESIDE MIE	103.200	104.300	1.100
8	BRA-SER TO MII-ATE OF CABLE	107.700	111.010	3.310
9	HATFIELD SER - BOLINGBROKE FSS	49.750	54.900	5.150
10	MACARTHUR JUNCTION SER	137.203	140.218	3.015
11	MII-ATE TO MII-FSS OF CABLE	111.100	116.200	5.100
12	MII-ATW TO SWJ-SER OF CABLE	123.030	127.580	4.550
13	MII-FSS TO MII-SER OF CABLE	116.200	120.450	4.250
14	MII-SER TO MII-ATW OF CABLE	120.450	123.030	2.580
15	ONE-FSS TO JIL-SR3 OF CABLE	23.628	28.800	5.172
16	PRAGUELANDS SER - OONOOIE FSS	28.800	23.628	9.003
17	PRAGUELANDS SER -GRASSTREE BEA	14.625	9.750	4.875
18	SWJ-CER TO SWJ-TSC O/FBR CABLE	127.480	128.320	0.840
19	SWJ-CER TO TOT-SER O/FBR CABLE	127.480	132.739	5.259
20	TOT-AT0 TO MCJ-SER OF CABLE	135.505	137.203	1.698
21	TOT-SER TO TOT-AT0 OF CABLE	132.739	135.505	2.766
22	WAITARA AT EAST TO WAITARA MI	94.960	98.160	3.200
23	WAITARA MWR TO BRAESIDE TSC	100.450	103.200	2.750
24	WAITRARA MI TO WAITARA MWR	98.160	100.450	2.290
25	WANDOO FSS TO WANDOO WSS	87.219	92.000	4.780
26	WANDOO SER TO WANDOO FSS	85.920	87.300	1.380
27	WANDOO WSS TO WAITARA AT EAST	92.000	94.960	2.960
28	YUKAN AT TO BLACK MOUNTAIN TSC	33.990	35.513	1.523
29	YUKAN SER TO YUKAN AT	28.800	33.990	5.000
TOTAL				116.971

Scope comment:

- The 117 kilometres of optic fibre to be replaced in this program equates to 19.5% of the total kilometres of optic fibre in the Goonyella System (approx. 600Km)

vi. Transmission & Data Network Renewals

Transmission & Data Networks consist of:

- Control Systems Infrastructure – the physical buildings, towers and equipment rooms that support the Control Systems assets.
- Data Network – the infrastructure and electronics required to provide the data network across the CQCN; and
- Transmission – digital and microwave radio systems.

In FY23, Aurizon Network proposes to undertake \$3.0m of asset renewals in the Goonyella System for Transmission & Data Network renewals. The location and extent of these works for FY23 are outlined in the following tables.

Control Systems Infrastructure

Table 102 Control Systems Infrastructure Renewal Locations - Goonyella

	Scope		Qty	Unit	Location
1	DEHYDRATOR	RENEWAL	1	SITE	BLAIR ATHOL
2	DEHYDRATOR	RENEWAL	1	SITE	MORANBAH
3	GENERATOR	RENEWAL	1	SITE	BLAIR ATHOL MWR
4	TELE BATTERY		8	SITE	VARIOUS

Scope comments:

- Scope items 1, 2 & 3 are to improve the air conditioning at these locations. Signal equipment rooms and signal interlockings are required to be kept at a certain temperature range. As such many of the buildings that house signalling and telecommunications equipment require air conditioning.
- Scope Locations 4 is the renewal of specialist batteries utilised in remote sites as they offer higher energy density for longer lasting operation between charge. These batteries are a component on the microwave radio equipment.

Data Network

Table 103 Data Network - Goonyella

	Scope	Qty	Unit
1	ROUTERS SWITCHES FIREWALLS	1	SYSTEM

Scope Comment:

- In FY23 an allocation of \$0.7m has been proposed to renew aged data routers that provide the connectivity between the field assets and the data network via the internet interface.

Transmission

Table 104 Transmission Renewal Locations - Goonyella

	Scope	Qty	Unit	Location
1	ACOM	1	SITE	MACKAY
2	NMS	1	SYSTEM	GOONYELLA
3	POWER SUPPLY	1	UNIT	BOLINGBROKE ATS 65.9KM
4	POWER SUPPLY	1	UNIT	BOLINGBROKE FS
5	POWER SUPPLY	1	UNIT	COPPABELLA ATS 154.2KM

	Scope	Qty	Unit	Location
6	POWER SUPPLY	1	UNIT	ISAAC PLAINS MINE CER
7	POWER SUPPLY	1	UNIT	LAKE VERMONT BALLOON SER
8	POWER SUPPLY	1	UNIT	LAKE VERMONT TCU
9	POWER SUPPLY	1	UNIT	MILLENNIUM MINE CER
10	POWER SUPPLY	1	UNIT	MINDI FS
11	POWER SUPPLY	1	UNIT	MOORVALE LOADOUT CER
12	POWER SUPPLY	1	SITE	NORTH GOONYELLA SER1
13	POWER SUPPLY	1	UNIT	NORWICH PARK FS
14	POWER SUPPLY	1	UNIT	RED MOUNTAIN SER
15	POWER SUPPLY	1	UNIT	RED MOUNTAIN TSC
16	POWER SUPPLY	1	SITE	SOUTH WALKER JUNCTION CER
17	POWER SUPPLY	1	UNIT	STEPHENS SER
18	POWER SUPPLY	1	SITE	VILLA FRANCA ATS
19	POWER SUPPLY	1	SITE	VILLA FRANCA TSC
20	SDH TO IP	1	SYSTEM	CHANGE ROUTER LINKS FROM SDH TO OF DIRECT CONNECTION
21	TETRA RADIO	1	SITE	LOCATION BASED ON PERFORMAMCE REVIEW
22	TRANSMISSION – TETRA CYBER SECURITY UPGRADE	1	SYSTEM	SYSTEM WIDE

Scope comments:

- The radio system primarily provides vital voice communications between Network Control Officers and Rail Traffic Crew throughout the CQCN. It also allows Rail Traffic Crew to communicate with Rail Transfer Facilities (RTF) and workers on the corridor.
- The digital based Terrestrial Trunked Radio (**TETRA**) network has been in operation since late 2019. It will eventually replace the analogue train control radio system, which is more than 20 years old, occupies radio frequencies that need to be handed back to the federal government.

vii. UTC/DTC Systems Renewals

In FY23, Aurizon Network proposes to undertake \$1.0m of asset renewals in the Goonyella System train control systems. This includes in field digital modernisation of the life expired analogue telemetry that receives the control message via the train control system and safety and application enhancements to the Universal Train Control (UTC) system. These upgrades are scope prioritised by the Train Control team to improve the safety functions of UTC or to reduce potential scheduling and process errors.

The location and extent of these works for FY23 are outlined in the following table.

Table 105 UTC / DTC System Renewals - Goonyella

Scope		Location	Quantity	Unit
DIGITAL TELEMETRY	RENEWAL	MORANBAH NORTH	1	SITE
UTC CODE AND SAFE WORKING	RENEWAL	SYSTEM WIDE	1	SYSTEM

viii. Other Control systems Renewals

Other Control Systems Renewals in FY23 are for minor designs to renew items in FY24. The work is driven by obsolete contactors within a particular type of points machine. This is a component within the points machine that can no longer be repaired or purchased. Remaining spare levels are becoming critical. In FY23 the following designs are to be progressed:

Table 106 Other Control Systems Renewals - Goonyella

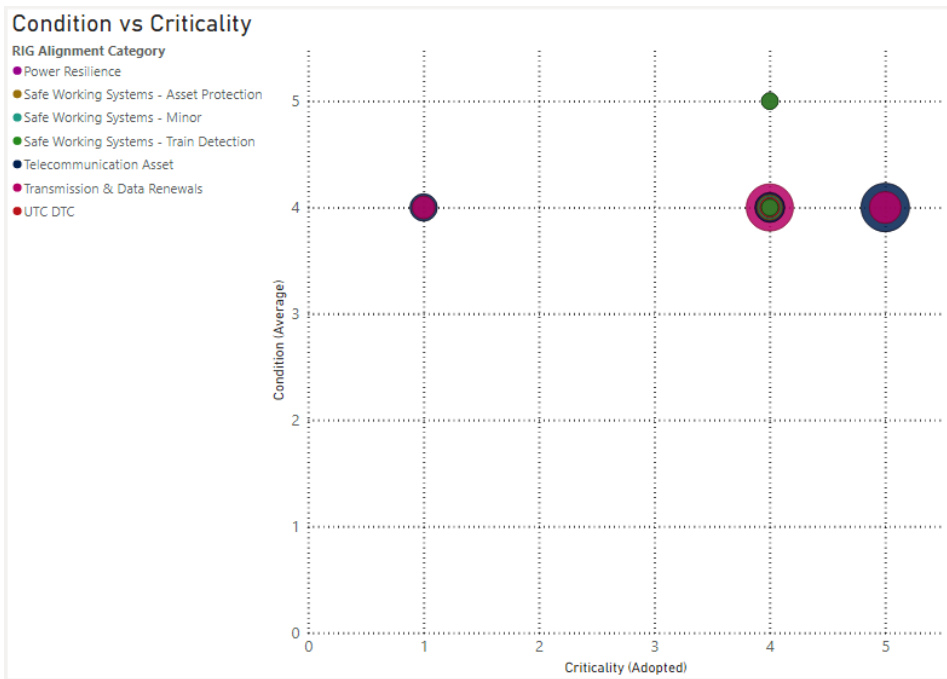
Scope	Location	Qty	Unit
M23A CONTACTOR REMOVAL	BLAIR ATHOL	14	UNITS

FY23 Scope Asset Condition and Criticality Assignment

The following graphic plots the Control Systems renewals against asset condition and location/ operational criticality. As can be seen:

- All scope items across all items are listed as condition rating 4. This reflects the age of assets targeted for renewal in FY23. Control Systems assets are mostly electronic, so renewal is a trigger of support, spare parts or software obsolescence. As such condition is more a matter of asset age against design life rather than a physical demonstration of wear.

Figure 47 Control Systems – FY23 Scope Priority Ratings - Goonyella



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Control Systems Assets FY23 Program - Options Considered

All the proposed renewal scope for Goonyella Control Systems in FY23 is condition rating 4 or above and critical to system operations.

For the proposed FY23 Control Systems renewals the renewal driver is predominantly age of the assets and technological obsolescence. The assets identified for renewal are at the end of their useable lives and in some

instances operating beyond design life. Systems are unsupported by the original vendor and spares to maintain the systems are rare.

As a result, the options considered are centred around the speed of renewal or the technology choice to replace.

Table 107 Control Systems Program Options

Option	Description	Risk of Asset Failure	Impact
Plan scope over a multi-year program, managing asset performance risk	<p>Planning objective is to maintain or reduce network service delays relative to current levels.</p> <p>The proposed scope can be completed within planned possession constraints.</p>	Low	The proposed scope nominally targets this level of obsolescence risk. Other options are considered only when other factors (opportunities or costs) associated with the practicability of program implementation outweigh the capacity benefit associated with this renewal objective.
Defer some or all the proposed scope, taking asset performance risk	<p>Deferral may increase the near-term risk of unplanned disruption due to increasing failure frequency, or delay to return to service after failure.</p> <p>A future acceleration of renewal to redress the deficit may require an increase in the number or duration of possessions.</p>	Medium	<p>This option is considered for assets where asset performance remains satisfactory, and where spares inventory can be sustained through a recover and reuse strategy to ensure return to service upon failure.</p> <p>It is used to reduce the demand for track possessions to within target levels in the planned year, or to moderate demand for finite execution resources.</p>
Accelerate scope, to eliminate obsolescence risk	While the availability of assets may improve, any significant acceleration may require an increase in track possession beyond the annual budget, eroding annual throughput.	Low	<p>This option is typically considered when there is an efficiency associated with the bundling of renewals within a geographical location, or to remove a category of equipment from a maintenance district (possibly supporting deferral of renewal in another district through replenishing of obsolete spares).</p> <p>It may also be used where a capacity impact is observed from a previous deferral of renewals.</p>
Modernisation	Reduce delays due to failures through deployment of resilient systems and architectures using modern technologies	Low	In conjunction with the scheduling of asset renewals, alternative modern technologies and resilient system architectures are considered to ensure advantages of networked digital assets.
Alternative Fibre Optic Cable installation	<p>Options:</p> <p>OPGW (Optical Ground Wire) fibre optic cable, installed in lieu of the traction earth wire.</p> <p>Air Dielectric Self Supporting (ADSS) fibre installed on traction masts.</p>	Medium	These options would be more expensive to install and maintain given interaction with OHLE, however is considered in certain circumstances where appropriate.
Digital Microwave Radio	As a replacement for fibre optic cable, it introduces a significant capacity constraint, and increases exposure to cyclone and storm events due to equipment exposed on structures.	High	<p>Digital Microwave Radio provides limited capacity between 2 points. It is a highly precise focal beam technology requiring substantial tower structures (height and strength) to sustain connection.</p> <p>Microwave Digital Radio is not considered sufficient for baseline capacity requirements.</p>

Option	Description	Risk of Asset Failure	Impact
5G mobile data network	Not practicable	N/A	5G options were not deemed appropriate as the 5G network is not commercially available for use in the CQCN.

Electrical Assets

Electrical Renewal Program

Several of Aurizon Network's power systems assets are nearing the end of their design life in the coming financial years. Aurizon Network is progressing its analysis to better understand options with respect to future power systems renewal requirements. As this develops, Aurizon Network will engage with the RIG in relation to those options.

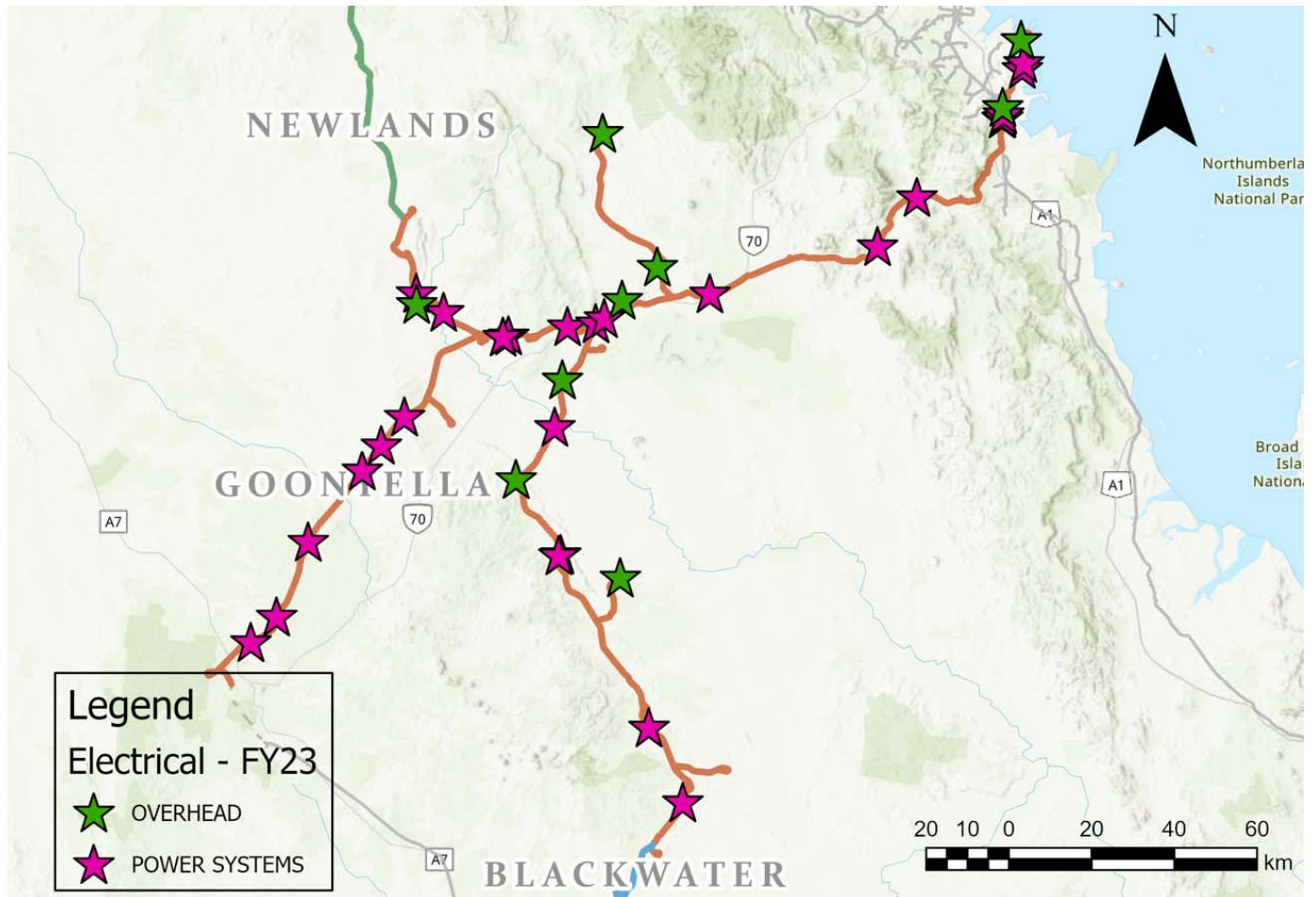
In FY23 Aurizon Network proposes to undertake \$11.3m of Electrical Renewals or enhancements in the Goonyella System. Table 108 below summarises the scope and budget for each relevant renewal item.

Table 108 Electrical Asset Renewal Program - Goonyella

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Overhead Line Equipment Renewals	38.0	Units	4.7	Overhead Line Equipment consists of all overhead wiring and support structures of the Aurizon Network's electrified system which transmit the power from the points of connection to the electric locos.
ii. Power Systems Renewals	47.0	Units	2.6	The traction power systems assets (e.g., autotransformers and motorised isolators) manage the transmission and distribution of power from the electricity grid to the electric locomotives.
iii. Goonyella Ports Overhead Renewals			3.5	Targeted works in FY23 to increase the performance of the overhead assets in the port areas of the Goonyella systems
iv. Traction Substation Renewal			0.5	Aurizon Network's traction substations enable a connection to the transmission grid, provide switching capability and high voltage protection systems.
TOTAL			11.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

Figure 48 FY23 Electrical Renewal Sites – Goonyella



i. Overhead Line Equipment (OHLE) Asset Renewals

The proposed scope for OHLE renewals in FY23 is a \$4.7m investment across the scope items outlined in Table 109.

Table 109 Overhead Line Equipment Renewals - Goonyella

Scope	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Detail
Overhead Reactive Works		Fix on Fail	1.1	Allocation to fix on fail for componentry renewals.
Overhead feeder wire and Clearance Improvement Renewal	2.0	Sites	1.5	Increasing the clearance of the OHLE at several sites to bring back to current standard to minimise faults primarily due to wildlife and/or to minimise safety hazards.
Section Insulator & Neutral Section Renewal	7.0	Sites	0.5	Replacement of life expired section insulators.
Head Span Renewals	13.0	Units	0.9	Rectification of head spans with light portal arrangements to extend their service life.
Termination Portals	16.0	Units	0.7	Renewal of termination structures which support the overhead line on each side of mine loadouts.
TOTAL			4.7	

Scope comments:

- **Overhead Reactive Works** - The \$1.1m allocation to overhead reactive works is consistent with prior years expenditure for overhead component renewals.
 - Scope consists of renewing overhead line components including insulators clamps, and steelwork fittings.
- **Overhead feeder wire and clearance improvement** – increasing the distance between the overhead wire equipment and the rail infrastructure at selected locations.
 - In 2020, Aurizon Network reported a dangerous electrical event at Edungalba siding after the live feeder wire was accidentally earthed.
 - Following this incident, a review of similar arrangements in the network was undertaken. Sites were identified for rectification to remove these hazards. Rectification works are now part of an ongoing feeder wire Clearance improvement program which will address these hazards across the network. The program is planned out to FY27.
- **Section Insulators (SI) & Neutral Section Renewals** - renewal works of assets that physically separate the electrical sections.
 - Renewal of obsolete section insulators at 7 locations. Renewal includes removal of the old asset and renewal with modern engineering equivalent asset based on a standard design.
- **Head Span Renewals** – renewal of individual head spans in 2 track sections to portal structures
 - Reinforcing the structural elements of the head span design to reduce the likelihood of asset failure.
- **Termination Portal Renewals** - renewal of key components of termination portals at selected mine sites that have advanced corrosion evident.
 - Component renewal not full structure renewal
 - A program for renewal of all termination portals is required through to FY26

ii. **Power Systems Renewals**

The proposed scope for Power Systems renewals in FY23 is a \$2.6m investment as outlined in Table 110.

Table 110 Power System Asset Replacement and Renewals Scope

Scope	FY23 Scope	Scope Units	FY23 Budget (\$m)	Description
Autotransformer Renewal	2.0	Units	0.9	Renewal of aged Autotransformers that are operating beyond design life, including site renewal.
Current Detectors	3.0	Units	0.05	To narrow the area of investigation required when an electrical trip occurs and reduce response times.
Earthing & Bonding	9.0	Site	0.4	Renewal of key elements to ensure the ongoing integrity of the traction power return current circuit, and to mitigate unsafe earth potential rises when faults occur.
Motorised Isolator Renewal	17.0	Unit	0.7	Electrical switching assets that can be remotely operated by the Electric Control Operator.
Power Supply Cubicle (PSC) Renewals	4.0	Site	0.2	Renewal of backup power supplies at 3 sites and full site renewal at 1 site.
Protection Relays	12.0	Site	0.3	Renewal of protection relays which disconnect the HV power supply when faults are detected.
TOTAL			2.6	

- **Autotransformer Renewal** - Over the past few years, Aurizon Network has observed that Tyree autotransformers installed in the mid 1980s can fail in service without any advanced warning, despite showing healthy oil test results. This increases the risk of a bow wave of future renewals due to the aging transformer fleet. Aurizon Network is addressing this risk by implementing a new Autotransformer Renewal Strategy which takes account of condition and known failure modes.
 - In FY23, 2 sites will be renewed, Balook and Coppabella
 - Renewal includes installation of bund walling where required which is an environmental protection requirement to contain any oil spill for autotransformer failure.
 - Autotransformer suppliers require a long lead time to manufacture materials. As a result, it may be necessary to place orders in FY23 for autotransformers which will be installed in future years. Early payment milestones may be achieved within FY23.
- **Current Detectors** – devices which measure current to detect faults within electrical sections. Current detectors enable maintenance staff to locate faults in multi-track areas.
- **Earthing & Bonding** – renewal and upgrade of electrical earthing and bonding at selected sites
- **Motorised Isolators (MI's)** – MI's allow the Electrical Control Operator to remotely isolate track sections by opening electrical circuits. This program is a renewal of MI's that were installed as part of the mainline electrification project in the mid-1980's.
- **Power Supply Cubicle Renewals** – Renewal of 3 battery chargers and 1 PSC site renewal.
- **Protection Relays** – Renewal of protection relays at 12 sites. These assets detect a fault condition and initiate a trip of the power circuit.

iii. Goonyella Ports Overhead Renewals

In November 2018, a dewirement (failure of the overhead wiring) occurred at Dalrymple Bay Coal Terminal (DBCT) on Departure Road 2. This single event resulted in 18 train service cancellations, 11,976 minutes of train service delays and closure of DBCT. This incident highlighted some inherent weaknesses in the Overhead Line (OHL) infrastructure at the critical ports section of the Goonyella System and triggered an investigation into how such failure events could be addressed.

Building on the investigation and analysis, Aurizon Network has developed a new OHL Asset Management Strategy and conducted a review of the OHL configuration at the Goonyella Ports. Several key observations have been made which are pertinent to the Goonyella Ports:

- The levels of corrosion in OHL supporting steelwork are very high due to its coastal, high corrosion environment, and if not addressed will substantially reduce the reliability, safety, and service life of the traction asset in this region.
- The 7-strand catenary wire used in the original construction is prone to premature breakage of individual strands. This defect is difficult to detect and is the leading cause of failure for the Electrical assets.
- Inherent weakness in the original OHL configuration design for this region, specifically the mechanical coupling between adjacent roads due to the configuration of wire-runs, results in two disadvantages. Firstly, single line isolations which can make effective use of small access windows are difficult to achieve given the high level of utilisation of this infrastructure for the operation of trains and train stowage during closures. Secondly, the operational impact of a dewirement can be quite extensive (as experienced in November 2018) with serious impacts on train operations.

This proposed project will be delivered over several years and Aurizon Network will engage with the RIG on the proposed scope and options considered for the full project delivery. Initial detail of these options and Aurizon Network's preferred option is in Chapter 8. The delivery of this project over the next 5 years includes some opportunities to trade off cost, access and reliability in a way that meets the service level expectations of users of the Goonyella Supply Chain.

The works proposed for FY23 include some mechanical separation of wire-runs, new mast foundations and detailed design works for construction in subsequent years.

iv. Traction Substation Renewals

In FY23 Aurizon Network is proposing an allocation of \$0.5m to further develop the design requirements, estimated costs and timeframes required for the renewal of the 14 Air-Insulated Switchgear (AIS) traction substations which will reach the end of their nominal service life in the next 5 to 10 years.

The project presents an opportunity for Aurizon Network and its customers to consider the reliability requirements of the electrified rail corridors, and possible trade-offs between network resilience, renewal expenditure and ongoing maintenance costs.

The selected "Generation 1" Air Insulated Switchgear (AIS) traction substations will reach the end of their 40-year design life in the next 5 years. These substations were constructed in the mid-1980s, and while short-term life extension may be possible at some sites with increased asset management attention, these assets require renewal over the next decade to maintain reliability, safety and compliance with modern standards. The renewal of the 1980's substation assets is the first major renewal of the electrical traction system since its installation.

The work to date has involved a specialist consultant assisting in developing a range of substation renewal treatment options and associated estimated costs for each of the substations approaching end of life. The engineering solution for each substation is expected to be identified towards the end of FY22, with options baselined and further design development to be completed during FY23. Undertaking this early design phase is an important element to inform the decision making process. Aurizon will present the outputs and the possible investment options to the RIG, with the view of involving the RIG in the investment approach into future years.

As is consistent with treatment of design costs with other assets, these costs will form part of the cost base of the final assets.

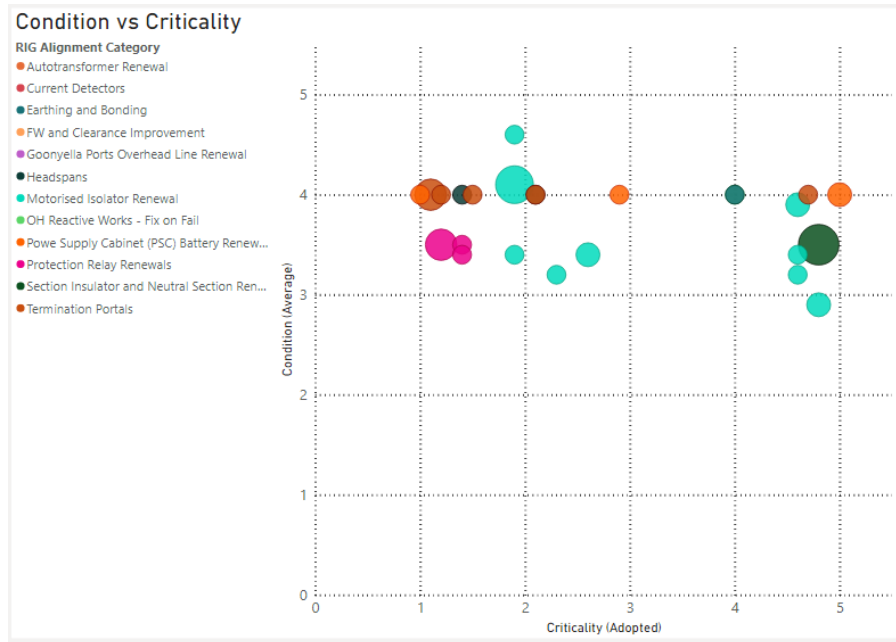
A high-level forecast of future investment requirements for this program is included in Chapter 9.2.

Electrical Assets - FY23 Scope Asset Condition and Criticality Assignment

The following graphic plots the Electrical renewals against asset condition and location/ operational criticality. Figure 49 indicates that:

- There are a large population of scope items around criticality 1.5 albeit with a condition greater than 3. Although these renewal scope items have lower criticality scores, they are important assets in the traction network and must be renewed as they are reaching end of life.
- Some renewals scope is designated as "strategic" and is not shown on the graph below. Strategic renewals are typically undertaken to improve safety or operations (e.g., feeder wire clearance improvements), or where there is a significant multi-year investment strategy is being pursued (e.g., the Autotransformer Renewal Strategy).

Figure 49 Electrical Assets – FY23 Scope Priority Ratings – Goonyella



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Electrical Assets FY23 Program - Options Considered

The proposed renewal scope for Goonyella Electrical assets in FY23 have an average condition rating of 3.7 and are critical to system operations.

For the proposed FY23 renewals the renewal driver is predominantly age of the assets, importance to electrical safety and component renewals to maintain the operations of the electrical infrastructure and avoid faults that by their nature introduce significant delay into the supply chain.

Table 111 Electrical Asset Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Minor impact as works are completed in the shadow of other renewal and maintenance activities or in feeder stations that can be de-energised whilst still retaining throughput due to the N-1 resilience built into the system.	Low	The renewal or upgrade will maintain reliability and availability levels and extend the asset's life. It will also maintain electrical safety risks at acceptable levels. The OHLE component renewal will change out defective or degraded electrical components and reduce the risk of dewirements that have a significant impact on electrical safety and system availability.
Defer some of the proposed scope	Deferral of end of life components could result in failure that requires unplanned rectification and reduced network availability.	Medium	Failure to renew worn components can lead to unplanned failure and expose the network to unacceptable electrical safety and compliance risk
Do not complete proposed scope	Failure to replace end of life components could result in failure that requires unplanned rectification and reduced network availability.	Moderate	Failure to renew worn components can lead to unplanned failure and expose the network to unacceptable electrical safety and compliance risk.

Technology Projects

Technology Projects

As detailed in Chapter 3 of this FY23 Final Draft Proposal, Aurizon Network is progressing several technology projects to renew existing systems or better understand, analyse, and identify scope across the CQCN assets. These projects improve Aurizon Network's ability to make data driven decisions regarding the management of the rail assets on the behalf of the customers, stakeholders and safety regulators.

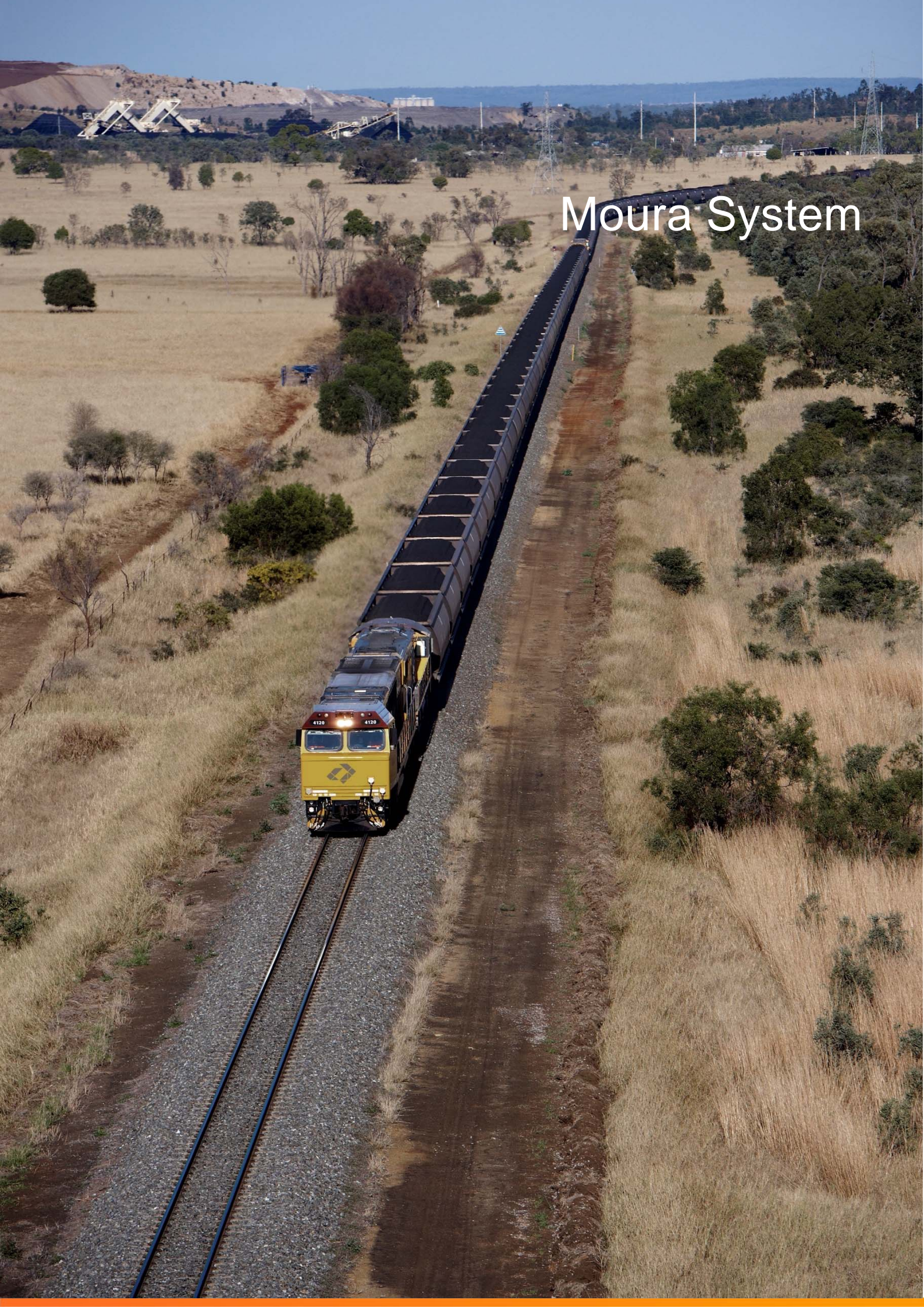
In FY23, Aurizon Network intends to progress a number of these initiatives and will seek support from the RIG to invest in these systems to enhance the maintenance and renewal programs for the Central Queensland Coal Network.

Two items are proposed to be progressed in FY23:

- ATIS – Automated Track Inspection system (ATIS) is a combination of autonomous measurement devices that provide frequent measurement of track and overhead geometry, pantograph interface and forward

facing track vision. ATIS will provide Aurizon Network with increased understanding of track and overhead alignment, moving decisions of rail and overhead alignment management from qualitative decisions to quantitative data driven assessments. Currently Aurizon Network is finalising the trial of the Wire Geometry Measurement system (WGMS) and the Pantograph Collision Detection System (PCDS) in the Blackwater and Goonyella systems ahead of presenting the business case for investment. This business case will be discussed with the RIG, seeking customer support in Q3 FY22.

- As the standardisation of the OneSAP system is completed across Aurizon Network some system functionality gaps may become evident requiring investment in SAP modules or system architecture changes. No allowance has been included in the FY23 Final Draft Proposal. If an investment is required, then Aurizon Network will engage with the RIG on the required level and timing of investment.



Moura System

7. Moura System

This chapter presents Aurizon Network's Draft Maintenance and Renewal Strategy and Budget for the Moura System during FY23. In line with 7A.11.3 of UT5, this section will be subject to vote by the relevant Moura End Users.

Aurizon Network's FY23 Final Draft Proposal for the Moura System provides for:

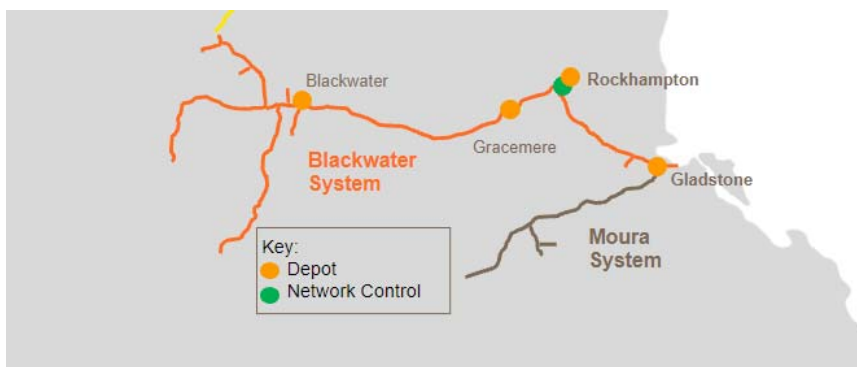
- **A Direct Maintenance Cost Allowance (excluding ballast undercutting plant depreciation) of \$12.8m**
This represents an increase of \$0.3m compared to Aurizon Network's current FY22 full year maintenance forecast and an increase of \$0.5m compared to the FY22 RIG Approved Maintenance Strategy and Budget.
- **A Renewals Allowance of \$15.8m**
This represents an increase of \$1.2m compared to Aurizon Network's current full year capital forecast and an increase of decrease of \$4.0m compared to the FY22 RIG Approved Renewals Strategy and Budget.

7.1 Moura System – Characteristics and Corridor Strategy

The Moura System is the smallest of Aurizon Network's Coal Systems in terms of both tonnage and distance. It services coal mines in the Moura region and Callide Basin, with coal being hauled to Gladstone for use at domestic industrial plants, Gladstone Power Station or for export via the Port of Gladstone. The system is not electrified other than a 7Km section near Gladstone which forms part of the Blackwater System electric asset base and provides an alternate path from Gladstone back to Callemondah.

Maintenance and renewal activities in the Moura System are primarily delivered from Aurizon Network's depot located in Gladstone, with mobile mechanised plant based in Rockhampton. Aurizon Network's depots are strategically located to enable incident response times within approximately two and a half hours. Mechanised plant (e.g., resurfacing) is typically able to respond to an urgent defect (e.g., a buckle or geometry defect) in the Moura System within 2 days.

Figure 50 Depot Locations – Blackwater and Moura System



Aurizon Network has considered asset conditions specific to this Coal System when developing the FY23 Final Draft Proposal, particularly in relation to:

- **Civil Assets** – The Moura System was constructed in the 1960's as a purpose-built coal line. However, the assets installed did not consider the axle loads or train sizes now being operated in the system. It also has some geographical challenges with track access and alignment. The Moura System traverses sections of black soils leading to formation and alignment issues when wet or very dry. It also has a large range crossing, tight radius curves, several original constructed corrugated metal pipe culverts inside large embankments and has poor drainage on the plateau west of Mt Rainbow. The lower volumes on the Moura

System mean that the time between tonnage-based inspection and interventions is longer than in higher-volume systems. Combined with the Coal System's topographical and infrastructure challenges this can lead to higher reactive maintenance requirements and temporary speed restrictions.

- **Control Systems Assets** – Some processor based interlockings installed in Moura System in the 1990's are nearing the end of their design life and, one (1) of these interlockings has been identified for renewal in FY23 with the remaining 10 sites being assessed to determine their renewal requirements and timing in future years. There is no optic fibre linkage in the Moura System, with telecommunications carried by the microwave radio system. As a result, there is limited back up communication paths in the event of microwave failures.

Corridor Strategy:

- The Moura System is subject to asset inspection and intervention requirements consistent with the three other Coal Systems, however, the lower tonnage profile results in less frequent intervention, leading to a higher proportion of reactive maintenance costs and lower operational performance, including temporary speed restrictions and unplanned outages.
- Maintenance and Renewal activity is planned to hold the system in a fit for purpose manner to achieve the required throughput while maintaining sufficient operational performance and safety for the most efficient cost.
- Asset Renewals seek to renew or replace aged assets ahead of unplanned failure or obsolescence.

7.2 Moura System – Integrated Closure Plan

Aurizon Network has engaged with the RIG and other stakeholders to better understand their requirements and has taken the following into consideration when developing the FY23 Final Draft Proposal, Integrated Closure Plan:

Specific Moura Supply Chain considerations:

- **Avoiding closure conflicts with adjacent corridors:**
 - Integrated closures in the Moura System are offset with those in the Blackwater System to allow capacity to be serviced by the adjacent system.
- **Reducing impact of major closures:**
 - Major scope delivery is packaged and executed in extended integrated closures once or twice per year (scope dependent).
 - All other planned maintenance activities are completed in scheduled maintenance blocks or in-between trains. The execution of works in-between trains is favoured due to the higher frequency of available time in-between trains, which enables asset activity to be completed outside of closures with minimal disruption to throughput.
- **Closure timing:**
 - Where possible, peak demand periods evident in a system are avoided to provide the opportunity to maximise railings at these times.

Table 112 below outlines the proposed closure hours for FY23. This provides for an increase in System Closure hours of 9 hours compared to the FY22 Approved Strategy and Budget.

Table 112 Planned integrated closures, branch closures and BCM – Moura System

FY23 Integrated System Closures													
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Hours	0	0	0	0	0	72	0	0	0	48	0	0	120
FY23 Callemondah works impacting Moura													
Hours	0	12	0	0	0	0	0	12	0	0	0	0	24

Due to rostering and fatigue management of maintenance staff, a closure in December in the Moura system was unavoidable. Included in the FY23 strategy are nominated periods where works in Callemondah yard can be undertaken during Blackwater integrated system closures. In August and February for 12 hours, the Moura system traffic will be impeded while critical maintenance tasks are completed on roads within the Callemondah area. This provides an increase of 24 hours and scope driven increase of 9 hours to integrated system hours, totalling a 33 hour increase when compared to FY22 (see Figure 51).

In addition to the integrated system and Callemondah closures (outlined in Table 112), single line maintenance activities will be planned during the year (as required by the asset) and will have regard to seeking to deliver Committed Capacity, and that outages are coordinated with other Supply Chain Participants wherever reasonably possible with a view to maximising throughput.

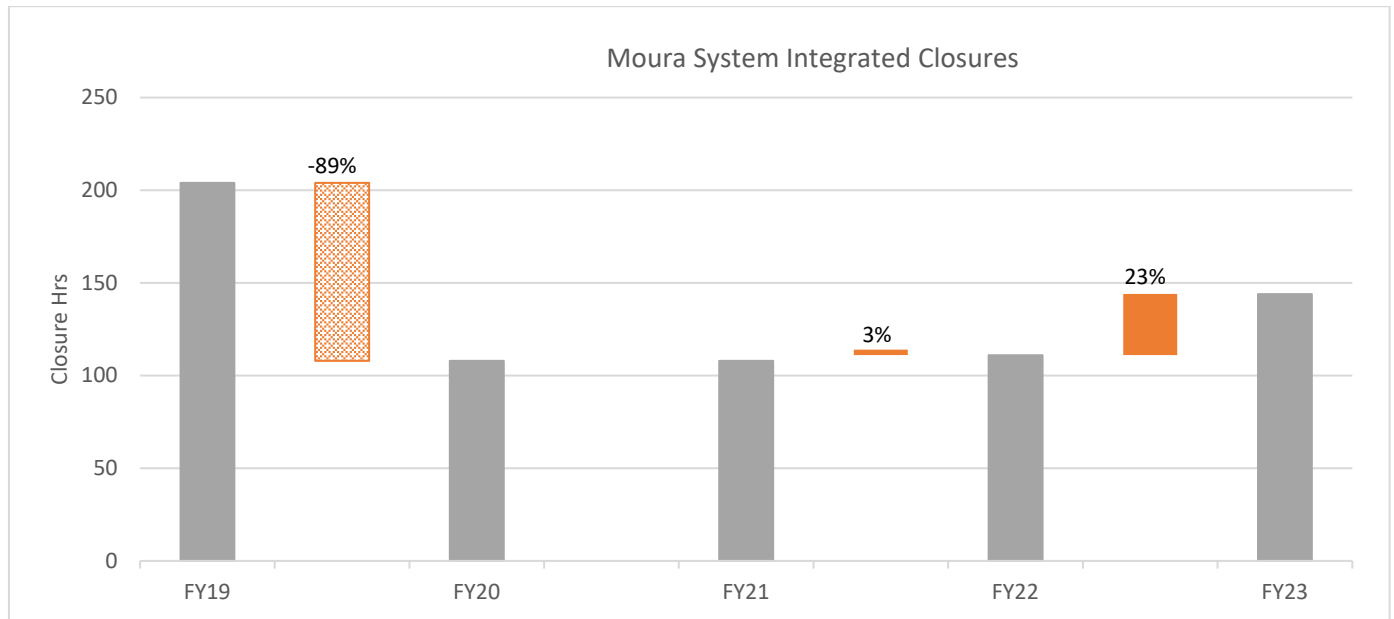
The following asset activities are a selection of activity determining the planned integrated possessions and access requirements in the Moura System during FY23.

Table 113 Critical Scope Activity in the Moura System

Planned Delivery (hrs)	Asset	Location
72	Formation Renewal	Annandale (123.3 to 123.9Km)
52	Bridge Rollout	Dumgree – Bells Creek (100.81 to 100.96Km)
72	Rail Renewal	Mt Rainbow (80.985 to 82.830Km)
72	Culvert Renewal (6 sites)	Mt Rainbow (81.710 to 86.97Km)
48	Level Crossing Renewal	Belldeen – Banana Holding Road (ID6047)
36	Ballast Cleaning	Annandale & Dumgree

Figure 51 below illustrates the historical Moura integrated system closure hours in comparison to the FY23 Final Draft Proposal.

Figure 51 Trend of Integrated System Closure Hours FY19 to FY23 – Moura



Since FY19, the integrated closure strategy was rationalised, with a focus on the execution of renewals scope. In recent years, Aurizon Network also introduced the concept of maintenance blocks to this Coal System, i.e., nominated days where maintenance would be executed in a nominated zone of the Moura System and limited to a maximum duration. Under this process, pathing remains available until a possession is created in the maintenance block. The level of demand in this Coal System, combined with the maintenance blocks, has generally eliminated the need for regular system closures. Where necessary, longer maintenance blocks may be agreed with other Supply Chain Participants to support maintenance activity. Reactive access is often required and can generally be supported between trains therefore having negligible impact to the supply chain.

7.3 Moura System – FY23 Maintenance Strategy and Budget

Aurizon Network has developed its Draft Maintenance Strategy and Budget for the Moura System having regard to all relevant matters outlined in clause 7A.11 of UT5, including the Maintenance Objectives. Aurizon Network considers its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of Moura System Rail Infrastructure and seeking to deliver Committed Capacity.

7.3.1 Summary of Historic, Forecast & FY23 Maintenance Strategy and Budget

Aurizon Network's FY23 Final Draft Maintenance Strategy and Budget for the Moura System provides for a Direct Maintenance Cost Allowance of **\$12.8m** (excluding ballast undercutting plant depreciation) which is:

- \$0.5m higher than the FY22 Approved Maintenance Strategy and Budget; and
- \$0.3m higher than Aurizon Network's current FY22 full-year forecast.

Figure 52 below provides a summary of historic direct maintenance costs as well as the proposed direct maintenance cost budget in respect of FY23. To ensure comparability with prior periods, the direct maintenance costs shown in the chart below exclude depreciation on ballast undercutting plant.

Figure 52 Moura System Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

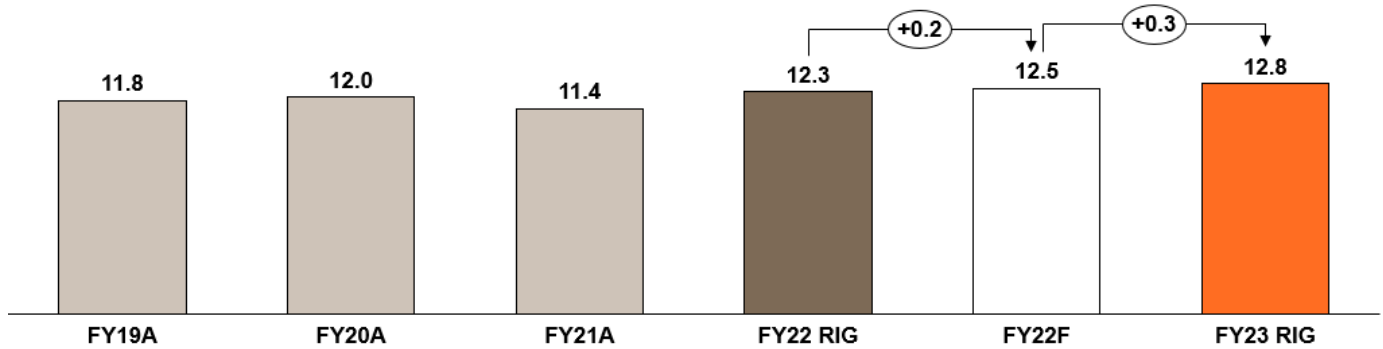
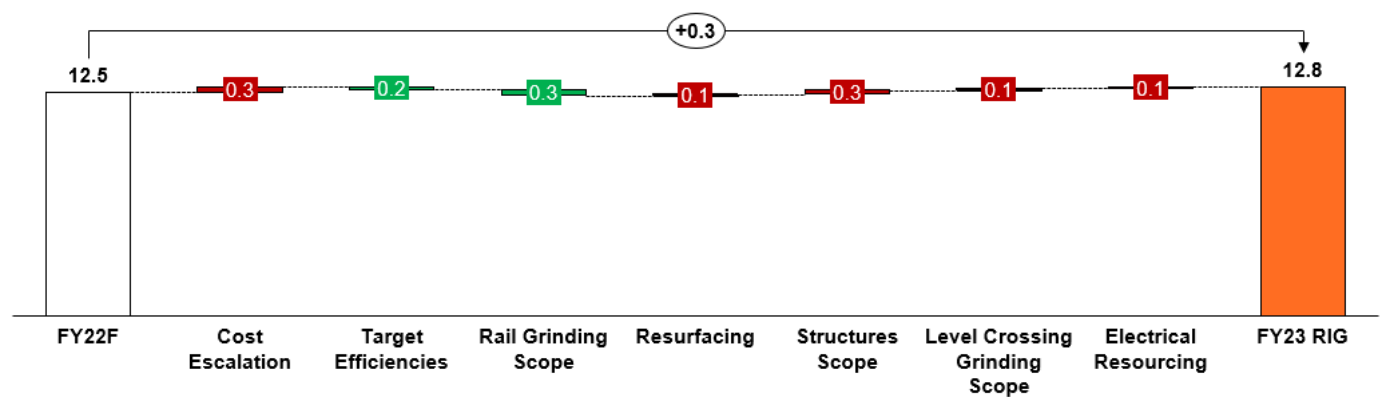


Figure 53 Moura System Direct Maintenance Cost movement (excluding ballast undercutting plant depreciation)



As noted in the Quarterly Report for Q1 FY22, the current forecast for FY22 direct maintenance costs excluding ballast undercutting plant depreciation is \$12.5m (at 30 September 2021). This is \$0.2m higher than the FY22 RIG-approved maintenance budget of \$12.3m with the increase driven by higher Structures and Facilities maintenance (\$0.1m) and higher Other General maintenance (\$0.1m) costs.

The current forecast also takes account of actual conditions and run rate costs from FY21 and Q1 FY22. The FY22 forecast is subject to review and will be updated at the end of Q2 FY22.

The proposed direct maintenance cost allowance (excluding ballast undercutting plant depreciation) is \$12.8m; \$0.3m higher than the current FY22 direct maintenance cost forecast which has been used as the basis for developing the FY23 Final Draft Proposal. This increase reflects the net impact of assumed cost escalations and scope changes (+\$0.5m) and target efficiencies (-\$0.2m).

An overview of the methodology used to establish the FY23 maintenance cost budget is provided in Chapter 13. Chapter 7.3.2 below provides a summary of the maintenance and scope and budget proposed for the Moura System in FY23 for each maintenance item.

7.3.2 FY23 Maintenance Strategy and Budget

As detailed in Chapter 11, Aurizon Network's Asset Management approach is based on achieving the appropriate level of asset availability at the most efficient cost of ownership, through the entire asset life cycle, which will best meet the customer requirements in each Coal System.

Aurizon Network's Asset Maintenance and Renewal Policy is to maintain the condition and availability of the network consistent with previous performance. The scope and closure requirements in different systems is influenced by demand, track arrangement, operating parameters, traction mode and signalling and communications systems. In addition to the lower volume profile, Moura operates with shorter train sets (limited by passing loop lengths) as compared to Blackwater and Goonyella and sees no passenger traffic. As a result, the maintenance and renewal pattern in Moura is different than other systems with a closer mix of maintenance in total capital and maintenance cost, as per the table below.

Table 114 FY23 Proposal – Moura System Maintenance & Capital spend % split

System	FY23 Renewals and Maintenance Cost (\$m)	% Maintenance	% Capital
Newlands	\$35.4	36%	64%
Goonyella	\$182.6	33%	67%
Blackwater	\$189.7	34%	66%
Moura	\$28.6	45%	55%

The time between renewals for those assets that wear (such as rail) is longer in Moura than other systems, whilst the maintenance inspection pattern is similar to the other systems. For example, rail in tight radius curves (200m – 600m) in Blackwater has an average life of 8 years until it reaches the renewal trigger of rail wear, whilst rail in the same arrangement in Moura has an average life of 33 years.

The planned and preventative maintenance activities and inspections, as well as the planned mechanised production scope, are derived in line with the intervention periods as detailed in the Asset Maintenance & Renewal Policy. This Policy determines the inspection regime and period based on asset type condition and location.

The proposed FY23 maintenance scope and budget for the Moura System is outlined in Table 115. Please note that the totals presented in the table below may not add due to rounding.

Table 115 FY23 Proposal – Moura System Maintenance

Maintenance Item	Scope Units	FY22 Forecast Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
Resurfacing			1.4		1.5
- Mainline	Km	170	1.3	170	1.4
- Turnout	Site	10	0.1	10	0.1
Rail Grinding			0.7		0.5
- Mainline	Km	█	0.6	█	0.4
- Turnout	Site	█	0.1	█	-
- Level Crossing	Track LX	█	0	█	0.1
General Track Maintenance			5.0		5.1
- General Track	Activity		4.6		4.9
- Track Recording	Km	514	0.3	514	0.2
- Ultrasonic Testing Car	Km	373	0.1	382	0.0
Signalling and Telecoms			3.0		3.0

Maintenance Item	Scope Units	FY22 Forecast Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
- Signalling Corrective	Activity		0.9		1.1
- Signalling Preventative	Inspection		1.2		1.3
- Telecoms Corrective	Activity		0.1		0.1
- Telecoms Preventative	Inspection		0.7		0.5
Structures and Facilities			0.7		1.0
Trackside Systems			0.2		0.3
Other Civil Maintenance			0.9		0.9
Other General Maintenance			0.5		0.5
- Asset Management & Inventory			0.2		0.2
- On Call			0.3		0.3
- RM900 Storage & Maintenance			-		-
Sub-Total			12.5		12.8
Ballast Undercutting Plant Depreciation			0.2		-
Total Direct Maintenance Costs			12.7		12.8
Non-Coal Allocation			(0.2)		(0.2)
Total			12.5		12.6

For the Moura System:

- **Direct maintenance costs** (excluding ballast undercutting plant depreciation) are budgeted to increase by \$0.3m from the current FY22 forecast to **\$12.8m** in FY23. The movement in cost between periods reflects the net impact of cost escalation and scope changes (+\$0.5m) partially offset by estimated target efficiencies (-\$0.2m). Key movements in RIG maintenance categories are summarised below.
 - **Resurfacing (+\$0.1m)** – increase primarily reflects annual cost escalation and an increase in cyclic maintenance costs. Resurfacing plant has varying annual maintenance cycles such that costs of maintaining the equipment will vary year on year for the life of the plant.
 - **Rail Grinding (-\$0.2m)** – decrease reflects the cyclic decrease in mainline and turnout scope due to lower annual tonnes compared to the other CQCN systems. This is partly offset by the proposed introduction of a preventive level crossing rail grinding program.
 - **General Track (+\$0.1m)** – this category represents around 40% of maintenance spend in the Moura system. Cost increase primarily reflects escalation.
 - **Ultrasonic Testing Car** - due to data improvements enabling the accurate collection of historical train movements over each track section, the requirement for ultrasonic testing (every 10MGT) has been effectively matched to actual traffic movement rather than assumptions of traffic flow across the railway.
 - **Structures and Facilities Maintenance (+\$0.3m)** – increase is driven by increased preventative culvert cleaning (\$0.1m), higher structures inspection costs (\$0.1m) and additional drainage maintenance defect repairs (\$0.1m).
- **Ballast Undercutting Plant Depreciation (-\$0.1m)** – no mainline undercutting scope is currently planned in Moura in FY23 resulting in no allocation of ballast undercutting plant depreciation.

-
- **Non-Coal Allocation** – this adjustment reflects an allocation of costs to non-coal services and is calculated by applying an estimate of the non-coal proportion of total system GTKs to total system maintenance costs (excluding ballast undercutting plant depreciation).

In aggregate, these changes result in total direct maintenance costs in FY23 of \$12.6m which is \$0.1m higher than FY22F.

- The scope of planned corrective and reactive maintenance tasks is heavily dependent on the faults identified via the planned inspection programs. Consequently, scope for these activities cannot be defined. Aurizon Network has assumed that in FY23, this Coal System will see a similar level of faults that require planned corrective or immediate maintenance response as in prior years. This is consistent with the treatment in prior years and as noted in Figure 54 the level of General Track maintenance has been consistent year on year.
- For the Moura System, the following activities are to be considered as an aggregated single “item” for the purpose of UT5, clause 7A.11.5(f)(ii)(B)(2) – Resurfacing, Rail Grinding, General Track Maintenance, ‘Signalling and Telecoms’, ‘Structures and Facilities’, Trackside Systems, Other Civil Maintenance and Other General Maintenance.

Set out in the chart below is a summary of historic, forecast and budgeted direct maintenance costs by maintenance category. To ensure comparability between periods, the direct maintenance costs presented in the chart exclude depreciation on ballast undercutting plant.

Figure 54 Moura System – Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

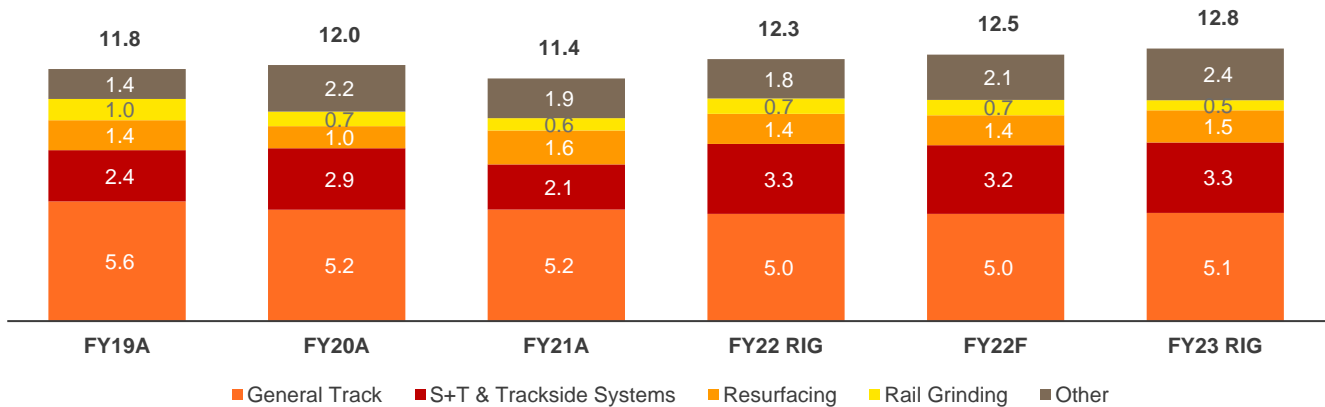
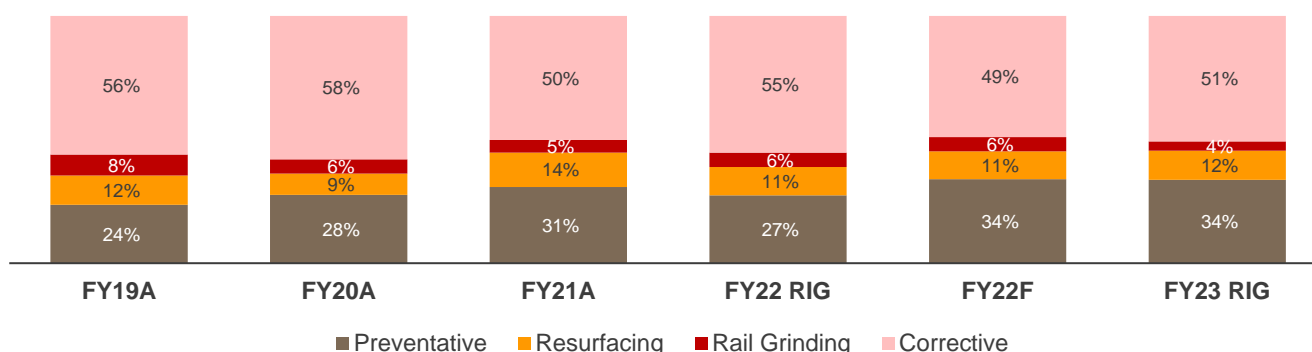


Figure 55 below illustrates the proportion of preventative and corrective maintenance expenses in the Moura System over time. The cost of both Rail Grinding and Resurfacing maintenance activities have been categorised as preventative in nature. Approximately 50% of the Moura System maintenance spend in FY23 is expected to be preventative in nature, which is lower relative to the other Coal Systems in the CQCN. It reflects the asset management approach and operational performance.

Figure 55 Moura System – Preventative / Corrective Maintenance Spend Composition



Further information in relation to the costing methodology used by Aurizon Network in the development of the FY23 Final Draft Proposal is outlined in Chapter 13. Additional detail in relation to the make-up of costs for each maintenance activity has also been provided to the RIG Expert Advisor.

7.3.3 Alternative maintenance options considered

Aurizon Network notes that there are several options available as to how and when asset renewal and maintenance is performed. When implemented, each option may have an associated flow on impact to other Supply Chain Participants. Aurizon Network’s access planning process endeavours to optimise impacts through appropriate access planning. Aurizon Network welcomes further discussions to explore alternative options.

As detailed in Chapter 11, Aurizon Network applies several different approaches with regards to maintaining the Rail Infrastructure. These approaches lead to the application of the maintenance task across the system. A summary of alternate considerations is detailed in Table 100 below. Aurizon Network welcomes the opportunity to work with Customers and other Supply Chain Participants to further explore alternate maintenance approaches.

Table 100 Maintenance Considerations

Activity	Description	Alternative maintenance option
Mainline & Turnout Resurfacing	Track settlement occurs in heavy haul railway conditions, presenting as track geometry defects that can result in derailments if not maintained effectively. Track resurfacing is an essential maintenance activity in railways to maintain safe track geometry for rolling stock. Track geometry defects can be symptomatic of an underlying defect, which is creating excessive or rapid track settlement. Multiple resurfacing interventions to maintain safety is a key consideration when determining whether ballast cleaning and formation renewal work is required. Resurfacing activities are currently delivered in a way that provides operational flexibility with these activities currently scheduled after customer train orders. Planned works are delivered in the shadow of other maintenance activities and/or where customer demand permits. Resurfacing scope is both preventative and corrective based on the method of identification.	<ol style="list-style-type: none"> Lower Production / Higher Cost / Higher Short-term Access Impact Option, provides: <ul style="list-style-type: none"> Attend all defects as quickly as possible Focus on asset reliability Negative impact on capacity Decreased productivity and increased travel Medium Production / Medium cost / Lower Short-term Access Impact Option – <ul style="list-style-type: none"> Larger periods of access between trains Stay in the system for a whole block (i.e., roster period) Reduce travel between systems Defects held for longer periods Attend high impact defects quickly <p>Aurizon Network currently utilises option 2 in Moura as it delivers the most appropriate outcomes for the supply chain.</p>

Activity	Description	Alternative maintenance option
Rail Grinding	<p>Rail grinding is a critical maintenance activity to reduce rail breaks and extend the life of rail.</p> <p>The rail grinding approach through the CQCN seeks to control surface initiated rail defects under a preventative regime. Intervention thresholds are based on throughput tonnage which are translated into a time-based frequency to allow long term planning. These frequencies are dictated by the 'tightness' of the curve as rail defects are directly correlated to the dynamic curving forces of trains.</p> <p>Rail grinding is also undertaken in a reactive way to remedy identified rail defects which are initiated from high traction locomotives or other unpredictable mechanisms.</p>	<ol style="list-style-type: none"> 1. Preventative grinding strategy with a small amount of corrective allowance 2. Corrective rail grinding strategy - A corrective rail grinding strategy would involve allowing rail surface defects to propagate to a severe condition, before reactively programming the rail grinder to perform deep rail grinding to remove the severe defect. This approach would reduce the rail grinding scope, however, significantly increases the risk that surface defects grow into the rail causing rail breaks. This approach would also restrict long term planning leading to disruption in the network for unplanned maintenance. Corrective rail grinding also reduces the rail asset life as more rail is removed during rail grinding to remove surface defects and cracks. Corrective rail grinding strategies are adopted in other rail networks that have lower throughput with plenty of maintenance windows or where the demand is seasonal. <p>Aurizon Network currently utilises option 1 in the Moura system to ensure high availability and reliability of the rail asset.</p>
General Track	<p>The current inspection approach for General Track is a mix of the Track Recording Car, Ultrasonic Test Car, High Rail Vehicle inspections, walking inspections and non-destructive hand testing as detailed in the Asset Maintenance & Renewal Policy.</p>	<ol style="list-style-type: none"> 1. Reduce Inspection Frequencies - Reduce inspection frequencies and revert to additional fix on fail methodology. A move to reduce the frequency of inspections would require consultation and approval from the Rail Safety Regulator. This option is not recommended and would likely lead to an increase in unplanned delays and increased cost to rectify in an unplanned manner. 2. Operational Intervention - To reduce the impact of high priority defects, Aurizon Network can apply temporary restrictions to manage risks e.g., Temporary Authorised Non-Conformance, Temporary Speed Restrictions, Axle Load Restrictions or rerouting loaded and empty trains. These interventions can be localised to the defect to keep the rail line open whilst working with the above rail operators to find a least impact time to rectify the defect. Whilst this keeps the rail line open, this will potentially impact operational performance and could result in unplanned closures if the defect changes. <p>Aurizon Network currently utilises option 2 in the Moura system as it delivers the most appropriate outcomes for the supply chain.</p> <p>Aurizon Network is currently trialling ATIS, an alternative option to the Track Recording Car outlined in Chapter 3.3. The results of this trial and possible effect on the frequency of general track inspections will be discussed with the RIG in due course.</p>
Control Systems	<p>Maintenance is based on defined time-based inspections of equipment items (e.g., points, level crossings) and of equipment enclosures and power supplies.</p>	<ol style="list-style-type: none"> 1. Maintain only on failure – not recommended and would likely lead to an acceleration of faults which will reduce the reliability of the systems which in turn reduces the capacity of the railway. 2. Planned frequency (current approach) - recommended. The current planned frequencies are

Activity	Description	Alternative maintenance option
	<p>The frequency of inspection varies between equipment types and is based on failure modes and criticality.</p> <p>Frequency and tasks are reviewed annually for effectiveness based on observed asset condition, fault performance, and impact on rail services.</p>	<p>reviewed on an annual basis to align the required inspections to the condition of the assets.</p> <p>3. Increased inspection frequency and/or accelerated replacement and refurbishment to reduce the likelihood of service affecting failures - this is not recommended outside of the annual review of planned frequencies and would increase the cost of control systems maintenance. Any change to the inspection frequencies requires consultation and approval from the Rail Safety Regulator.</p>

7.4 Moura System – FY23 Renewals Strategy and Budget

Aurizon Network has developed its Draft Renewals Strategy and Budget for the Moura System having regard to all relevant matters outlined in clause 7A.11 of UT5. Aurizon Network considers that its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of Moura System Rail Infrastructure and seeking to deliver Committed Capacity.

7.4.1 Supply Chain Benefits of the Renewal Program

In addition to an optimised cost outcome, Aurizon Network’s renewal program seeks to provide the following benefits for the Moura System supply chain.

Table 116 Supply Chain Benefits of the Renewal Program

Renewal Activity	Benefit Type	Description
Permanent Way	Asset reliability	Reduce network delays associated with unplanned asset activity. Asset components such as rail, sleepers and turnouts have a low likelihood of failure in a new state and require minimal maintenance once renewed.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition.
Ballast Cleaning	Asset reliability	Reduce network delays due to asset failure associated with track geometry defects and mudholes linked to poor ballast condition due to coal fouling.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses. Proactive ballast condition management mitigates TSR’s caused by poor ballast condition.
	Safety	Improve the wet weather resilience of track (reduced unplanned defects which need to be responded to in a reactive manner). Reduces train derailment risk by managing asset condition.
Civil Assets	Asset reliability	Reduce network delays associated with asset failure and lifting renewed sections to the current required tonnages.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition. Removal of redundant assets reduces the risk of rail staff accessing the rail corridor and members of the public accessing no longer required live crossings.

Renewal Activity	Benefit Type	Description
Transmission and Data Networks	Asset reliability	Given these assets do not wear but rather age to a point where they are no longer supported renewal ahead of failure is required to retain the assets' reliability.
	Throughput	Renewal and system improvements to best move trains through the system in an efficient and safe way.
	Safety	Ensuring the critical signalling and train control systems are robust and effective in the separation of trains. Providing clear communications functionality across the CQCN systems.

7.4.2 Summary of FY23 Renewals Strategy and Budget

Aurizon Network's FY23 Final Draft Renewal Strategy and Budget for the Moura System provides for a Capital Renewals requirement of \$15.8m which is:

- \$4.0m higher than the FY22 Approved Maintenance Strategy and Budget; and
- \$1.2m higher than Aurizon Network's current FY22 full-year forecast.

A summary of the FY23 renewals budget and scope quantity compared to FY22 for the Moura System is outlined in Table 117. Please note that the totals presented in the tables below may not add due to rounding.

Table 117 FY23 Proposal – Moura System Renewals

Renewals Item (\$m)	Assets Include:	FY22 Approved Budget	FY22 Full Year Forecast	FY23 Draft Budget
Civil Assets		9.7	12.7	12.5
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	3.5	5.1	5.2
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	2.4	2.8	1.9
Structures	<i>Culverts, Bridges</i>	0.9	2.3	2.4
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	2.8	2.5	2.9
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>	2.0	1.8	3.3
Technology Projects		0.2	0.1	--
Total		11.8	14.7	15.8

The FY22 full year forecast variance to the FY22 Approved Strategy and Budget is primarily driven by delayed FY21 scope in turnout renewals and structures. COVID-19 impacts on the supply chain and increased safety requirements to 3rd party contractors operating on the Network were the key causes to the delay.

The detail of the above-mentioned change and all variances in FY22 will be detailed as parts of the Quarterly RIG reporting process.

Table 118 FY23 Proposal – Moura System Renewals as a % of Total System Assets

Renewals Item	Assets Include:	Total system Assets	FY22 RIG Approved Scope	FY23 Proposed Scope	FY23 scope % Total system Assets
Civil Assets					
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	• 550Km rail	• 1.60Km rail	• 6.0Km rail	• 1.1%
		• 275Km sleepers	• 1.3Km sleepers	• 0Km sleepers	• 0.5%
		• 275Km track	• 0Km track upgrade	• 1.6Km track upgrade	• 0.6%
		• 62 turnouts	• 0 turnouts	• 2 turnouts	• 3.2%
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	• 275Km Mainline	• 3.9Km Mainline	• 1.5Km Mainline	• 0.5%
		• 62 Turnouts	• 1 Turnouts	• 2 Turnouts	• 3.2%
		• 39 bridges	• 1 bridge	• 1 bridge	• 2.6%
Structures	<i>Culverts, Bridges</i>	• 39 bridges	• 0 bridges	• 0 bridges	• nil
		• 550 culverts	• 2 culverts	• 8 culverts	• 1.5%
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	• 275Km formation	• 0.5Km formation	• 0.6Km formation	• 0.2%
		• 148 level crossings	• 1 level crossings	• 1 level crossings	• 0.7%
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>		• 4 sites	• 12 sites	
			• 5 units	• 0 units	
			• 0Km Optic Fibre	• 2.8Km optic fibre	

Note: Control Systems count of assets is a collective of sites, nodes, cable routes, communications assets and systems and is included to indicate level of work comparable to prior year. Detail of actual scope is provided later in this Moura section.

7.4.3 Details of the FY23 Renewals Strategy and Budget

This section provides detailed information in relation to the individual scope items selected for renewal in FY23, along with the rationale for those selections and alternative options considered.

Aurizon Network notes that the prioritisation of renewals scope is based on currently available information and that this prioritisation may change over the period prior to execution (of up to 18 months) because of environmental factors, relative degradation rates or other considerations. Changes to the proposed scope will be dealt with through the reporting and change management processes as appropriate.

In the preparation of the FY23 proposal, Aurizon Network conducted a likelihood of change review to determine scope that may incur project change to either cost or delivery, time to complete or location change. Further detail of this review is detailed at Chapter 12.1.7 of Part B and change drivers against individual scope items are included in this section.

Through the likelihood of change review, it was identified that of the 76 scope items proposed in Moura in FY23, 8% had a high likelihood of change, 40% had a moderate likelihood of change and 52% of the program is expected to have no change to either site cost, scope creep or works duration. An overview of this information by asset class can be seen in the table below.

Table 119 FY23 Likelihood of Change – Moura

Asset Class	Total scope items	Items with High Likelihood of change	% of scope with High Likelihood of change
Civil	59	4	7%
Control Systems	17	2	12%
TOTAL	76	6	8%

The percentage of scope change relative to total scope is expected to be higher in the Control Systems assets as these are mechanical and computer-based assets. The renewal of these assets is linked to the obsolescence of the aged assets so there is an element of unknown about the commissioning of new generation technology into Aurizon Network’s existing systems. This can lead to scope creep, cost impact or delay in delivery time.

Civil Assets – Permanent Way

Permanent Way Renewal Program

Aurizon Network’s FY23 Final Draft Proposal provides \$5.2m to deliver the scope of permanent way renewals in the Moura System. Table 120 below summarises the scope and budget for each relevant renewal item.

Table 120 FY23 Permanent Way Renewals – Moura

Description	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Rail Renewal	6.0	Rail Km	1.8	Equates to 1.1% of rail in the Moura System.
ii. Track Upgrade	1.6	Track Km	1.7	1 Track Upgrade site planned and assigned to planned closure. This work will renew 1.8Km of track being sleepers and rail (2.282 sleepers and .0024 rail Km) which is 0.6% of track in the Moura System.
iii. Turnout Renewal	2.0	Sites	1.1	Equates to 0.03% of turnouts in the Moura System. Scope is coordinated between all asset disciplines given the interplay between Civil, Electrical and Control Systems assets.
iv. Turnout Components		Fix on Fail	0.6	Same allocation made to major component renewal as in FY22.
v. Permanent Way Other		Fix on Fail	0.1	Glued Insulated Joints (GIJ's), Rail Lubrication and Rail fix on fail scope.
TOTAL			5.2	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Rail Renewal

Rail renewal scope is triggered by rail which is either at or near wear limits or has seen tonnages that indicate a heightened risk of near-term failure due to rail fatigue. The location and extent of these works for FY23 are outlined in Table 121.

Table 121 FY23 Rail Renewal Program – Moura, length in Rail kilometres

Ref	Track Section		Start Km	Finish Km	Length (Km)
1	FRY	MOUNT RAINBOW	80.985	82.830	3.690
2	STOWE	GRAHAM	27.299	28.469	2.340
TOTAL					6.030

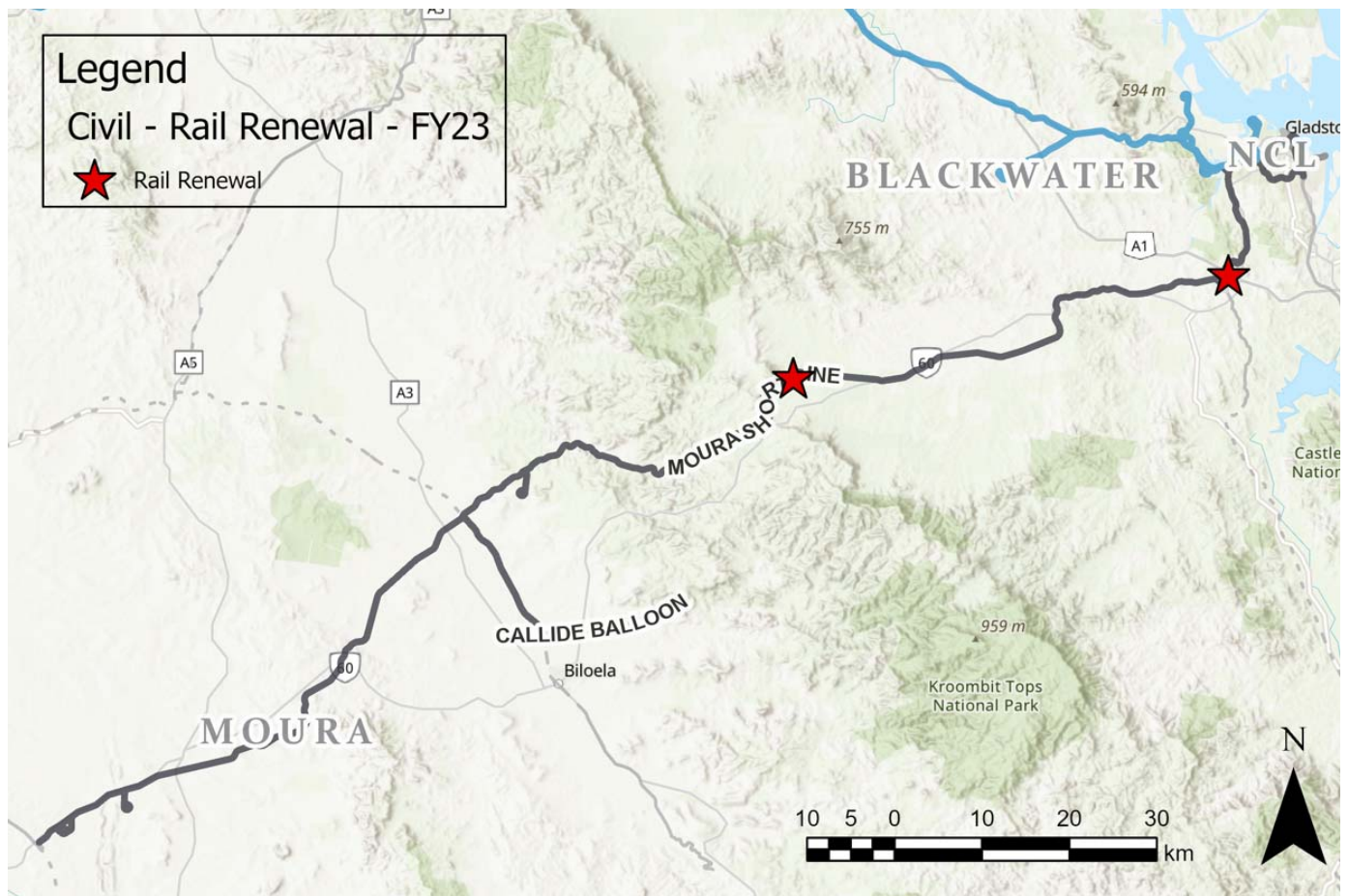
Scope comment:

- The 6.03 rail kilometres being renewed in this program equates to 1.1% of the total rail in the Moura System (273 track Km)
- Both sites identified in FY23 are being renewed due to rail wear.

“Rail wear” is the progressive loss of steel in the rail head caused by the forces from heavy haul trains and preventative grinding. The rail wears to the point where it is not sufficiently strong enough to sustain the heavy axle loads and generally only manifests itself in curved track. The sharper (i.e., tighter) the curve, the higher the wear rate.

Aurizon Network’s planned unit length of rail is typically 108m, as this is the nominal longest length of rail that can be transported around the rail network. In certain circumstances lesser lengths can be used.

Figure 56 Rail Renewal Sites Moura FY23



ii. Track Upgrades

Track upgrade is an activity where more than one track element requires renewal at the same location. Rail, sleepers and ballast are completed together to realise efficient delivery and avoid the need to revisit a site several

times to complete works in subsequent years. A total of 1.56 kilometres has been identified for track upgrade in the FY23. The location and extent of this work for FY23 are outlined in the following table.

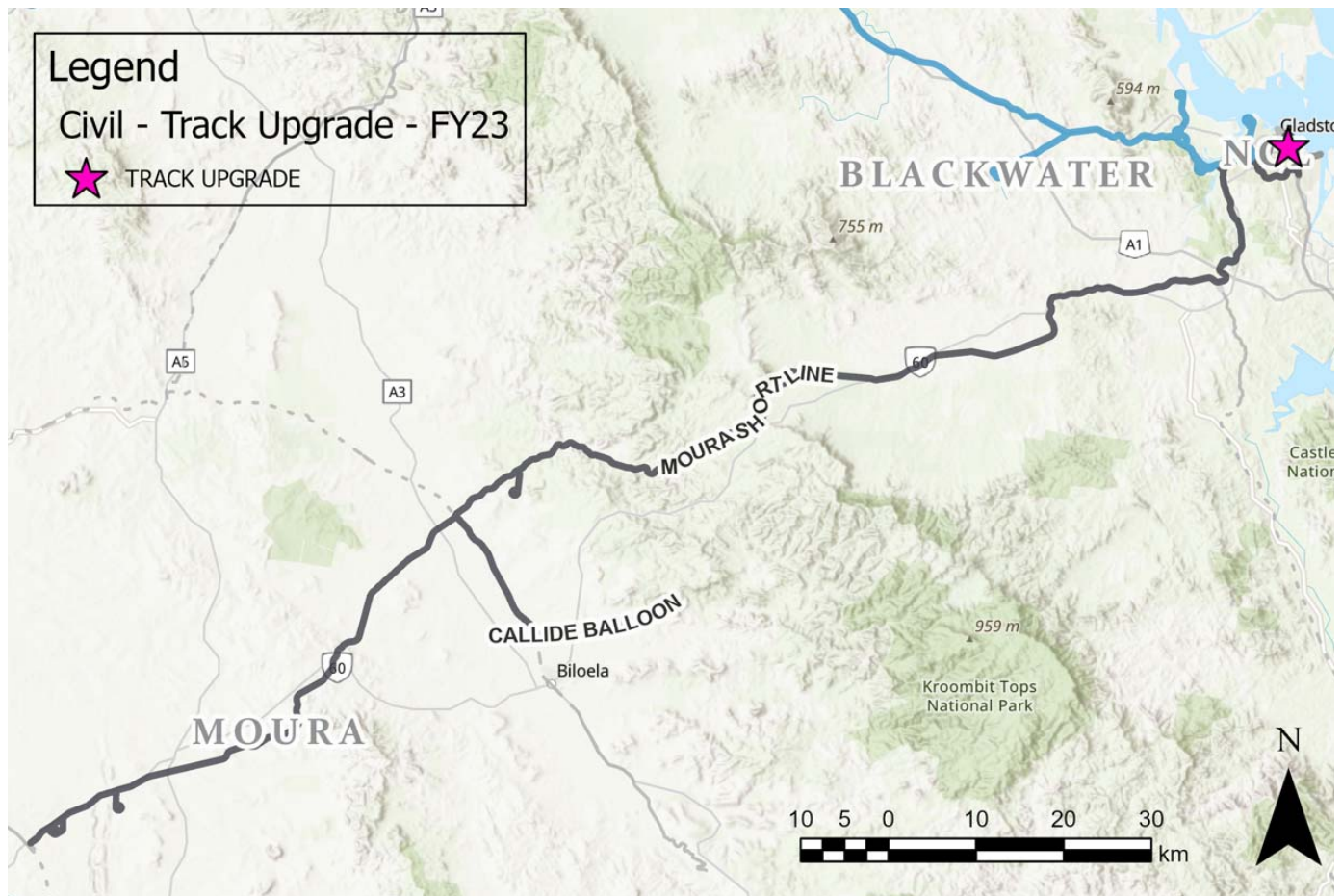
Table 122 FY23 Track Upgrade Program – Moura

Ref	Track Section	Start Km	Finish Km	Length (Km)	Rails	Sleepers
1	GLADSTONE YARD	527.694	529.180	1.563	29	2,282
TOTAL				1.563	29	2,282

Scope comments:

- Gladstone Yard Thru and Loop Roads to be upgraded from timber to low profile concrete sleepers.
- Existing 47kg rail to be renewed with part worn 60kg rail cascaded from mainline track renewals.
- The 1.6Km to be renewed in FY23 equates to equates to 0.6% of the total rail in the Moura System (273 track Km).

Figure 57 Track Upgrade Renewal Sites Moura FY23



iii. Turnout Renewal

There are 63 turnouts in the Moura System. Turnouts are complex assets that have a high level of integration between the civil elements (rail, bearer) and Control Systems elements (turnout motors, switch detection, etc) and the switching of the turnout is controlled remotely by the Train Controller via the Universal Train Control system.

The FY23 Turnout Renewal program includes:

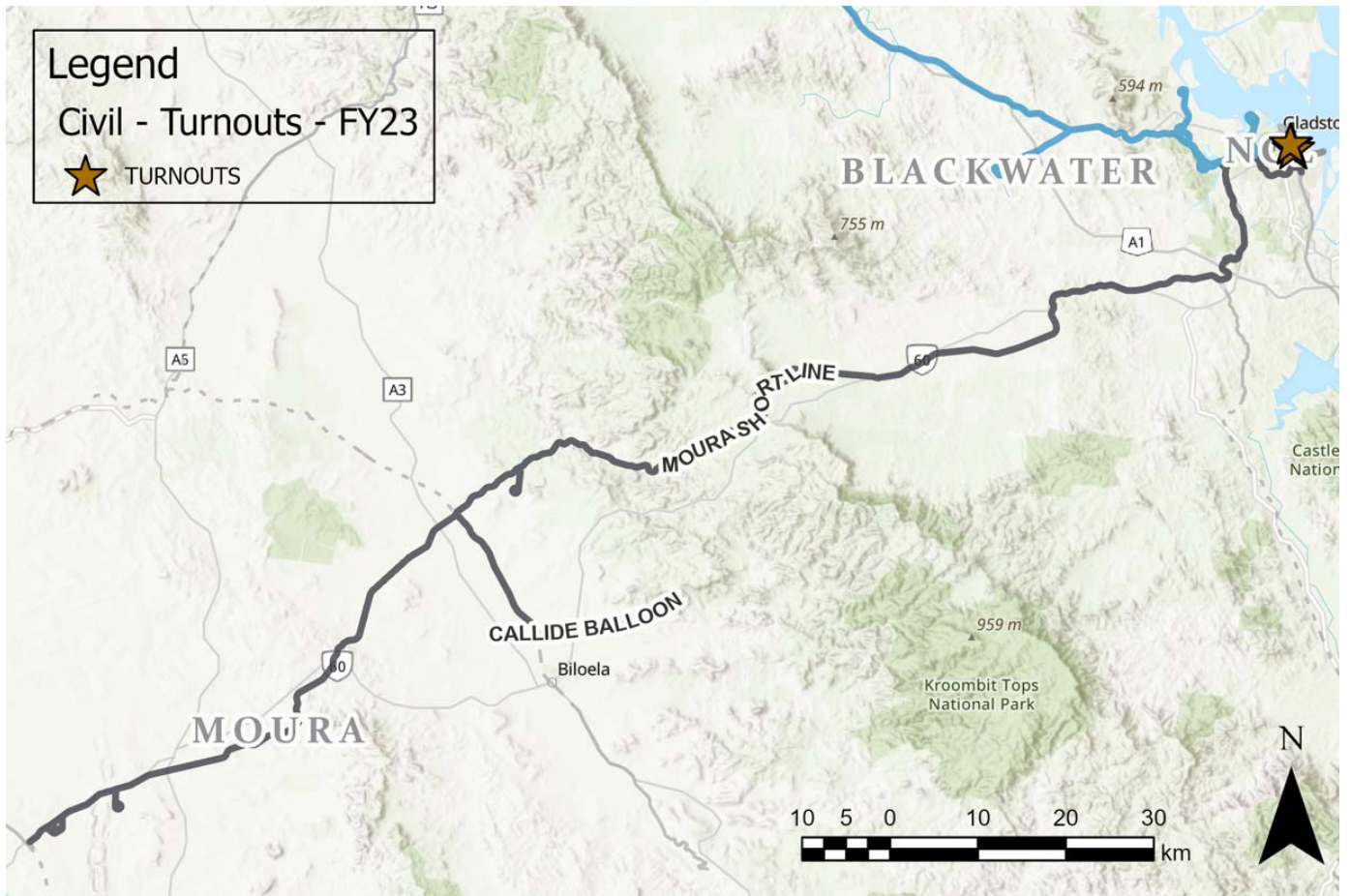
Table 123 FY23 Turnout Renewal Program – Moura

Ref	Location	Turnout	KM Point
1	GLADSTONE	GE182A	528.330
2	GLADSTONE	GE182B	528.250

Scope Comments:

- Gladstone and South Gladstone Yards – These yards are part of the Moura System and were used when coal was railing to Barney Point. With the cessation of railing to this port, several roads are no longer in use. Aurizon Network closed (red boarded) these roads and stopped maintenance and renewals on these track sections given there was no demand for the assets. North Coast Line traffic and Moura System coal services traverse through these yards, but this traffic has been constrained to two tracks. The turnout upgrades and the track upgrade are focused on maintaining this reduced function of Gladstone Yard.
- Through the likelihood of change review, it was identified that there is a moderate likelihood of change to site costs as the final design for these sites had yet to be finalised (scheduled completion February 2022).

Figure 58 Turnout Upgrade Renewal Sites Moura FY23



iv. Turnout Components

Component renewal is a standard asset management practice which allows Aurizon Network to maximise the overall asset’s useful life. Component replacements typically include switch and stock replacement or vee/crossing replacement.

In FY23, Aurizon Network has included an amount of \$0.5m for Turnout Component scope for steel rail components in the Moura System. Also, an allowance of \$0.05M has been allocated for Turnout Signalling component replacement which is the mechanical and electrical components that operate the turnout.

v. Permanent Way Other

- Glued Insulated Joints:

An amount of \$0.04m for the renewal of defective Glued Insulated Joints (GIJs) has been included in the proposed FY23 scope of works. The renewal of 4-hole GIJs to 6-hole GIJs is to improve robustness, resilience and mitigate rail failure points from aged joints. In track sections that utilise axle counters GIJs are redundant so will be removed prior to failure and renewed with a rail weld.

- Rail Lubrication:

There are 26 lubricator units in the Moura System. Rail lubricators deploy grease that is picked up by the train wheels and distributed through curves to reduce friction, aiding wheel and rail wear and to reduce squeal noise.

An allocation of \$0.01m has also been made for fix on fail requirements for the lubrication units.

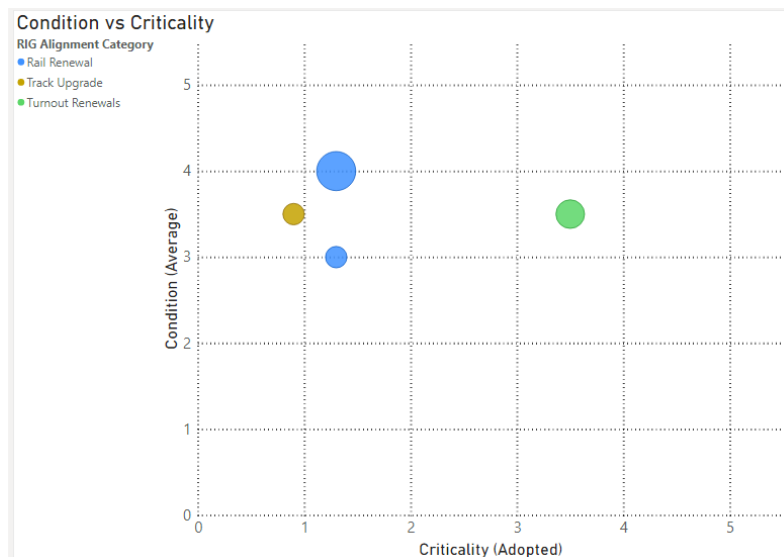
- Rail Fix on Fail

An allocation of \$0.04M have been made for fix on fail requirements for rail replacement. This amount covers reactive rail replacements that are over 26 metres long. Typical rail defects in this category are rail burns left by locomotives or rail foot strikes from dragging equipment.

Permanent Way FY23 Scope – Asset Condition and Criticality Assignment

The following graphic plots the permanent way renewals against asset condition and location/ operational criticality. As can be seen, all planned FY23 renewals are either advanced in wear or degradation. The track upgrade scope of work is in track sections identified as requiring intervention to maintain performance of the Rail Infrastructure with historical trends.

Figure 59 Permanent Way – FY23 Scope Priority Ratings – Moura



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Permanent Way FY23 - Options Considered

In FY23, the permanent way assets identified for renewal have an average condition rating of 3.75, which is at or near the point of renewal identified in the Asset Maintenance and Renewal Policy.

The assets in this class degrade in condition based on usage and wear, as such a decision to defer or not do the renewal does not stop the wearing of the asset and the further degradation of condition. Deferral or removal of this scope increases the risk of the asset failing requiring an unplanned rectification. As outlined in Part B, the approach to renewals is to affect an asset renewal ahead of an asset failure to minimise the disruption to the network, reduce the mix of reactive works and maintain system throughput.

Table 124 Permanent Way Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	This scope is typically completed within existing integrated closures. Turnout components and removals are not complete renewals and can be carried out in the shadow of other activities within integrated closures	Low	The renewal or upgrade will provide maintain system reliability through the avoidance of unplanned outages and re-life the renewed assets. Component renewal will extend the life of assets. Removal of surplus or redundant assets will reduce the associated maintenance costs for the inspection and service of assets.
Defer some of the proposed scope	Deferral of worn components could result in asset failure that requires unplanned rectification and added delay. Given these works are often completed in the shadow of other major tasks or between trains there would be little increase in throughput. Where there is a capacity impact and deferred works are moved to the next available period any capacity gain through deferral is potentially eroded by having to complete the scope later.	Medium	Deferral of the renewal of worn components can lead to unplanned failure and will need to be renewed in a future year. This option will incur additional ongoing maintenance costs.
Do not complete proposed scope	Worn components that are not replaced will eventually result in failure, unplanned rectification and delays. The benefit of any short-term access reduction is likely to be offset by the impact of future unplanned closures in the event of asset failure.	Medium to High	Failure to renew worn components will lead to unplanned failure. This option will incur additional ongoing maintenance costs.

Options for the Delivery of Permanent Way renewals

Always replace both rails	Limited impact on throughput as time taken to replace both rails is minimal within the closure required. Replacing both rails would negate the need to go back to the same site in a future year to replace the other rail The lower rail in a curve generally wears at a slightly higher rate given the loads are increased on the lower rail due to imperfect balance of speed and cant. That is trains are travelling at slower speeds than that which the track is canted for. Current practice is to renew the rail closest to the wear limit and assess the other rail to determine its remaining life.		Replacing both rails will have the effect of replacing some rail prematurely in that rail would be replaced that had significant life left. There is an opportunity to cascade this rail to yards and low speed locations but would require freight charges to reposition the rail.
---------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Option	Description	Risk of Asset Failure	Impact
Complete track upgrade instead of individual rail or sleeper replacement	Sleepers and rail have differing deterioration rates and expected lives hence why they are currently treated as separate assets. Current practice is to assess the need for sleeper or rail replacement at the same site during the planning phase and where applicable bring required rail and required sleeper upgrade together as a Track Upgrade.		Always replacing sleepers will result in sleepers being replaced prematurely. Sleeper life is typically far more than rail life. As such, rail replacement is generally the predominant trigger for track upgrade. This will have the effect of an increase in short-term cost with longer-term efficiencies brought about through single mobilisation and reduced track access.

Civil Assets - Ballast Cleaning & Renewals

Ballast Cleaning Renewal Program

In FY23, Aurizon Network proposes to undertake \$1.9m of Ballast Cleaning in the Moura System. Table 125 below summarises the scope and budget for each ballast cleaning renewal items.

Table 125 Ballast Cleaning Program - Moura

Description	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Mainline Undercutting	1.5	Track Km	0.9	Cleaning of the ballast on mainline sections and through level crossings. Scope delivery for FY23 assumes the use of excavator undercutters.
ii. Turnout Undercutting	2.0	Turnout	0.3	Ballast cleaning in turnouts to reinstate the drainage properties of the ballast.
iii. Bridge Rollout	170	Metres	0.7	Full renewal of ballast on bridge structures to reinstate the drainage properties of the ballast.
TOTAL			1.9	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Mainline Undercutting

The FY23 mainline undercutting program will see 1.5Km of scope delivered for a forecast cost of \$0.9m in aggregate. All scope will be delivered using the excavator undercutters, which means the BCM has not been planned to be used in the Moura System in FY23. An allowance of mainline undercutting has been assigned to account for ballast renewal at the lead in and out of the planned turnout undercuts. These areas are highly fouled and difficult to access.

Table 126 Mainline Undercutting Scope - Moura

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)
Mainline Undercutting - Excavator	1.5	Track Km	0.9
Total	1.5		0.9

Undercutting adjoining Turnouts - The location and extent of these works for FY23 are outlined in the following table. Each location is a small allowance of scope to complete in conjunction with the planned turnout undercutting using the same excavator undercutting approach.

Table 127 Mainline Undercutting Locations - Moura

Track Section	Length (Km)	Scope
UNALLOCATED SCOPE	1.250	EXCAVATOR UNDERCUTTING
MAINLINE ADJACENT TO 2 TURNOUTS	0.240	EXCAVATOR UNDERCUTTING
TOTAL	1.490	

Scope Comments:

- Excavator undercutting (C14) adjoining turnouts adjacent to 2 turnouts are short ballast cleaning sites on the lead into and out of turnouts. Due to the dynamic forces applied by trains, these locations have an accelerated fouling rate. Historically, Aurizon Network has taken the opportunity to undercut these locations with the excavator during turnout undercuts. In the FY23 Final Draft Proposal, Aurizon Network is presenting this scope as excavator undercutting for transparency. This unallocated allowance for excavator undercutting has been reduced by the equivalent amount.
- An unallocated scope of 1.250Km has been added to the FY23 program. This is to react to sites that require ballast cleaning as sites degrade ahead of expectation or present with little notice. The methods of undercutting will be determined on a site by site basis but is likely to be excavator undercutters given the ability to mobiles to site as the BCM will be on planned works across the CQCN and can't be readily deployed to fix on fail sites. Additionally, the fix on fail sites are traditionally shorter than is economic for the BCM to be deployed.
- All ballast cleaning sites in the Moura system will be completed by rail mounted excavator fitted with ballast cutter bars. This application is utilised for short sections and avoids the relocation, setup and spoil management required for the BCM.

The scope of ballast cleaning is based on the identification of track sections with fouling above the Acceptable Fouling Limit (AFL). The AFL is expressed as a percentage of void contamination (PVC). At a level of over 38% PVC fouling, the ballast draining properties are diminished and the wet weather performance of track is impaired.

Aurizon Network utilises Ground Penetrating Radar (GPR) to determine the level of fouling. The review and analysis of the FY22 GPR run data is currently ongoing. These results will be used along with local condition data from field teams to determine scope for FY24 ballast renewals.

The current mainline scope is based upon data up until the 2020 GPR run and the historical performance of the Moura system. In 2021, a further GPR run was completed and provides for a further data set to compare against, to determine the rate of coal fouling throughout the CQCN. It is expected that the results of this GPR run will be presented to the Ballast Working Group in the third quarter of FY22.

In FY22, Aurizon Network, along with members of the Rail Industry Group and rollingstock operators, have established the Ballast Working Group to investigate, quantify and implement options for mitigating coal entering the ballast. The Ballast Working Group also continues to discuss the efficient delivery of the current ballast cleaning task across the CQCN.

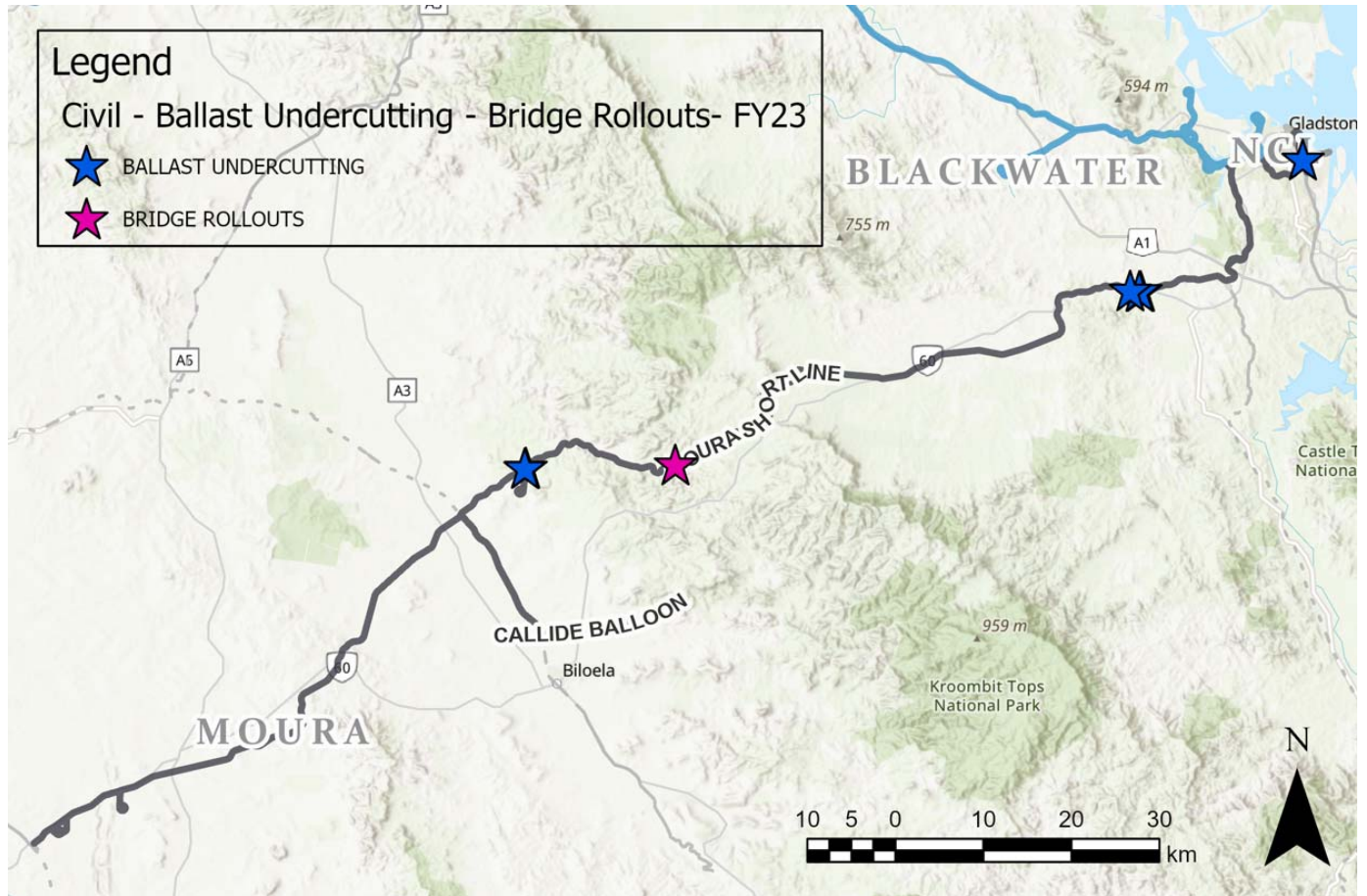
ii. Turnout Undercutting

2 turnouts are proposed to be undercut via the excavator undercutter in FY23 at a forecast cost of \$0.3m. The mainline track around these two turnouts will be undercut using the planned excavator undercutting presented above.

Table 128 Turnout Undercutting Scope Locations

Turnout Location	Km Point
1 ANNANDALE	119.570
2 STIRRAT	39.388

Figure 60 Ballast Cleaning & Bridge Rollout Sites Moura FY23



iii. Bridge Rollout

The proposed FY23 program for bridge rollouts in the Moura System is 1 bridge for a total of 170 metres. The location and extent of these works for FY23 are outlined in the following table.

Table 129 Bridge Rollout Scope Locations

Location	Start Km	End Km	Length (metres)
Bridge 100.890Km Bells Creek	100.800	100.970	170

Scope Comment:

- Geotechnical studies of bridge ends are to be completed prior to the commencement of the FY23 period to finalise works limits. This may result in additional formation renewal or strengthening at bridge ends.
- The bridge at Bells Creek requires formation renewal, sleeper renewal and kerb raising which has all been incorporated into the cost estimate, resulting in a higher unit rate. Bells Creek is the only bridge in FY23 containing all these variables.

iv. Ground Penetrating Radar

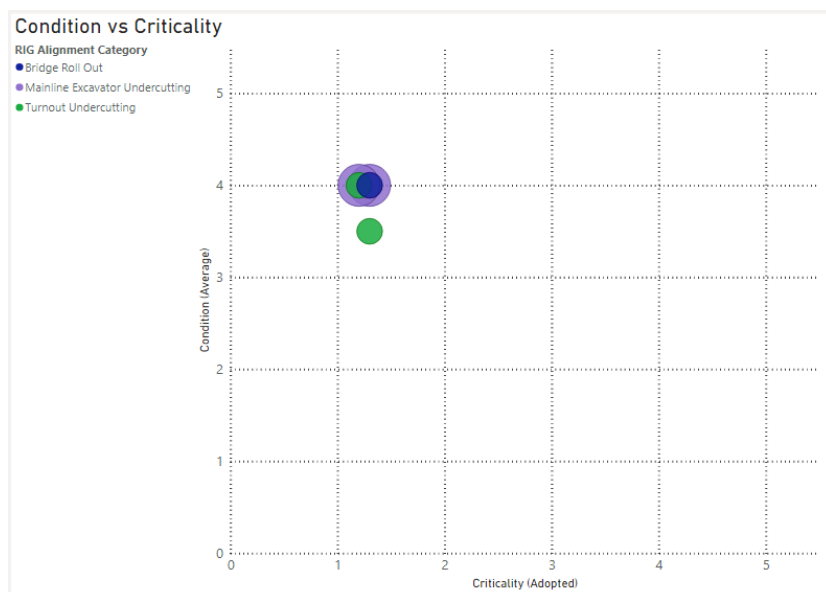
Given the general condition and current understanding of ballast with regards to fouling rates and the lower tonnage across the system, there is no requirement to include the Moura System in the FY23 GPR inspection that will occur in other coal systems.

Ballast Cleaning FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots ballast renewals against asset condition and location/ operational criticality. This shows that all identified scope has a current condition of 3.5 or above with advanced fouling and will degrade further without intervention.

All identified scope has a current condition of 3.5 or above with advanced fouling and will degrade further without intervention.

Figure 61 Ballast Cleaning – FY23 Scope Priority Ratings - Moura



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Ballast Cleaning FY23 Program - Options Considered

Failure to remove fouling from the ballast results in drainage issues that affect formation condition and results in track geometry defects. These defects manifest as temporary speed restrictions until a track resurfacing or track tamping is conducted as part of the General Maintenance activity. Therefore, the options of deferring or not completing ballast cleaning works on identified locations, increases the risk of these track alignment defects propagating and an increase in temporary speed restrictions.

Other options are available in the delivery of the undercutting process and are assessed for the cost of doing the alternate activity and the time required to complete against the long term asset condition benefits.

Table 130 Ballast Cleaning Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Proposed scope has been in the system-wide planning process to balance system throughput with scope requirements.	Low	All identified scope has a current condition of 3 or above with advanced fouling and will degrade further without intervention. The Risk of Asset Failure categorisation is somewhat subjective but has been assessed

Option	Description	Risk of Asset Failure	Impact
			based on the proposed and planned scope and available data at the time of preparation. The cleaning of each site as per the proposed plan will remove the most fouled locations whilst balancing production rates and track time of the undercutting activities against throughput capacity demand.
Defer some of the proposed scope	<p>Deferral of works will push requirement into future years with ballast condition becoming more fouled in deferred locations.</p> <p>Some throughput would be returned to the supply chain, where ballast cleaning is the critical scope for possessions, but this would be eroded by operational restrictions and unplanned delays caused by degraded ballast condition</p>	Medium	<p>Locations identified for cleaning are already at a high level of fouling. Deferral will see condition worsen resulting in increased reactive maintenance and increased TSRs ahead of possible unplanned full replacements.</p> <p>The condition could worsen through the development of mud-holes and compromised track geometry, leading to speed restrictions.</p>
Do not complete proposed scope	Not completing the scope will see the ballast continue to foul and the associated impacts increase. This will lead to unplanned outages and delays that will reduce system capacity at the planned renewal sites	Medium	Locations identified for cleaning are already at a high level of fouling. Not completing the works will see condition worsen, resulting in increased reactive maintenance and increased TSRs ahead of possible unplanned full replacements.
Options for the delivery of Ballast Cleaning			
Move to 100% ballast replacement	This option would result in a slightly higher production rate of the mainline undercutter as ballast would no longer be screened and returned. It would require additional ballast at undercut sites with additional ballast train (work train) hauls to deliver or stockpile the ballast		<p>The mainline undercutter consist includes several ballast spoil wagons but these would be filled quickly, and the rest of the ballast would be ejected to track side to be stockpiled for future removal. The increase in ballast spoil management is not accounted for in the ballast cleaning unit rates, and therefore would cause an increase in cost.</p> <p>Failing to remove spoil from the corridor or stockpiling adjacent to the track can create drainage, access and maintenance issues.</p>
Slabtrack all bridges to reduce Bridge ballast replacement	<p>Slabtrack design and installation is both expensive and time consuming to execute. It will however eliminate the need to renew ballast on bridge decks and has positive capacity benefits in the long-term due to reduced renewal and maintenance activity.</p> <p>Aurizon Network has installed Slab Track on the Cooling channel bridge in Gladstone and continues to look at this as an option for other critical bridges.</p>		If the bridge and/or slab track infrastructure is structurally damaged through derailment or bridge strike (e.g., from an over-height vehicle), the ability to recover from such an event is heavily compromised and would require new reconstruction techniques and stocks of large inventory items (e.g., slab track panels or bridge girders)
Shoulder Cleaning	Shoulder cleaning would provide, in the short-term reduced throughput impact to execute work (i.e., higher production in a given time) and in the medium-term risk to throughput due to potential TSRs from ballast fouling immediately beneath track.		Shoulder cleaning has been shown to provide short-term benefits however the intervention thresholds are very narrow, intervening too soon may result in benefits not being realised, whilst intervening too late will result in wasted effort and loss of capacity due to the need to execute a full undercut and the likely

Option	Description	Risk of Asset Failure	Impact
			imposition of TSR's to manage the short-term geometry degradation.
Cleaning of turnouts using a Vacuum Truck	Vacuuming of turnouts is appropriate in certain areas. It remains a slow process and in areas of high fouling is used to manage the otherwise high likelihood that components will be unable to be inspected and unplanned failure rates will increase.		<p>Vacuuming of turnouts does not address the underlying level of fouling and will not negate the need to undercut ballast in turnouts but rather ensure that components are able to be inspected and remain lubricated and functional.</p> <p>Aurizon Network is aware of Plasser's and other vacuum-based technologies which include on-track vacuum machines, with the ability to remove all fouled ballast, and off-track vacuum trucks which do not have this capability and, therefore, can only manage surface contamination. Aurizon Network does make use of off-track vacuum-trucks to manage heavy surface fouling at critical locations.</p> <p>Enquires in relation to this technology identified that a bespoke on-track machine would likely need to be designed and manufactured for Aurizon Network's narrow gauge railway, requiring investment in new plant. Aurizon Network also understands that the production rates of vacuum machines are lower than excavator undercutters. On-track machines will also face constraints such as the ability to store the necessary spoil.</p> <p>Essentially, use of such a machine would result in increased cost (investment in new plant either Network-owned, Leased or Contracted Machines and Labour) for a negligible change in production rate relative to the existing excavator undercutter approach.</p>

Civil Assets - Structures Renewals

Structures Renewal Program

The Moura System has a total of 39 bridges and 550 culverts which are designed to allow the natural flow of water through the rail network. In FY23 Aurizon Network proposes to undertake \$2.4m of structures renewal works in the Moura System. Table 131 below summarises the scope and budget for each relevant renewal item.

Table 131 Structures Renewals - Moura

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Bridges	-	Sites	-	No bridge works planned for FY23
ii. Culvert Renewal	8.0	Sites	2.3	Equates to 1.5% of culverts in Moura

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
iii. Culvert Design	3.0	Sites	0.1	Design packages for identified sites to be renewed in future years. Completing early design improves the estimating accuracy.
			2.4	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Bridges

No bridge related works are programmed for FY23. Over 90% of bridges in the Moura System are ranked as condition rating 2.5 or better. The limited number of structures above 2.5 are being inspected routinely and performing as expected and do not require any intervention or future design effort at this stage.

ii. Culvert Renewals

The culverts used in the railway are typically concrete culverts or corrugated metal pipes which are similar to what is used in other heavy civil infrastructure (e.g., roads, mines, airport runways etc). Given this, the design activity for culvert renewals is outsourced to design houses with demonstrated experience in design matching standard culvert units to local conditions to achieve the required hydrology capability.

Through the likelihood of change review, it was identified that the scope presented assumes that the degradation of the culverts will not accelerate ahead of renewal. However, the proposed scope does consider the forecast condition of the structure both at the time of scope identification and at planned renewal, so the likelihood of change is low.

Aurizon Network proposes to complete 8 culvert renewals in FY23, which equates to 1.4% of the total culverts in the Moura System. The locations of these renewals are outlined in Table 132.

Six (6) of the culvert sites are in the Mt Rainbow track section. Aurizon Network has identified this track section has historic issues with siltation of resulting in culvert blockage and rail overtopping. Aurizon Network engaged AECOM to conduct a hydrology assessment between the 80Km to 90Km track section. In this study 59 sites were inspected and assessed with 6 sites identified for renewal or strengthening activities in FY23.

The AECOM study allowed Aurizon Network to make a fit for purpose decision to retain the required drainage across this track section rather than simply assessing each culvert as an individual asset. This resulted in a series of renewal and upgrade outcomes as detailed in Table 132 below.

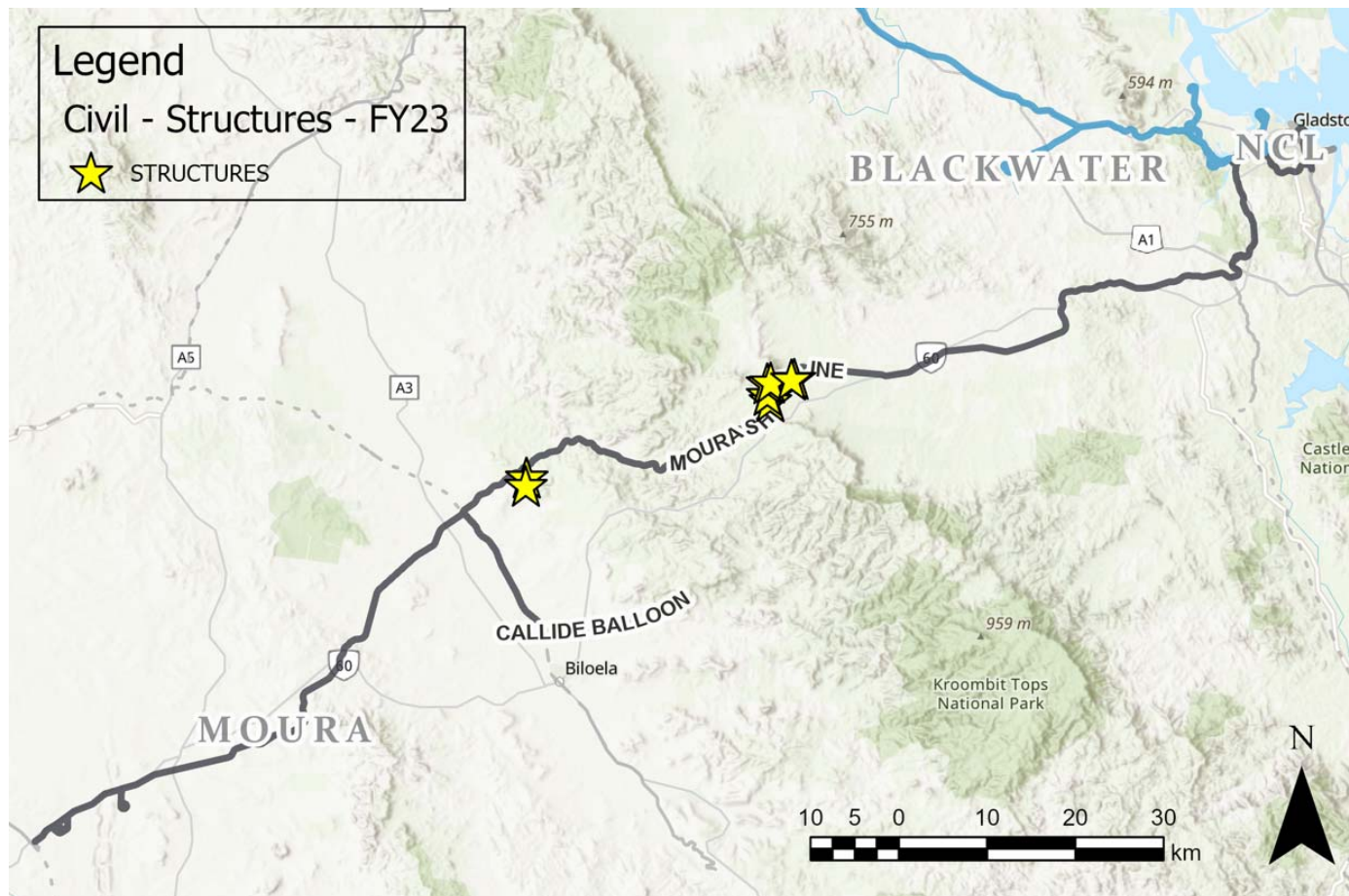
The other two culvert renewal sites are a remove and replace of aged and under standard culverts on the Boundary Hill Mine balloon loop.

Table 132 Culvert Renewal Scope Locations - Moura

	Culvert Renewal Location	Km Point	Detail
1	BOUNDARY HILL ARR RD	1.490	Remove and replace concrete old 15tal box culvert with new 30tal culvert
2	BOUNDARY HILL DEP RD	4.490	Remove and replace concrete old 15tal box culvert with new 30tal culvert
3	FRY-MT RAINBOW	81.710	Renewal of inlet drop structure and install of debris grate
4	FRY-MT RAINBOW	82.030	Remove aged, corrugated metal pipe with new concrete pipe
5	FRY-MT RAINBOW	84.420	Concrete line base of aged pipe to strengthen structure

6	FRY-MT RAINBOW	84.810	Install outlet scour protection
7	FRY-MT RAINBOW	86.220	Divert via longitudinal drain and grout fill culvert
8	FRY-MT RAINBOW	86.970	Divert via longitudinal drain and grout fill culvert

Figure 62 Structures Renewal Sites Moura FY23



iii. Culvert Design

Aurizon Network also proposes to undertake culvert design works for 3 locations in the Moura System for future years construction. These locations are outlined in Table 133 below.

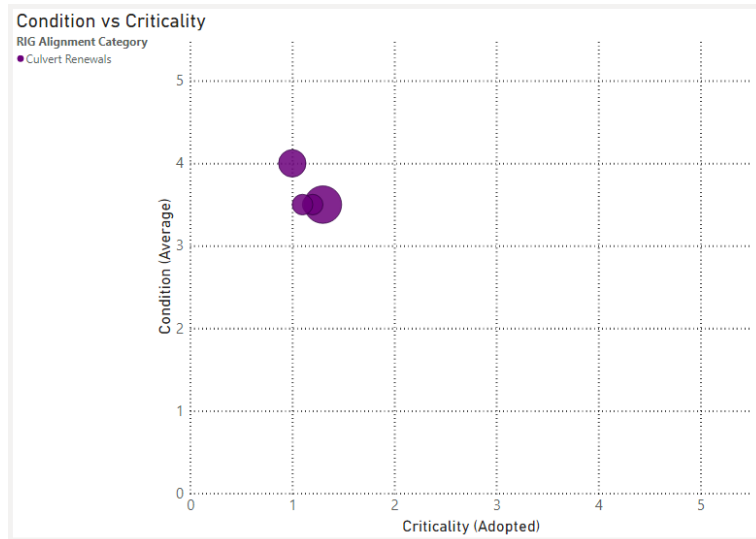
Table 133 FY23 Culvert Design Scope Location - Moura

	Culvert Design Location	Km Point
1	MOURA	80.300
2	FRY-MT RAINBOW	86.780
3	STIRRAT-CLARKE	60.820

Structures FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Structures against asset future condition and location/ operational criticality. The average future condition for the FY23 program is 3.5.

Figure 63 Structures – FY23 Scope Priority Ratings - Moura



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Structures FY23 Program – Options Considered

The structures in the proposed FY23 scope are condition rating 3.5 or above. As such they are at or near a condition state that the next condition will be asset failure. As such deferral or not completing the scope introduces a higher risk of asset failure that would require an unplanned intervention to correct.

In developing the scope of structures renewal there are a range of options available to retain the drainage requirements of the structure. As evident in the Mount Rainbow cluster of renewals in FY23, Aurizon Network is applying this range of options to correct the defects that are driving the condition scoring. These range from remedy of outlet scour damage thorough to full removal and replacement.

Table 134 Structures Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	<p>All culverts identified for renewal are at condition rating 3.5 or above. Renewing in a planned manner allows for optimal access planning and track occupancy for the required renewal works.</p> <p>Where applicable Aurizon Network sleeves pipe culverts so the renewal works can occur under traffic not requiring a possession.</p> <p>Renewing in a planned manner allows for optimal access planning and track occupancy for the required renewal works.</p> <p>Where appropriate Aurizon Network seeks to sleeve pipe culverts so the renewal works can occur under traffic not requiring an extended track possession.</p>	Low	In order to renew a culvert or upgrade an element of the culvert, as is the scope in FY23, the culvert is required to be in good alignment, and not heavily deformed and out of shape. The planned renewals in FY23 are currently in a condition that the proposed scope is achievable. Culverts that present as a risk, either structurally or hydraulically, create impacts which include load and speed restrictions and a higher likelihood of track washouts respectively,
Defer some of the proposed scope	Deferral will push the renewal requirement to a future year and	Medium	Deferral of renewal of worn components can lead to unplanned failure.

Option	Description	Risk of Asset Failure	Impact
	increase the risk of failure during the period of extension.		Deferral can see further alignment degradation negating the opportunity for lining of pipes or element upgrades.
Do not complete proposed scope	Failure to renew planned scope will leave faulty structures that if not treated will fail in the near term and effect the alignment of the railway such that emergency possessions will be required to remedy or a TSR would be required until a renewal could be planned.	High	Failure to renew worn components will lead to unplanned failure and increase derailment risk related to track misalignment at defective structure sites. The loss of hydraulic capacity of the culvert during the wet season could cause the track to washout.

Civil Assets - Civil Renewals

Civil Assets Renewal Program

In FY23 Aurizon Network proposes to undertake \$2.9m in renewals for these assets. Table 135 below summarises the scope and budget for each relevant renewal item.

Table 135 Civil Assets Renewal Program - Moura

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Formation Renewal	0.6	Track Km	1.1	Equates to 0.2% of formation length
i. Formation Reactive		Fix on Fail	0.8	Fix on fail scope allocation to accommodate formation that fails in a yet to be known location
ii. Level Crossing Renewals	1.0	Sites	0.4	Equates to 0.7% of level crossings in Moura
ii. Level Crossing Design	1.0	Design	0.03	Design of identified renewal sites to be completed in future years, which improves the estimate for the site.
ii. Level Crossing Other	11.0	Sites	0.2	Minor signage upgrades and a fix on fail allocation to accommodate level crossing elements that fail or reduce the safety of the road rail interface & Level Crossing removals
iii. Access Roads & Access Points		Fix on Fail	0.2	Upgrade of defined sites and fix on fail allocation for Corridor Access Points and Roads
iv. Corridor Fencing & Security		Fix on Fail	0.2	Fix on fail allocation to reinstate required corridor fencing to sperate the rail corridor from neighbouring land.
TOTAL			2.9	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Formation

The location and extent of these works for FY23 are outlined in Table 136.

Table 136 Formation Renewal Scope Location - Moura

Location	Start Km	End Km	Distance (Km's)
ANNANDALE EARLSFIELD	123.300	123.900	0.600

Scope Comments:

- The 0.6 kilometres of formation being renewed under this program equates to 0.2% of the total formation asset in the Moura System (275Km).
- The site has a full design and a geotechnical study completed so has a low likelihood of change.

An allocation of \$0.8m has been made for fix on fail formation sites in Moura. Each site is identified by the local Track Inspection staff and assessed by the District Engineer. A geotechnical investigation is conducted to determine the extent of the works. This informs the site estimate and draws down of the fix on fail allocation.

ii. Level Crossings

There are 148 level crossings in the Moura System. Aurizon Network's proposed level crossing program for FY23 includes:

- Level Crossing Renewals – Full upgrade of crossing, incremental safety upgrades or signage upgrades.
- Level Crossing Removal – Elimination of crossings no longer required, includes removal or road crossing and reinstatement of ballast.
- Level Crossing Design – Crossings with active protection require coordination into the localised signalling system and therefore require a level of design works. The designs are to improve the site estimate and for delivery in future years.

The location and extent of these works for FY23 are outlined in the following table.

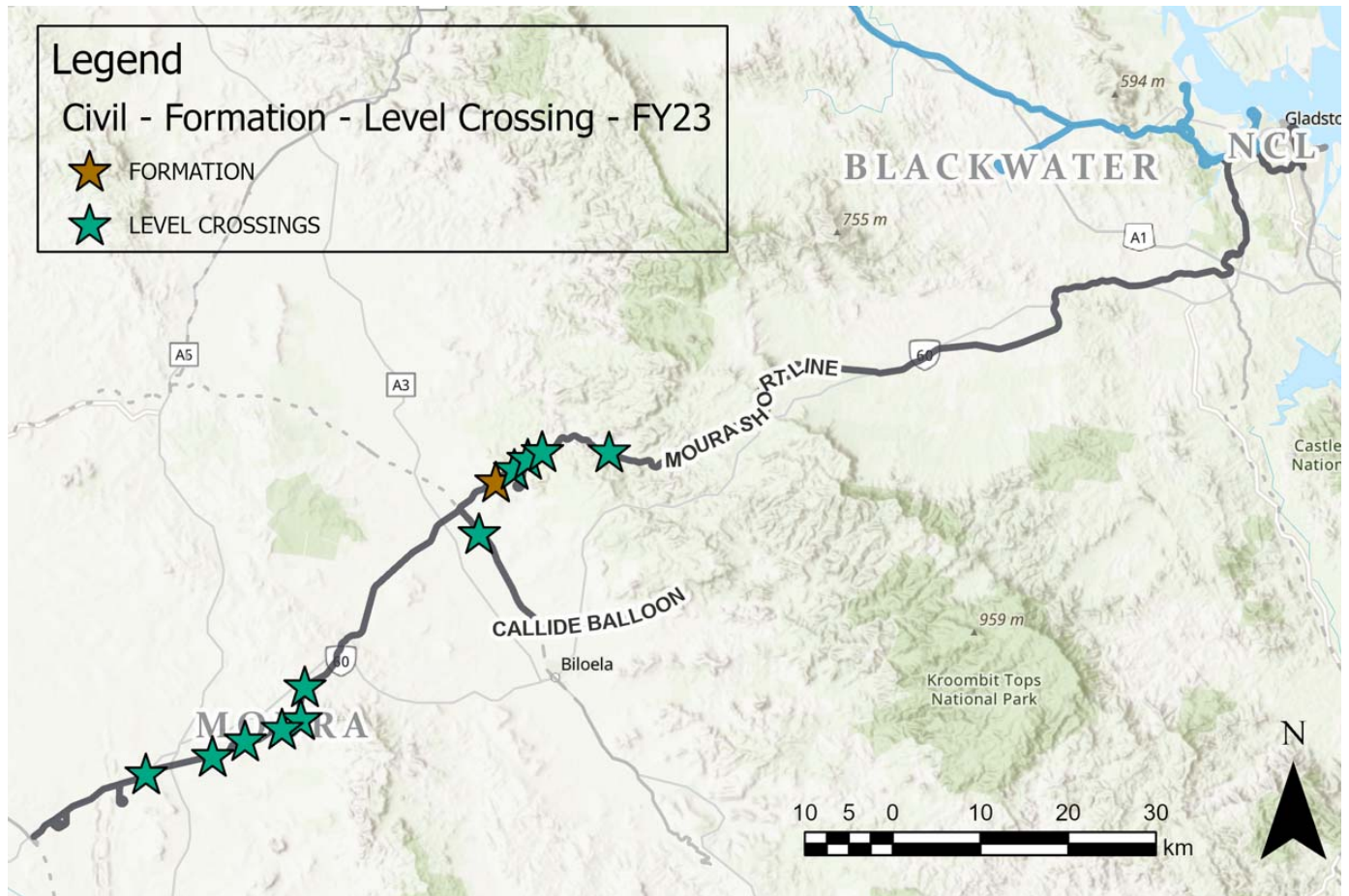
Table 137 Moura FY23 Level Crossing Program Moura

Scope	Location	KM point	Description
MAJOR RENEWAL	LX6047 159.500KM Banana - Holding Road	159.500	Full reconstruction of the level crossing road service from ground level up (formation, ballast, rail, sleepers, asphalt and flangeway)
MINOR UPGRADE-BOOM GATES	LX708 533.888Km Callemondah Drive	533.890	Upgrade of boom gate mechanisms
SIGNAGE UPGRADE	10 locations		Minor signage upgrades - Renewal of faded signs - Signage upgrade to bring to current standard - Realignment of signage
LEVEL CROSSING DESIGN	LX5965 24.710KM Old Coach Road	24.710	Design for renewal in FY24

Scope Comments:

- The 2 level crossings to receive major and minor upgrades equate to 1.4% of total crossing in the Moura system (148).
- An allocation of \$0.1m has also been made for fix on fail upgrades for level crossings in the Moura System.
- No issues with regards to Likelihood of Change were raised as part of this review.

Figure 64 Formation & Level Crossing Renewal Sites Moura FY23



iii. Access Points and Access Roads

Corridor access points are locations where Train Crew and Aurizon Network workers and contract staff need to leave the public road network to access the rail corridor. These access points are turnoffs that intersect with public and private roads. The railway and public road network in the Moura system are quite separated and many of these access points are off rural public roads signposted at 80 or 100 kph. “Drive to stay alive” is a critical safety commitment in the Aurizon Network business so the safe access to the public road system from the rail corridor is part of the treatment of this risk.

There are approximately 700 known access points on the Moura System. Aurizon Network has been working with local road authorities (DTMR & local Council) to better sign access points. A focus is to progressively eliminate unsafe or high-risk access points and to better define and identify the controlled access points.

There are 486Km of rail access roads in the Moura system that provide passage along the rail corridor. They are utilised by maintenance and rail operations staff to access the rail corridor.

Access Points and Access Roads Scope Comments:

- An allocation of \$0.2m has been made in FY23 for fix on fail works relating to Access Points and Access Roads.
- Post rain events, sections of access roads will require renewal and reinstatement.

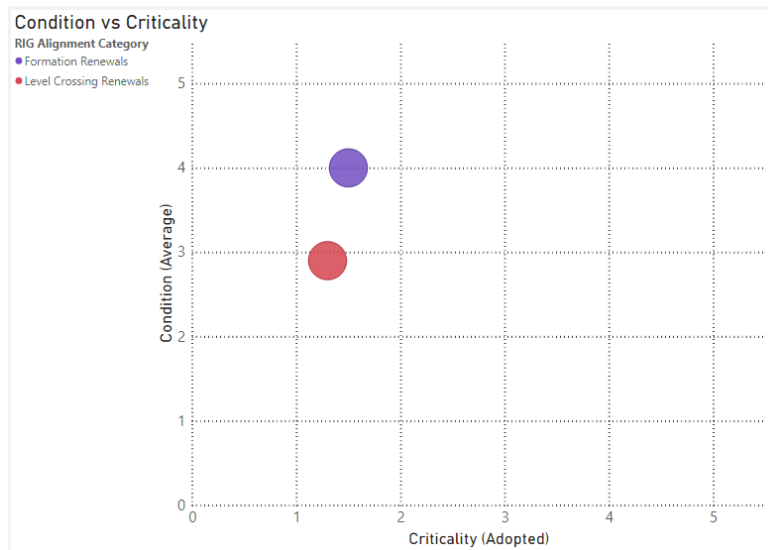
iv. Corridor Fencing and Security

There are 477Km of fencing in the Moura System. An allocation for fix on fail fencing has been made in the FY23 program of \$0.2m. Consistent with previous years, this will be allocated to address failed fencing in locations as identified by the local Infrastructure teams or via Aurizon Network’s Community Engagement team in consultation with neighbouring land holders.

Civil Renewals FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the civil renewals against asset condition and location/ operational criticality.

Figure 65 Civil Renewals – FY23 Scope Priority Ratings - Moura



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Civil Renewals FY23 Program - Options Considered

All the proposed FY23 Civil Assets scope is condition rating 3 or above. Not actioning these assets will increase the risk of asset failure leading to a requirement for an unplanned rectification.

Not addressing formation requirements will result in additional track resurfacing requirements to maintain track alignment and avoid temporary speed or operating restrictions.

Level crossing and corridor access points are safety related upgrades to maintain the safety of Aurizon staff and the public.

Table 138 Civil Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Formation renewals treat formation sections that have failed and are causing track alignment issues leading to speed restrictions and the need to complete resurfacing works. Completing the scope at these locations addresses the underlying formation issue avoiding future operational delays.	Low	Completing the scope will maintain the assets performance across these asset classes. Formation failure is a root cause defect which is treated by speed restrictions and resurfacing. Renewing the formation will remove the need to apply a speed restriction or increased resurfacing activities at the renewed site.
Defer some of the proposed scope	Deferral of identified scope could result in failure that requires unplanned rectification and added delay. Deferral of formation works will result in additional track resurfacing activity at these sites to restore track geometry and associated operational delays.	Medium	Failure to renew aged assets can lead to unplanned failure and speed restrictions.
Do not complete proposed scope	Not completing the scope will result in unplanned outages when these assets fail or require an extended period to rectify from faults.	High	Failure to renew the formation can lead to unplanned failure and speed restriction.

Options in the delivery of Formation Works

Formation – Lime Slurry Injection	Aurizon Network has in the past used the injection of lime slurry that hardens as a way to fill voids that were identified in the formation with some success.	Medium	Lime slurry injection only treats the visible issues, given the issues are mostly not visible it has only a limited effect in the short term. The more efficient process is to re-life the asset by removal and rebuild.
-----------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------	--------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Level crossing renewals and upgrades are proposed to maintain or increase the safety of the road rail interfaces at level crossings. Failure to complete the proposed scope will either retain a poor road condition or fail to increase the passive or active protection at these sites to the required condition.

Control Systems Assets

Control Systems Renewal Program

In FY23 Aurizon Network proposes to undertake \$3.3m of Control Systems renewals or replacement in the Moura System. Table 139 below summarises the scope and budget for each relevant renewal item.

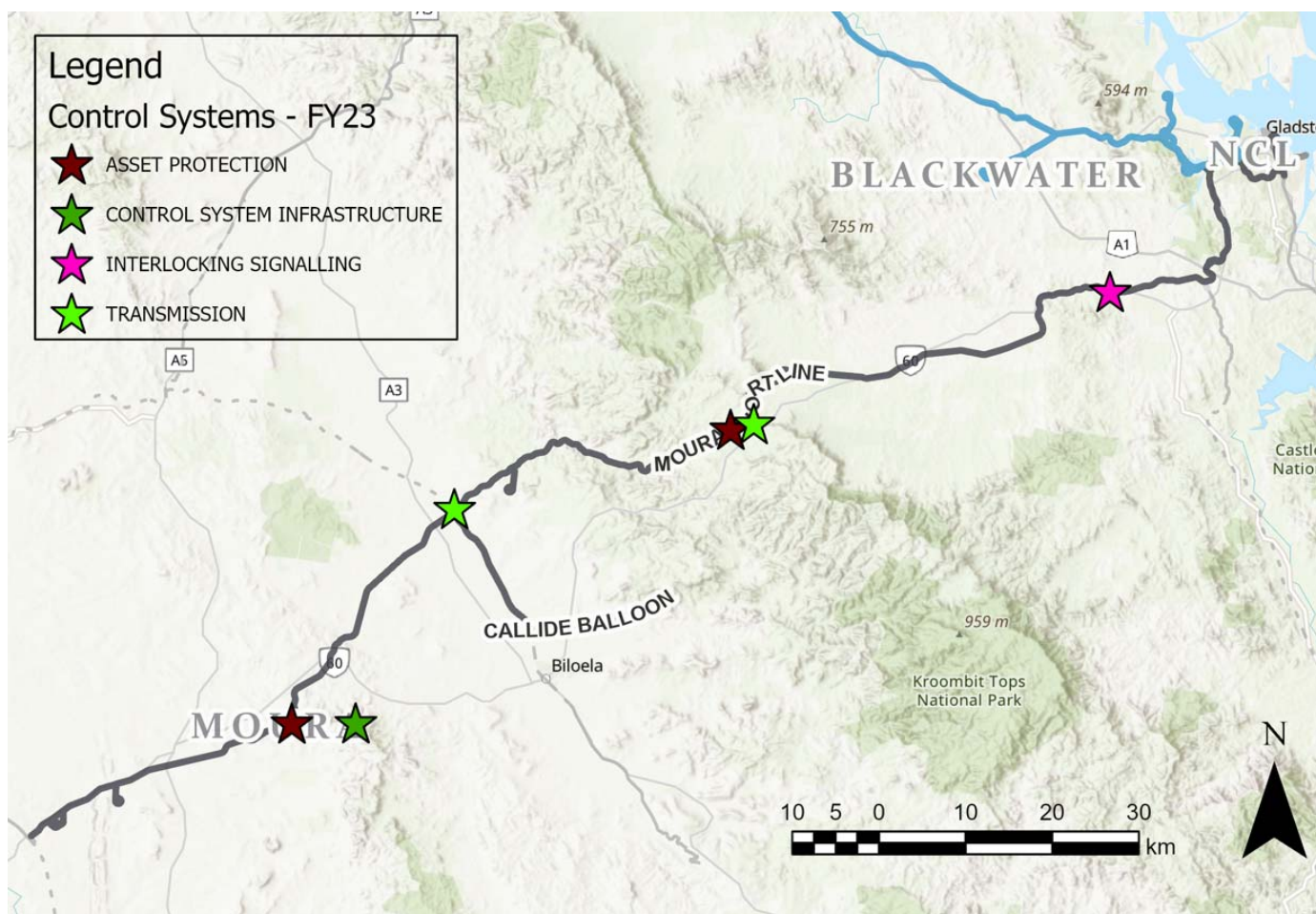
Table 139 Control Systems Renewal Program - Moura

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Safeworking Systems - Asset Protection	3.0	Site	1.2	Renewal of Hot Bearing Detection / Hot Wheel Detection systems at 2 sites Integrated Asset Monitoring and Protection System (IAMPS) Upgrade.

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
ii. Safeworking Systems – Interlockings	1.0	Sites	1.2	Renewal of the original 1980's Processor Based Interlocking with digital Interlocking.
iii. Telecommunications Assets	2.8	Track Km	0.2	Optic fibre renewal
iv. Transmission & Data Renewal	7.0	Sites	0.4	Collection of small renewals including TETRA Radio enhancements, Radome Covers at radio towers, standby power back up.
v. UTC/DTC Systems Upgrades	1.0	Sites	0.1	Ongoing system upgrades for the train control system.
vi. Other Control Systems Renewals			0.2	Design costs associated with Axel Counters and Interlockings to be delivered in future years.
TOTAL			3.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

Figure 66 FY23 Control Systems Renewals - Moura



i. Safeworking Systems - Asset Protection Renewals

The location and extent of these works for FY23 are outlined in the following table.

Table 140 FY23 Safeworking System Scope - Moura

Scope		Location	Qty	Unit
HBD/HWD	RENEWAL	BELLDEEN	1	SITE
HBD/HWD	RENEWAL	MOUNT RAINBOW	1	SITE
IAMPS	RENEWAL	SYSTEM WIDE	1	SYSTEM

Scope comments:

- Hot Bearing Detectors/Hot Wheel Detectors are asset protection devices that detect abnormal temperatures in wheel bearings and wheels. Increased temperature is a pre-condition of bearing failure or brake lock. Seized wheels can create flat spots on the wheels which lead to rail breaks, rail damage and derailment. Hot Bearing Detectors/Hot Wheel Detectors are located throughout the coal systems at strategic locations.
- The Hot Bearing Detectors/Hot Wheel Detectors units in Moura are an old style STC (Southern Technologies Corporation) based Hot Bearing Detector Systems. All upgraded in Newlands and Goonyella. Obsolete equipment – server infrastructure that holds temperature data is on non-supported OS. Not cost effective to upgrade those apps as Vendor no longer has capability or resources. Leverage servers already used for new Hot Bearing Detector systems in Goonyella and Newlands.
- Integrated Asset Monitoring and Protection System - consolidates alarms from multiple systems to present to Universal Train Control. Scope is various minor updates.

ii. Safeworking Systems - Interlocking Upgrades

In FY23, one (1) Vital Processor Interlocking (VPI) electronic interlocking is proposed for renewal at Earlsfield. There are 10 VPI electronic interlockings and 1 Microlok+ in the Moura system that have been in operations for 30 years. All these units are still providing effective operations, but the availability of critical spares is a developing risk. A failure of an interlocking with no spares would result in the station being bypassed and train movements managed by the manual process of “forms” until a spare can be sourced, or an upgrade completed. Operating on forms reduces throughput for the track section under restriction by nominally 50%.

The asset management approach to this population of interlockings is to renew the site at Earlsfield and the site at Stowe (planned for FY24) with Westrace Mark 1 Interlockings. There is also the intention to remove Graham as a passing station, releasing another set of spares. The upgrade of these two sites will allow the VPI spares to be deployed as spares for the remaining 7 VPI interlockings. These 7 may operate for another 5 years based on current fault data. The interlockings will then be assessed to ensure that the arrangement is aligned for the forecast system demand beyond FY28. This future renewal strategy across the Moura system will be consulted with the RIG in Q3 FY22.

Table 141 FY23 Interlocking Scope - Moura

Scope		Location	Qty	Unit
VPI REPLACEMENT	RENEWAL	EARLSFIELD	1	STATION

- The final design and commissioning plans for this renewal have yet to be finalised (expected in Q4 FY22). As such there is a medium likelihood of change regarding total cost for this site.

- The FY23 Draft Proposal included the site for Stirrat. In the FY23 Final Draft submission, the VPI Replacement site has been changed to Earlsfield. This is due to the critical consequence of an interlocking failure at Earlsfield, as an RCS – DTC junction station, would have a greater impact to operations.

iii. Telecommunications Assets Renewals

During FY21, Aurizon Network commenced an Optic Fibre renewal program. A very small portion is situated at the very eastern end of the Moura System which is on the NCL. This program is continuing into FY23. The renewal program seeks to renew life expired 6 core fibre optic cable installed in 1980s with modern 24 core optic fibre. This modernisation also supports the increasing data network security and capacity requirements between field and control centre systems, and for monitoring asset condition in real time.

In FY23, Aurizon Network proposes to renew 2.8Km of optic fibre at a cost of \$0.2m. The location and extent of these works for FY23 are outlined in the following table.

Table 142 FY23 Telecommunications Scope - Moura

Scope	Location	Start KM	End KM	Distance (metres)
OPTICAL FIBRE RENEWAL	Gladstone Yard to QAL Junction	529.130	526.460	2,800

Scope comment:

- The 2.8 kilometres of optic fibre to be replaced in this program equates to 33% of the total kilometres of optic fibre in the Moura System (approx. 9Km) and is limited to a very small portion of NCL that is part of the Moura System.
- The rest of the Moura system communications is facilitated by microwave digital radio. Installation of fibre for the full system is not considered.

iv. Transmission & Data Network Renewals

Transmission & Data Networks consist of:

- Control Systems Infrastructure – the physical buildings, towers and equipment rooms that support the Control Systems assets
- Transmission – digital and microwave radio systems

In FY23, Aurizon Network proposes to undertake \$0.4m of asset renewals in the Moura System for Transmission & Data Network renewals. The location and extent of these works for FY23 are outlined in Table 143, Table 144 & Table 145.

Table 143 Control Systems Infrastructure Scope Location - Moura

	Scope		Qty	Unit	Location
1	INFRASTRUCTURE – DEHYDRATOR RENEWAL		1	SITE	BANANA RANGE
2	INFRASTRUCTURE - TELE BATTERY RENEWAL		2	SITE	SYSTEMWIDE
3	TRANSMISSION - MICROWAVE RADIO (NERA) RENEWAL		2	SITE	SPECIMEN HILL
4	TRANSMISSION - RADOME COVER RENEWAL		1	SYSTEM	SYSTEMWIDE
5	TRANSMISSION – TETRA CYBER SECURITY UPGRADE RENEWAL		1	SYSTEM	SYSTEM WIDE

Scope comments:

- Infrastructure – equipment buildings that house signalling equipment are air conditioned to maintain equipment operating temperatures and have back up power supplies. The infrastructure scope in FY23 is to renew air conditioning hydrators at Banana Range and renew the backup power battery bank at two sites.
- Transmission – the FY23 scope is for the upgrade of the microwave radio link between Specimen Hill and Calliope Range and a cyber security upgrade for the TETRA radio system.

v. UTC/DTC Systems Renewals

In FY23 Aurizon Network proposes to undertake \$0.1m of asset renewals in the Moura System train control systems as per Table 140. This includes in field digital modernisation of the life expired analogue telemetry that receives the control message via the train control system and safety and application enhancements to the Universal Train Control (UTC) system. These upgrades are prioritised by the Train Control team to improve the safety functions of UTC or to reduce potential scheduling and process errors.

Table 144 UTC / DTC Renewal - Moura

Scope		Location
UTC CODE AND SAFE WORKING	RENEWAL	SYSTEM WIDE

vi. Other Control Systems Renewals

In FY23 Aurizon Network will commence early planning for Interlocking Renewal in future years, this work will support the required design works on FY24 but determining the best delivery pattern to minimise system outages and match the required scope with the design effort ahead of renewals commencing in FY25.

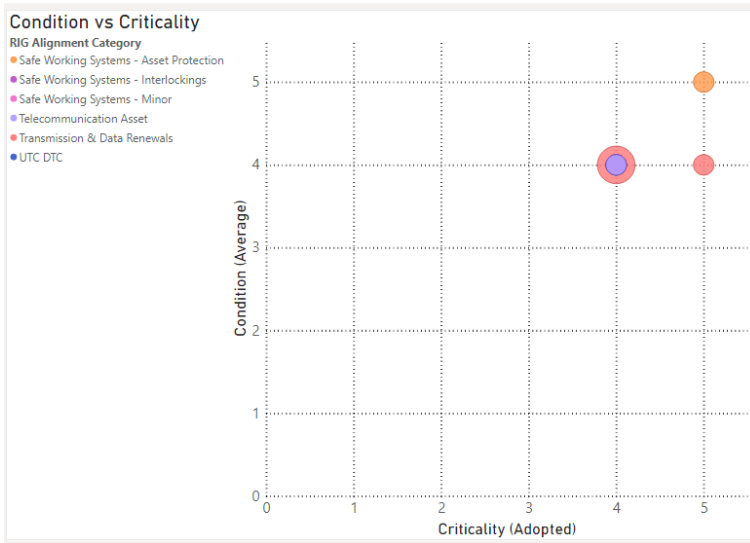
Table 145 Other Control Systems Renewal - Moura

Scope	Qty	Unit	Location
Train Detection – Axle Counter Design	1	Design	BYELLE
Train Detection – Axle Counter Design	1	Design	STOWE

Control Systems Renewals FY23 Scope - Asset Condition and Criticality Assignment

Figure 67 plots the Control Systems renewals scope against asset condition and location/ operational criticality. All scope items across all items are listed as condition rating 4 or above. This reflects the age of assets targeted for renewal in FY23. Control Systems assets are mostly electronic, so renewal is a trigger of support, spare parts or software obsolescence. As such condition is more a matter of asset age against design life rather than a physical demonstration of wear.

Figure 67 Control Systems – FY23 Scope Priority Ratings - Moura



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Control Systems Assets FY23 Program - Options Considered

For the proposed FY23 Control Systems renewals the renewal driver is predominantly age of the assets and technological obsolescence. The assets identified for renewal are at the end of their useable lives and in some instances operating beyond design life. Systems are unsupported by the original vendor and spares to maintain the systems are rare.

As a result, the options considered are centred around the speed of renewal or the technology choice to replace.

Table 146 Control Systems Program Options

Option	Description	Risk of Asset Failure	Impact
Plan scope over a multi-year program, managing asset performance risk	<p>Planning objective is to maintain or reduce network service delays relative to current levels.</p> <p>The proposed scope can be completed within planned possession constraints.</p>	Low	The proposed scope nominally targets this level of obsolescence risk. Other options are considered only when other factors (opportunities or costs) associated with the practicability of program implementation outweigh the capacity benefit associated with this renewal objective.
Defer some or all of the proposed scope, taking asset performance risk	<p>Deferral may increase the near-term risk of unplanned disruption due to increasing failure frequency, or delay to return to service after failure.</p> <p>A future acceleration of renewal to redress the deficit may require an increase in the number or duration of possessions.</p>	Medium	<p>This option is considered for assets where asset performance remains satisfactory, and where spares inventory can be sustained through a recover and reuse strategy to ensure return to service upon failure.</p> <p>It is used to reduce the demand for track possessions to within target levels in the planned year, or to moderate demand for finite execution resources.</p>
Accelerate scope, to eliminate obsolescence risk	While the availability of assets may improve, any significant acceleration may require an increase in track possession beyond the annual budget, eroding annual throughput.	Low	<p>This option is typically considered when there is an efficiency associated with the bundling of renewals within a geographical location, or to remove a category of equipment from a maintenance district (possibly supporting deferral of renewal in another district through replenishing of obsolete spares).</p> <p>It may also be used where a capacity impact is observed from a previous deferral of renewals.</p>
Modernisation	Reduce delays due to failures through deployment of resilient systems and architectures using modern technologies	Low	In conjunction with the scheduling of asset renewals, alternative modern technologies and resilient system architectures are considered to ensure advantages of networked digital assets.
5G mobile data network	Not practicable	N/A	5G options were not deemed appropriate as the 5G network is

Option	Description	Risk of Asset Failure	Impact
			not commercially available for use in the CQCN.

Technology Projects

Technology Projects

As detailed in Chapter 3 of this FY23 Final Draft Proposal, Aurizon Network is progressing several technology projects to renew existing systems or better understand, analyse, and identify scope across the CQCN assets. These projects improve Aurizon Network’s ability to make data driven decisions regarding the management of the rail assets on the behalf of customers, stakeholders and safety regulators.

In FY23, Aurizon Network intends to progress a number of these initiatives and will seek support from the RIG to invest in these systems to enhance the maintenance and renewal programs for the Central Queensland Coal Network.

Two items are proposed to be progressed in FY23:

- ATIS – Automated Track Inspection system (ATIS) is a combination of autonomous measurement devices that provide frequent measurement of track and overhead geometry, pantograph interface and forward facing track vision. ATIS will provide Aurizon Network with increased understanding of track and overhead alignment, moving decisions of rail and overhead alignment management from qualitative decisions to quantitative data driven assessments. Currently Aurizon Network is finalising the trial of the Wire Geometry Measurement system (WGMS) and the Pantograph Collision Detection System (PCDS) in the Blackwater and Goonyella systems ahead of presenting the full business case for investment. This business case will be discussed with the RIG, seeking customer support in Q3 FY22.
- As the standardisation of the OneSAP system is completed across Aurizon Network some system functionality gaps may become evident requiring investment in SAP modules or system architecture changes. No allowance has been included in the FY23 Final Draft Proposal. If an investment is required, then Aurizon Network will engage with the RIG on the required level and timing of investment.

Newlands System



8. Newlands System and GAPE

This chapter presents Aurizon Network's Draft Maintenance and Renewal Strategy and Budget for the Newlands System and the Goonyella to Abbot Point Expansion (GAPE) during FY23. In line with 7A.11.3 of UT5, this section will be subject to vote by the relevant Newlands and GAPE End Users.

Aurizon Network's FY23 Final Draft Proposal for the Newlands System and GAPE provides for:

- **A Direct Maintenance Cost Allowance (excluding ballast undercutting plant depreciation) of \$12.9m**

This represents an increase of \$0.6m compared to Aurizon Network's current FY22 full year maintenance forecast and an increase of \$0.6m compared to the FY22 Approved Maintenance Strategy and Budget.

The inclusion of ballast undercutting plant depreciation and an adjustment for non-coal traffic provides for a total Maintenance Indicator of \$13.2m. Aurizon Network proposes to allocate the total Maintenance Indicator as follows:

- \$4.3m allocation to Newlands System Allowable Revenues and Reference Tariffs; and
- \$8.9m allocation to GAPE Allowable Revenues and Reference Tariffs.

- **A Renewals Allowance of \$22.5m**

This represents a decrease of \$2.2m compared to Aurizon Network's current FY22 full year renewals forecast and a decrease of \$2.8m compared to the FY22 Approved Renewals Strategy and Budget.

Aurizon Network proposes to allocate the total Capital Indicator as follows:

- \$20.3m allocation to Newlands System Allowable Revenues and Reference Tariffs; and
- \$2.2m allocation to GAPE Allowable Revenues and Reference Tariffs.

Aurizon Network understands that the allocation of the FY23 Direct Maintenance Cost Allowance and the Renewals Allowance between Newlands and GAPE Train Services is a matter of interest to customers. Aurizon Network has established a working group with relevant customers to consider the pricing issues contained in the QCA's guidance paper released in September 2021. Aurizon Network continues to work with Newlands and GAPE end users to progress the examination of alternative pricing and allocation methodologies for the shared rail corridor. If an alternative to the currently approved methodology can be agreed with stakeholders, its implementation will be progressed through the appropriate regulatory mechanism, such as the annual review of reference tariffs or a DAAU.

8.1 Newlands System - Characteristics and Corridor Strategy

The Newlands System is located at the northern end of the Bowen Basin connecting to the port at Abbot Point. The system serves mines located in the Newlands System, as well as mines located in the Goonyella System via the GAPE Link. Commencing in FY22 the system also supports coal services from the Galilee coal basin. The Newlands System and GAPE are not electrified.

Maintenance and renewal activities in the Newlands System and GAPE are primarily delivered from depots located in Moranbah and Merinda, with mobile mechanised plant based in Yukan and Rockhampton.

Aurizon Network's depots are strategically located to enable incident response times across the Newlands System within approximately two and half hours. Mechanised plant (e.g., resurfacing) is typically able to respond to an urgent defect (e.g., a buckle or geometry defect) in the Newlands System within 2 days.

Figure 68 Depot Locations – Newlands System and GAPE



Note: The northern end of the Newlands system also receives maintenance support from the depot located at Moranbah

Aurizon Network has considered asset conditions specific to this Coal System when developing the FY23 Final Draft Proposal, particularly in relation to:

- **Civil Assets** – The GAPE project built a 65Km greenfield connection between the Goonyella and existing Newlands Systems in 2012. This project also upgraded the sections of the pre-existing Newlands System designed to carry loaded traffic from 20 tone axle load to 26.5 tonne axle load. These upgrades included rail replacements, formation strengthening and structure renewal. Current activity is centred around the sections that were not upgraded in 2012 which include sections of 53kg rail and fist fastener sleepers associated with the original 20 tonne axle load operations.
- **Control Systems Assets** – This asset class was also modernised during the GAPE project with upgraded sections fully digitised. Like the civil assets, these upgrades are intermixed with aged assets. For Control Systems, these aged assets include the section of non-Remote Controlled Signalling (RCS) controlled track between the Newlands Junction section and Collinsville and aged interlockings.

The non-upgraded sections of the Newlands System attract most of the maintenance and renewal activity given these assets are aged and there are sections of 53kg rail and fist fastener sleepers, and short span bridges associated with the original 20 tonne axle load operations.

Corridor Strategy:

- The Newlands System (which includes Rail Infrastructure constructed as part of the GAPE project) is a mix of new, recently upgraded, and original assets. As such most of the maintenance and renewal efforts are focused on the aged assets not upgraded or renewed during the GAPE.
- The asset management strategy for the Newlands System and GAPE is to hold availability required in a fit for purpose manner. The Newlands System and GAPE rail infrastructure is being maintained for forecast tonnages and not name plate capacity.
- The maintenance approach is consistent with the other Coal Systems being planned inspections with planned corrective maintenance to address identified defects and reactive maintenance to address service interrupting asset failures and incident response.
- Asset Renewals seek to renew or replace aged assets ahead of unplanned failure or obsolescence to minimise supply chain interruption.

8.2 Newlands System and GAPE - Integrated Closure Plan

Aurizon Network has engaged with the RIG and other stakeholders to better understand their requirements and has taken the following into consideration when developing the FY23 Final Draft Proposal, Integrated Closure Plan:

Specific Newlands and GAPE Supply Chain considerations:

- **Port alignment:**
 - Major scope delivery is preferably aligned with port outages.
- **Reducing impact of major closures:**
 - Major scope delivery is packaged and executed in extended integrated closures once or twice per year (scope dependent).
 - All other planned maintenance activities are completed in scheduled maintenance blocks or in-between trains.
- **Closure timing:**
 - December and June are avoided to provide the opportunity to maximise railings for the end of calendar and financial year respectively.

Table 147 below outlines the proposed closure hours for FY23. This provides for a slight reduction in system closure hours of 2 hours compared to the FY21 Approved Strategy and Budget.

Table 147 Planned integrated closures– Newlands System and GAPE

FY23 Integrated System Closures													
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total
Hours	0	0	108	0	0	0	0	0	48	0	0	0	156

In addition to the integrated system closures (outlined in Table 147), single line maintenance activities will be planned during the year (as required by the asset) and will have regard to seeking to deliver Committed Capacity and that outages are coordinated with other Supply Chain Participants wherever reasonably possible with a view to maximising throughput.

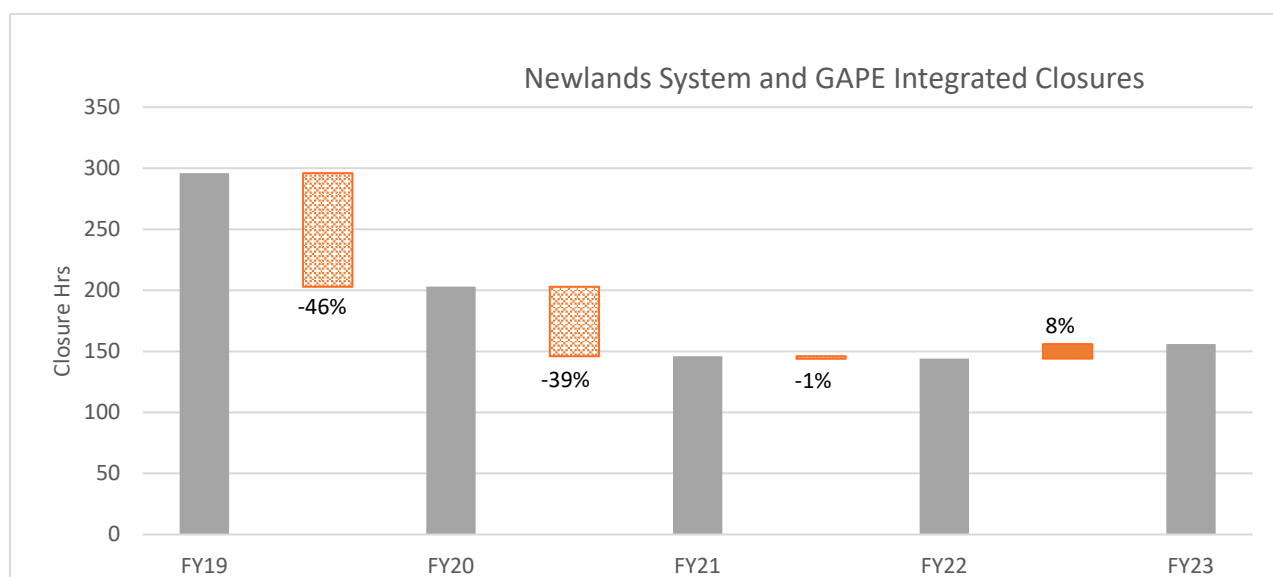
The following asset activities are a selection of activity determining the planned Integrated Closures and access requirements in the Newlands System and GAPE during FY23:

Table 148 Critical Scope in the Newlands System

Planned Delivery (hrs)	Asset	Location
108	Formation Repair (650m)	McNaughton (79.260 to 79.900Km)
48	Formation Renewal (365m)	Pring (5.500 to 5.870Km)
100	Bridge Ballast Rollout	Pelican Creek Bridge (80.355 to 80.505Km)
80	Track Upgrade	Aberdeen (39.800 to 42.905Km)
108	Structure Renewal (3 short span bridges)	Pring > Buckley > Armuna
30	Signal Interlocking	Collinsville (72.450 to 80.550Km)

Figure 69 below illustrates the historical Newlands and GAPE integrated system closure hours in comparison to the FY23 Final Draft Proposal.

Figure 69 Trend of Integrated System Closure Hours from FY19 to FY23 – Newlands and GAPE



8.3 Newlands and GAPE - FY23 Maintenance Strategy and Budget

Aurizon Network has developed its Draft Maintenance Strategy and Budget for the Newlands System and GAPE having regard to all relevant matters outlined in clause 7A.11 of UT5, including the Maintenance Objectives. Aurizon Network considers that its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of the Newlands System and GAPE Rail Infrastructure and seeking to deliver Committed Capacity.

8.3.1 Summary of Historic, Forecast & FY23 Maintenance Strategy & Budget

Aurizon Network's FY23 Final Draft Maintenance Strategy and Budget for the Newlands System and GAPE provides a Direct Maintenance Cost Allowance of \$12.9m (excluding ballast undercutting plant depreciation) which is:

- \$0.6m higher than the FY22 Approved Maintenance Strategy and Budget; and
- \$0.6m higher than Aurizon Network's current FY22 full-year forecast.

Figure 70 below provides a summary of historic direct maintenance costs as well as the proposed direct maintenance cost allowance in respect of FY23. To ensure comparability with prior periods, the direct maintenance costs shown in the chart below exclude depreciation on ballast undercutting plant.

Figure 70 Newlands System and GAPE Direct Maintenance Costs (excluding ballast undercutting plant depreciation)

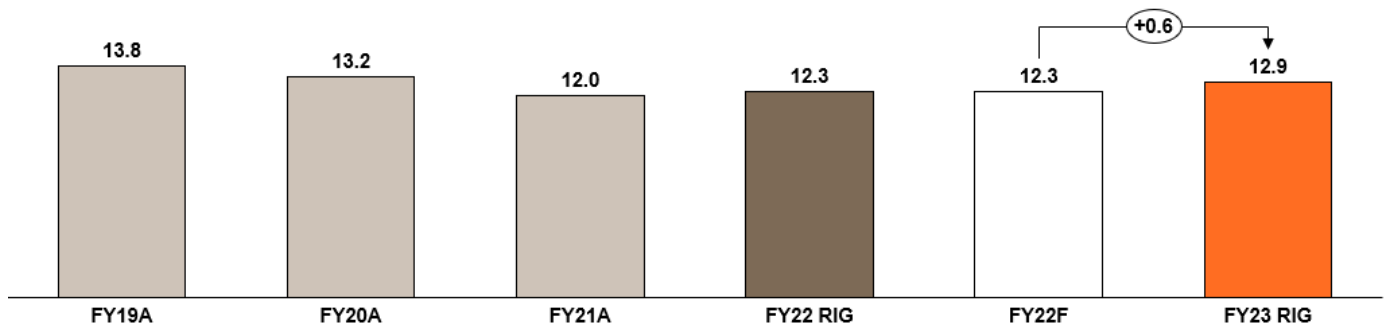
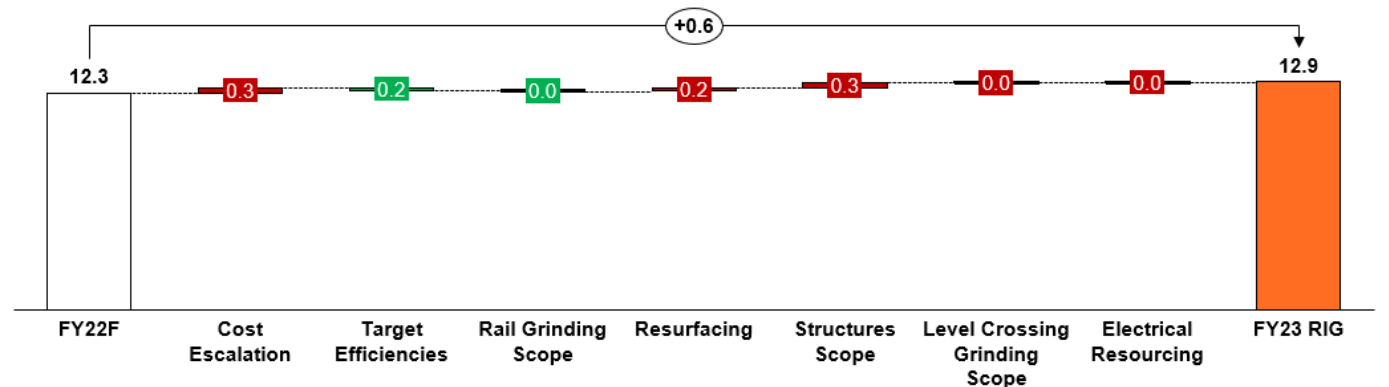


Figure 71 Newlands System and GAPE Direct Maintenance Cost Movement (excluding ballast undercutting plant depreciation)



As noted in the Quarterly Report for Q1 FY22, the current full year forecast for FY22 direct maintenance costs excluding ballast undercutting plant depreciation is \$12.3m (as at 30 September 2021) which is in line with the FY22 approved maintenance budget. The forecast takes account of actual conditions and run rate costs in FY21 and Q1 FY22. The FY22 forecast is subject to review and will be updated at the end of Q2 FY22.

The proposed direct maintenance cost allowance for FY23 (excluding ballast undercutting plant depreciation) is \$12.9m, \$0.6m higher than the current FY22 direct maintenance cost forecast, which has been used as the basis for developing the FY23 Final Draft Proposal. This increase reflects the net impact of assumed cost escalations and scope changes (+\$0.8m) partially offset by target efficiencies (-\$0.2m).

An overview of the methodology used to establish the FY23 maintenance cost budget is provided in Chapter 14. Chapter 8.3.2 below provides a summary of the maintenance scope and budget for the Newlands System and GAPE in FY23 for each maintenance item.

8.3.2 FY23 Maintenance Strategy and Budget

As detailed in Chapter 11, Aurizon Network’s Asset Management approach is based on achieving the appropriate level of asset availability at the most efficient cost of ownership, through the entire asset life cycle, which will best meet the customer requirements in each Coal System.

Aurizon Network's Asset Maintenance and Renewal Policy is to maintain the condition and availability of the network consistent with previous performance. The scope and closure requirements in different systems is influenced by demand, track arrangement, operating parameters, traction mode and signalling and communications systems.

In Newlands the predominant train length is an 84 wagon train (limited by passing loop lengths). This is a shorter train than operates in Blackwater or Goonyella. As a result, the maintenance and renewal pattern in Newlands System and GAPE is slightly different than other systems but more aligned to the larger systems regarding the mix of maintenance in total capital and maintenance cost, as per the table below.

Table 149 FY23 Proposal – Newlands System and GAPE Maintenance & Capital spend % split

System	FY23 Renewal and Maintenance Cost (\$m)	% Maintenance	% Capital
Newlands	\$35.4	36%	64%
Goonyella	\$182.6	33%	67%
Blackwater	\$189.7	34%	66%
Moura	\$28.6	45%	55%

In the Newlands System and GAPE, Aurizon Network's maintenance approach holds the system fit for purpose for forecast tonnages. The planned and preventative maintenance activities and inspections, as well as the planned mechanised production scope, are derived in line with the intervention periods as detailed in the Asset Maintenance & Renewal Policy. This Policy determines the inspection regime and period based on asset type condition and location.

The proposed FY23 maintenance scope and budget for the Newlands System and GAPE is outlined in Table 150. Please note that the totals presented in the table below may not add due to rounding.

Table 150 FY23 Proposal – Newlands System and GAPE Maintenance

Maintenance Item	Scope Units	FY22 Forecast Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
Resurfacing			1.7		1.8
- Mainline	Km	188	1.6	188	1.5
- Turnout	Site	21	0.1	21	0.2
Rail Grinding			1.6		1.7
- Mainline	Km	█	1.3	█	1.4
- Turnout	Site	█	0.3	█	0.3
- Level Crossings	Track LX		-	█	0.0
General Track Maintenance			3.9		3.9
- General Track	Activity		3.6		3.7
- Track Recording	Km	521	0.2	521	0.2
- Ultrasonic Testing Car	Km	915	0.1	918	0.1
Signalling and Telecoms			2.7		2.8
- Signalling Corrective	Activity		0.8		0.8
- Signalling Preventative	Inspection		1.2		1.5

Maintenance Item	Scope Units	FY22Forecast Scope	FY22 Forecast (\$m)	FY23 Scope	FY23 Budget (\$m)
- Telecoms Corrective	Activity		0.1		0.1
- Telecoms Preventative	Inspection		0.7		0.5
Structures and Facilities			1.0		1.3
Trackside Systems			0.3		0.3
Other Civil Maintenance			0.2		0.2
Other General Maintenance			0.9		1.0
- Asset Management & Inventory			0.3		0.3
- On Call			0.0		0.0
- Security			0.6		0.6
- RM900 Storage & Maintenance			0.0		0.0
Sub-Total			12.3		12.9
Ballast Undercutting Plant Depreciation			0.3		0.3
Total Direct Maintenance Costs			12.6		13.3
Non-Coal Allocation			(0.1)		(0.1)
Total			12.5		13.2

For the Newlands System:

- **Direct maintenance costs** (excluding ballast undercutting plant depreciation) are budgeted to increase by \$0.6m from the current FY22 forecast to \$12.9m in FY23. The movement in cost between periods reflects the net impact of cost escalation and scope changes (\$0.8m) partially offset by estimated target efficiencies (\$0.2m). Key movements in RIG maintenance categories are summarised below.
 - **Resurfacing (+\$0.1m)** - increase primarily reflects cost escalation and an increase in cyclic maintenance costs. Resurfacing plant has varying annual maintenance cycles such that the costs of maintaining the equipment will vary year on year for the life of the plant.
 - **Rail Grinding (+\$0.1m)** - increase primarily reflects an increase in mainline scope partially offset by a reduction in turnout scope. The draft budget also includes an allowance for the introduction of a preventative level crossing rail grinding program.
 - **Ultrasonic Testing Car** - due to data improvements enabling the accurate collection of historical train movements over each track section, the requirement for ultrasonic testing (every 10MGT) has been effectively matched to actual traffic movement rather than assumptions of traffic flow across the railway.
 - **Signalling & Telecoms (+\$0.1m)** - increase primarily reflects cost escalation as well as increased trainee apprentice resources in the Control Systems teams.
 - **Structures & Facilities (+0.3m)** – increase primarily reflects the cyclical nature of structures inspections which are carried out every two years for all structures in the Newlands systems together with planned corrective work on grouting considered to be in poor to very poor condition, concrete and causeway repairs in FY23 (\$0.1m), offset by absence of concrete bridge repair costs in FY23 (\$0.1m).
 - **Other General Maintenance (\$+0.1m)** - increase reflects cost escalation as well as an allowance for storage and maintenance costs relating to the BCM.

- **Ballast Undercutting Plant Depreciation** – is forecast to remain consistent with the FY22F.
- **Non Coal Allocation** – this adjustment reflects an allocation of costs to non-coal services and is calculated by applying an estimate of the non-coal proportion of total system GTKs to total system maintenance costs (excluding ballast undercutting plant depreciation).

In aggregate, these changes result in an increase in total direct maintenance costs of **\$0.7m** from **\$12.5m** in FY22F to **\$13.2m** in FY23.

- The scope of planned corrective and reactive maintenance tasks is heavily dependent on the faults identified via the planned inspection programs. Consequently, scope for these activities cannot be defined. Aurizon Network has assumed that in FY23, this Coal System will see a similar level of faults that require planned corrective or immediate maintenance response as in prior years.
- For the Newlands System and GAPE, the following activities are to be considered as an aggregated single “item” for the purpose of UT5, clause 7A.11.5(f)(ii)(B)(2) - Resurfacing, Rail Grinding, General Track Maintenance, ‘Signalling and Telecoms’, ‘Structures and Facilities’, Trackside Systems, Other Civil Maintenance and Other General Maintenance.

Set out in Figure 72 below is a summary of historic, forecast and budgeted direct maintenance costs by maintenance category. To ensure comparability between periods, the direct maintenance costs presented in the chart exclude depreciation on ballast undercutting plant.

Figure 72 Newlands and GAPE Direct Maintenance Costs (excluding Ballast Plant Depreciation)

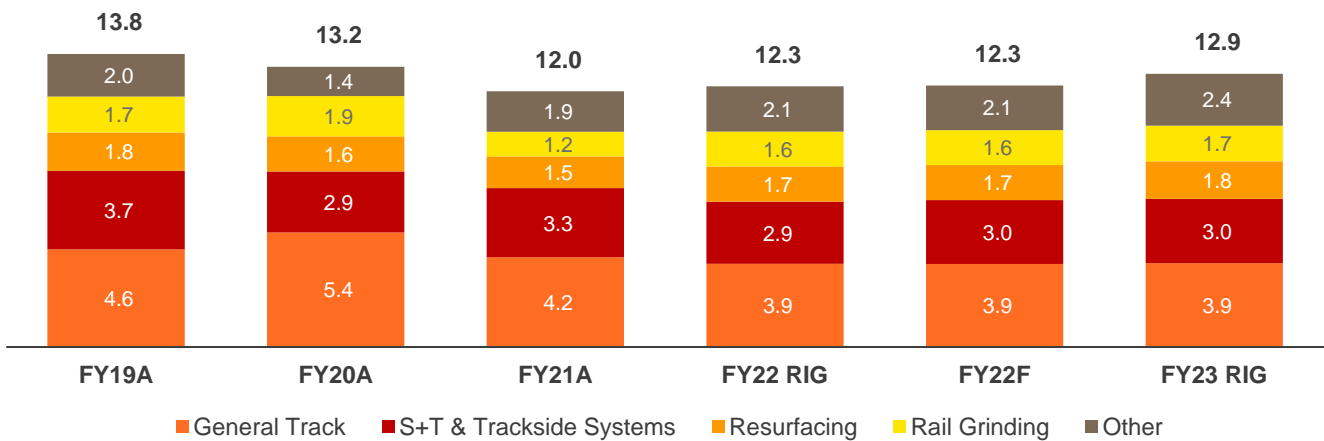
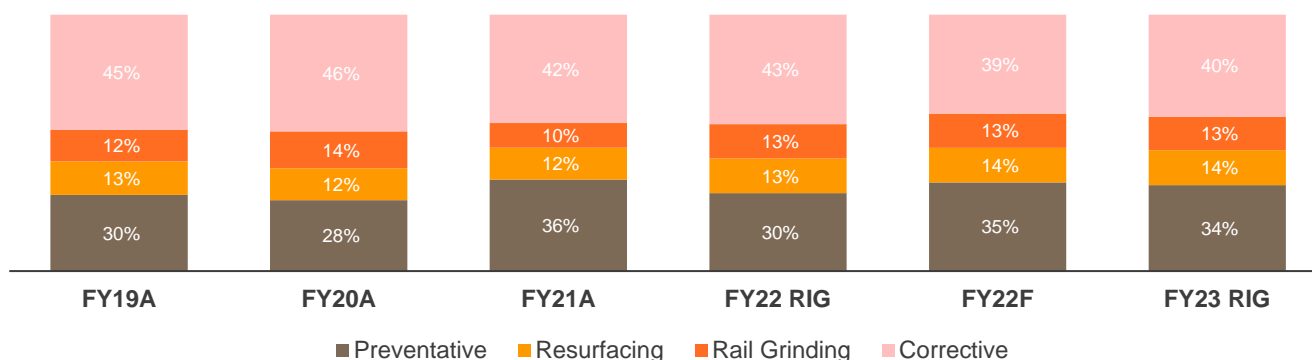


Figure 73 below illustrates the proportion of preventative and corrective maintenance expenses in the Newlands System and GAPE over time. Approximately 60% of the Newlands System and GAPE maintenance spend in FY23 is expected to be preventative in nature.

Figure 73 Newlands System and GAPE – Preventative / Corrective Maintenance Spend Composition



Further information in relation to the costing methodology used by Aurizon Network in the development of the FY23 Final Draft Proposal is outlined in Chapter 13. Additional detail in relation to the make-up of costs for each maintenance activity has been provided to the RIG Expert Advisor.

8.3.3 Alternative maintenance options considered

Aurizon Network notes there are a number of options available as to how and when asset renewal and maintenance is performed. When implemented, each option may have an associated flow on impact to other Supply Chain Participants. Aurizon Network’s access planning process endeavours to optimise impacts through appropriate access planning. Aurizon Network welcomes further discussions to explore alternative options.

As detailed in Chapter 11, Aurizon Network applies several different approaches with regards to maintaining the Rail Infrastructure. These approaches lead to the application of the maintenance task across the system. A summary of alternate considerations is detailed in Table 151 below. Aurizon Network welcomes the opportunity to work with Customers and other Supply Chain Participants to further explore alternate maintenance approaches.

Table 151 Maintenance Considerations

Activity	Description	Alternative maintenance option
Mainline & Turnout Resurfacing	Track settlement occurs in heavy haul railway conditions, presenting as track geometry defects that can result in derailments if not maintained effectively. Track resurfacing is an essential maintenance activity in railways to maintain safe track geometry for rolling stock. Track geometry defects can be symptomatic of an underlying defect, which is creating excessive or rapid track settlement. Multiple resurfacing interventions to maintain safety is a key consideration when determining whether ballast cleaning and formation renewal work is required. Resurfacing activities are currently delivered in a way that provides operational flexibility with these activities currently scheduled after customer train orders. Planned works are delivered in the shadow of other maintenance activities and/or where customer demand permits. Resurfacing scope is both preventative and corrective based on the method of identification. An alternative	<ol style="list-style-type: none"> Lower Production / Higher Cost / Higher Short-term Access Impact Option, provides: <ul style="list-style-type: none"> Attend all defects as quickly as possible Focus on asset reliability Negative impact on capacity Decreased productivity and increased travel Medium Production / Medium cost / Lower Short-term Access Impact Option provides: <ul style="list-style-type: none"> Larger periods of access between trains Stay in the system for a whole block (i.e., roster period) Reduce travel between systems Defects held for longer periods Attend high impact defects quickly <p>Aurizon Network currently utilises option 2 in Newlands as it delivers the most appropriate outcomes for the supply chain.</p>

Activity	Description	Alternative maintenance option
Rail Grinding	<p>approach could be to deliver preventative and corrective scopes in a different method which is more impactful to reliability and access.</p> <p>Rail grinding is a critical maintenance activity to reduce rail breaks and extend the life of rail.</p> <p>The rail grinding approach through the CQCN seeks to control surface-initiated rail defects under a preventative regime. Intervention thresholds are based on throughput tonnage which are translated into a time-based frequency to allow long term planning. These frequencies are dictated by the 'tightness' of the curve as rail defects are directly correlated to the dynamic curving forces of trains.</p> <p>Rail grinding is also undertaken in a reactive way to remedy identified rail defects which are initiated from high traction locomotives or other unpredictable mechanisms.</p>	<ol style="list-style-type: none"> 1. Preventative grinding strategy with a small amount of corrective allowance 2. Corrective rail grinding strategy - A corrective rail grinding strategy would involve allowing rail surface defects to propagate to a severe condition, before reactively programming the rail grinder to perform deep rail grinding to remove the severe defect. This approach would reduce the rail grinding scope, however, significantly increases the risk that surface defects grow into the rail causing rail breaks. Corrective rail grinding also reduces the rail asset life as more rail is removed during rail grinding to remove surface defects and cracks. Corrective rail grinding strategies are adopted in other rail networks that are lower throughput with plenty of maintenance windows or where the demand is seasonal. <p>Aurizon Network currently utilises option 1 in Newlands to ensure high availability and reliability of the rail asset.</p>
General Track	<p>The current inspection approach for General Track is a mix of the Track Recording Car, Ultrasonic Test Car, High Rail Vehicle inspection, walking inspections and non-destructive hand testing as detailed in the Asset Maintenance & Renewal Policy.</p>	<ol style="list-style-type: none"> 1. Reduce Inspection Frequencies - Reduce inspection frequencies and revert to additional fix on fail methodology. A move to reduce the frequency of inspections would require consultation and approval from the Rail Safety Regulator. <p>This option is not recommended and would likely lead to an increase in unplanned delays and increased cost to rectify in an unplanned manner.</p> <ol style="list-style-type: none"> 2. Operational Intervention - To reduce the impact of high priority defects, Aurizon Network can apply temporary restrictions to manage risks, e.g., Temporary Authorised Non-Conformance, Temporary Speed Restrictions, Axle Load Restrictions or rerouting loaded and empty trains. These interventions can be localised to the defect to keep the rail line open whilst working with the above rail operators to find a least impact time to rectify the defect. Whilst this keeps the rail line open, this will potentially impact operational performance and could result in unplanned closures if the defect changes. <p>Aurizon Network currently utilises option 2 in Newlands as it delivers the most appropriate outcomes for the supply chain.</p> <ol style="list-style-type: none"> 3. Aurizon Network is currently trialling ATIS, an alternative option to the Track Recording Car outlined in Chapter 3.3. The results of this trial and possible effect on the frequency of general track inspections will be discussed with the RIG in due course.
Control Systems	<p>Maintenance is based on defined time-based inspections of equipment items (e.g., points, level crossings) and of equipment enclosures and power supplies.</p> <p>The frequency of inspection varies between equipment types and is based on failure modes and criticality.</p> <p>Frequency and tasks are reviewed annually for effectiveness based on observed asset</p>	<ol style="list-style-type: none"> 1. Maintain only on failure – not recommended and would likely lead to an acceleration of faults which will reduce the reliability of the systems which in turn reduces the capacity of the railway. 2. Planned frequency (current approach): recommended. The current planned frequencies are reviewed on an annual basis to align the required inspections to the condition of the assets.

Activity	Description	Alternative maintenance option
	condition, fault performance, and impact on rail services.	3. Increased inspection frequency and/or accelerated replacement and refurbishment to reduce the likelihood of service affecting failures: this is considered annually in conjunction with maintenance check sheet review. Frequencies and activities are adjusted where it is believed that the in-service performance will be materially improved. Any change to the inspection frequencies requires consultation and approval from the Rail Safety Regulator.

8.4 Newlands System and GAPE– FY23 Renewals Strategy and Budget

Aurizon Network has developed its Draft Renewals Strategy and Budget for the Newlands System and GAPE having regard to all relevant matters outlined in clause 7A.11 of UT5. Aurizon Network considers that its draft proposal provides an appropriate level of asset activity that will promote the safety, reliability and performance of Newlands System and GAPE Rail Infrastructure and seeking to deliver Committed Capacity.

8.4.1 Supply Chain Benefits of the Renewal Program

In addition to an optimised cost outcome, Aurizon Network's renewal program seeks to provide the following benefits for the Newlands System and GAPE supply chain.

Table 148 Supply Chain Benefits of the Renewal Program

Renewal Activity	Benefit Type	Description
Permanent Way	Asset reliability	Reduce network delays associated with unplanned asset activity. Asset components such as rail, sleepers and turnouts have a low likelihood of failure in a new state and require minimal maintenance once renewed.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition.
Ballast Cleaning	Asset reliability	Reduce network delays due to asset failure associated with track geometry defects and mudholes linked to poor ballast condition due to coal fouling.
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses. Proactive ballast condition management mitigates TSR's caused by poor ballast condition.
	Safety	Improve the wet weather resilience of track (reduced unplanned defects which need to be responded to in a reactive manner). Reduces train derailment risk by managing asset condition.
Structures	Asset reliability	Reduce network delays associated with asset failure or degradation.
	Throughput	Increasing system capacity by reducing section run times through the removal of long term speed restrictions on short span bridges track sections.
	Safety	Reduced derailment risk due to track misalignment caused by structure failure of non renewed assets
Civil Assets	Asset reliability	Reduce network delays associated with asset failure and lifting renewed sections to the current required tonnages.

Renewal Activity	Benefit Type	Description
	Throughput	Renewing in a planned manner within identified closure pattern avoiding unplanned outages and associated throughput losses.
	Safety	Reduce derailment risk with trains by managing asset condition. Removal of redundant assets reduces the risk of rail staff accessing the rail corridor and members of the public accessing no longer required live crossings.
Transmission and Data Networks	Asset reliability	Given these assets do not wear but rather age to a point where they are no longer supported renewal ahead of failure is required to retain the assets' reliability.
	Throughput	Renewal and system improvements to best move trains through the system in an efficient and safe way.
	Safety	Ensuring the critical signalling and train control systems are robust and effective in the separation of trains. Providing clear communications functionality across the CQCN systems.

8.4.2 Summary of FY23 Renewals Strategy and Budget

A summary of the FY23 renewals budget for the Newlands System and GAPE is outlined in Table 152. Please note that the totals presented in the tables below may not add due to rounding.

The summary has been further separated in Table 153 to call out the proposed FY23 scope on the Goonyella to Abbott Point Extension track segment between the 231.800Km and to the 146.100Km points

Table 154 details the percentage of total system assets that are proposed to be renewed in FY23.

Table 152 FY23 Proposal – Newlands System and GAPE Renewals

Renewals Item (\$m)	Assets Include:	FY22 Approved Budget	FY22 Full Year Forecast	FY23 Draft Budget
Civil Assets		20.4	20.5	18.8
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	9.1	9.8	5.2
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	3.9	4.3	4.3
Structures	<i>Culverts, Bridges</i>	4.9	4.1	5.2
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	2.4	2.3	4.2
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>	4.6	4.1	3.7
Technology		0.3	0.1	--
Total		25.3	24.7	22.5

Table 153 FY23 Proposal – Highlight for GAPE Specific Renewals (Contained in table above)

Renewals Item (\$m)	Assets Include:	FY23 Draft Budget
Civil Assets		2.2

Renewals Item (\$m)	Assets Include:	FY23 Draft Budget
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	1.2
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	1.0
Structures	<i>Culverts, Bridges</i>	-
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	-
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>	-
Technology		-
Total		2.2

Table 154 FY23 Proposal – Newlands System and GAPE Renewals as a % of Total System Assets

Renewals Item	Assets Include:	Total system Assets	FY22 RIG Approved Scope	FY23 Proposed Scope	FY23 scope % Total System Assets
Civil Assets					
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	• 634Km rail	• 3.9Km rail	• 2.4Km rail	• 0.4%
		• 317Km sleepers	• 3.1Km sleepers	• 0 sleepers	
		• 317Km track	• 4.9Km track upgrade	• 3.1Km track upgrade	• 1.5%
		• 77 turnouts	• 1 turnout	• 0 turnout	
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	• 276Km Mainline	• 6.9Km Mainline	• 5.9Km Mainline	• 1.9%
		• 77 Turnouts	• 3 Turnouts	• 3 Turnouts	• 3.9%
		• 50 bridges	• 1 bridge	• 1 bridge	• 2.0%
Structures	<i>Culverts, Bridges</i>	• 50 bridges	• 2 bridges	• 3 bridges	• 6.0%
		• 664 culverts	• 5 culverts	• 1 culvert	• 0.2%
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	• 317Km formation	• 0.7Km formation	• 1.0Km formation	• 0.4%
		• 94 level crossings	• 0 level crossings	• 2 level crossings	• 3.3%
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>		• 33 sites	• 58 sites	

Note: Control Systems count of assets is a collective of sites, nodes, cable routes, communications assets and systems and is included to indicate level of work comparable to prior year. Detail of actual scope is provided later in this Newlands section.

8.4.3 Details of the FY23 Renewals Strategy and Budget

This section provides detailed information in relation to the individual scope items selected for renewal in FY23, along with the rationale for those selections and alternative options considered.

Aurizon Network notes that the prioritisation of renewals scope is based on currently available information and that this prioritisation may change over the period prior to execution (of up to 18 months) as a result of environmental

factors, relative degradation rates or other considerations. Changes to the proposed scope will be dealt with through the reporting and change management processes as appropriate.

In the preparation of the FY23 proposal, Aurizon Network conducted a likelihood of change review to determine scope that may incur project change to either cost or delivery time to complete or location change. Further detail of this review is detailed at Chapter 12.1.7 of Part B and change drivers against individual scope items are included in this section.

Through the likelihood of change review, it was identified that of the 66 scope items proposed in Newlands and GAPE in FY23, 15% had a high likelihood of change, 30% had a moderate likelihood of change, and 55% of the program is expected to have no change to either site cost, scope creep or works duration.

Table 155 FY23 High Likelihood of Change – Newlands and GAPE

Asset Class	Total scope items	Items with High Likelihood of change	% of scope with High Likelihood of change
Civil	51	8	16%
Control Systems	15	2	13%
TOTAL	66	10	15%

The percentage of scope change related to civil assets in Newlands is higher than other systems. The use of the BCM versus excavator undercutting for delivery of the mainline undercutting scope is still to be determined, with the decision expected in January 2022. The scope has been presented in this FY23 Final Draft Proposal as being completed with the BCM.

The percentage of scope change relative to total scope is expected to be higher in the Control Systems assets as these are mechanical and computer-based assets. The renewal of these assets is linked to the obsolescence of the aged assets so there is an element of unknown about the commissioning of new generation technology into Aurizon Network's existing systems. This can lead to scope creep, cost impact or delay in delivery time.

Unless otherwise indicated in Table 157, Table 159, Table 163, and Table 164 below, the asset renewal scope relates to Newlands System Rail Infrastructure and does not relate to the replacement of assets constructed as part of the GAPE infrastructure enhancements.

Civil Assets – Permanent Way

Permanent Way Renewal Program

Aurizon Network's FY23 Final Draft Proposal provides \$5.2m to deliver the scope of permanent way renewals in the Newlands System and GAPE. This is a reduction in permanent way forecast spend in comparison to FY22 due to the absence of planned sleeper or turnout scope in FY23. Table 156 summarises the scope and budget for each relevant renewal item.

Table 156 FY23 Permanent Way Renewals – Newlands and GAPE

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Rail Renewal	2.4	Rail Km	1.2	The rail renewal and track upgrade programs will see 0.4% of total Newlands System rail replaced.
ii. Track Upgrade	3.1	Track Km	3.2	1 Track Upgrade planned and assigned to planned closures.

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
iii. Turnout Components		Fix on Fail	0.6	Same allocation made to major component renewal as in FY22
v. Turnout Designs			0.1	Designs for locations to be renewed in future years
vi. Permanent Way Other		Fix on Fail	0.1	Glued Insulated Joints (GIJ's) & Rail Lubrication installation and rail fix on fail scope.
TOTAL			5.2	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Rail Renewal

The FY23 rail renewal program in Newlands System and GAPE will see rail renewals carried out at 3 sites near their wear limit. Rail identified for renewal has either reached (or is near) its wear limit or has seen tonnages that indicate a heightened risk of near-term failure due to rail fatigue.

The location and extent of these works for FY23 are outlined in the following table.

Table 157 FY23 Rail Renewal Program – Newlands and GAPE

Ref	Track Section		Start Km	Finish Km	Length (Rail Km)	GAPE [^]
1	BINBEE	BRIABA	50.425	51.250	0.864	✓
2	BRIABA	ALMOOLA	58.610	59.090	0.960	✓
3	COLLINSVILLE	MCNAUGHTON JCT	72.835	73.123	0.540	✓
TOTAL					2.364	

[^] Identifies scope relating to the replacement of assets constructed as part of the GAPE infrastructure enhancements.

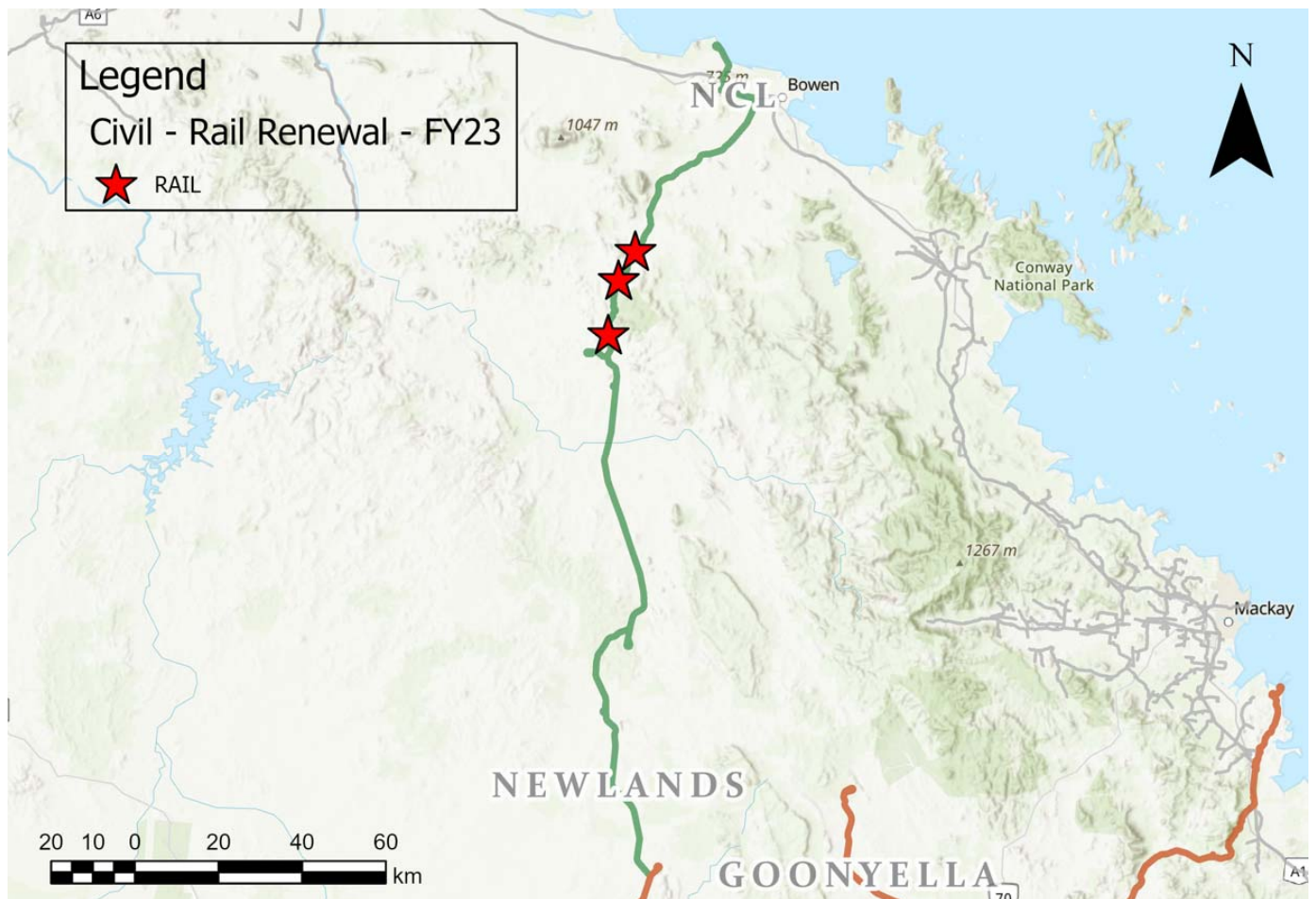
Scope comments:

- The scope at these locations is driven by rail wear.
- The 2.4km of rail being renewed in this program equates to 0.4% of the total rail in the Newlands System and GAPE (316 track Km).

“Rail wear” is the progressive loss of steel in the rail head caused by the very high lateral forces within curved track under train operations and preventative grinding. The rail wears to the point where it is not sufficiently strong enough to sustain the heavy axle loads and typically manifests itself in curved track. Generally speaking, the sharper (i.e., tighter) the curve, the higher the wear rate.

Aurizon Network’s planned unit length of rail is typically 108m, as this is the nominal longest length of rail that can be transported around the rail network. In certain circumstances lesser lengths can be used.

Figure 74 Rail Renewal Sites Newlands and GAPE FY23



ii. Track Upgrades

A total of 3.14 Track kilometres has been identified for track upgrade in the FY23. The location and extent of these works for FY23 are outlined in the following table.

Table 158 FY23 Track Upgrade Program – Newlands System and GAPE

Ref	Track Section	Start Km	Finish Km	Length (Km)	Rails	Sleepers
1	ABERDEEN BINBEE	39.795	42.931	3.136	58	4,578

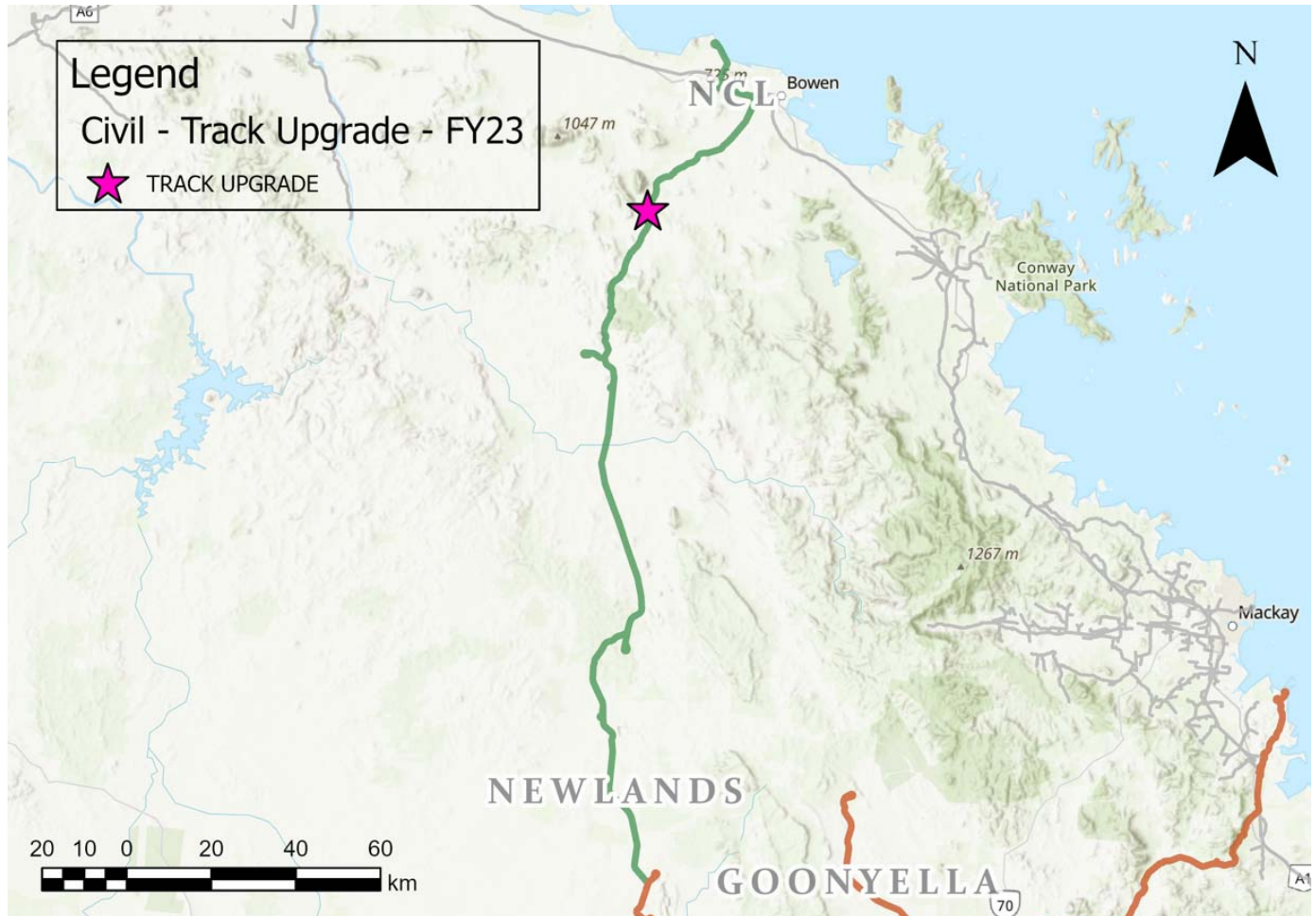
Scope Comment:

- This scope is for the renewal of both rails and the sleepers between the 39.795Km – 42.931Km on the Newlands line.
- Current rail was installed in 1984 and is 53kg Standard Carbon rail on concrete fist clip sleepers.
- Multiple rail defects have been uncovered within the scoped area. These defects result in unplanned work activity, unplanned delays and cancellations. Internal rail defects are identified by ultrasonic testing and are a result of rail fatigue.
- The replacement of rail and sleepers, where they are both at end of life, as part of the same activity provides for effective and efficient use of plant and labour.
- The cost per linear kilometre of Track Upgrade can vary dependant on the mix of assets to be renewed in the identified track sections. These differing renewals are:

- Both rails, sleepers and some ballast
- Left or right rail only, sleepers and some ballast
- Sleepers and some ballast only (i.e., no rail)

The FY22 scope is 1.8kms greater than the FY23 scope, however, this included approximately 2.5km where no rail was replaced. The 3.1km included in FY23 includes both rails and all sleepers being replaced in this section.

Figure 75 Track Upgrade Sites Newlands System and GAPE FY23



iii. Turnout Component

The FY23 Turnout Component scope is an allocation of \$0.6m for the Newlands System and GAPE. Component renewal is a standard asset management practice which allows Aurizon Network to maximise the overall asset’s useful life. Component replacements typically include switch and stock replacement or vee/crossing replacement. These components absorb the highest impact forces from trains and are deteriorate faster than the surrounding components.

iv. Turnout Design

The FY23 turnout design program for Newlands and GAPE will see turnout design completed during FY23 for two sites. Designs will be completed for turnouts in the following locations with the renewal planned for FY24.

Table 159 Turnout Design Scope Locations – Newlands and GAPE

	Station	Km Point	Points	GAPE^
1	EAGLEFIELD CK	207.610	EC12A	✓

Station	Km Point	Points	GAPE [^]
2 EAGLEFIELD CK	204.112	EC7A	✓

[^] Identifies scope relating to the replacement of assets constructed as part of the GAPE infrastructure enhancements.

Scope Comments:

- The design effort on the two turnouts outlined in Table 159 will look to change the turnout mechanism in these locations from the exiting crossing (also known as vee) WHRBM (Welded Heel Rail Bound Manganese) to SNX (Swing Nose crossover).
- The crossing is a static contact point for the train wheels in a turnout and have a typical life under traffic at line speed of 7 to 9 years. The Swing Nose arrangement has proven a more reliable and longer lasting arrangement across the CQCN as it moves under the train opposed to the fixed Vee.
- These turnouts were installed as part of the Goonyella to Abbot Point Expansion in 2012. These locations have exhibited higher than expected wear and damage due to the static contact point.
- These designs were included in the FY22 Approved Strategy and Budget, however, were subsequently deferred to prioritise other turnout designs in FY22.

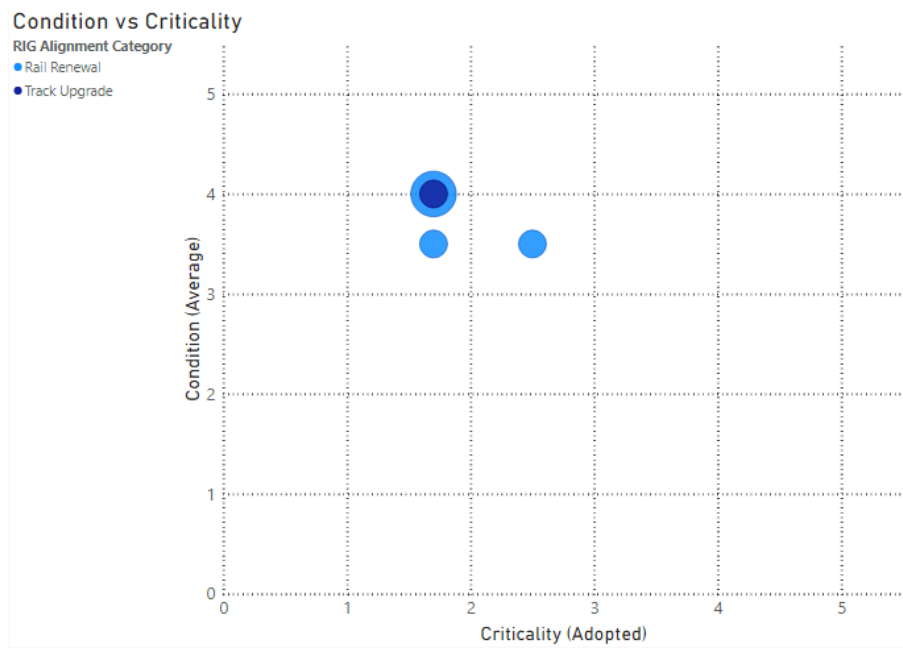
v. **Permanent Way Other**

- Glued Insulated Joints:
 - An amount of \$0.1m for the renewal of defective Glued Insulated Joints (GIJ) has been included in the proposed FY23 scope of works. The renewal of 4-hole GIJ's to 6-hole GIJ's is to improve robustness, resilience and mitigate rail failure points from aged joints. In track sections that utilise axle counters, GIJ are redundant so will be removed prior to failure and renewed with a rail weld.
- Rail Lubrication:
 - There are 16 lubricator units in the Newlands System. Lubricators deploy grease that is picked up by the train wheels and distributed through curves to reduce friction, aiding wheel and rail wear and reducing wheel squeal noise. An allocation of \$0.01m has also been made for fix on fail requirements for the mobile lubrication units.
- Rail Fix on Fail
 - An allocation of \$0.04m has been made for fix on fail requirements for short rail replacement. This small amount of funding covers reactive rail replacements that are not predictable and are over 27 metres long. Typical rail defects in this category are rail burns left by locomotives or rail foot strikes from dragging equipment.

Permanent Way FY23 Scope – Asset Condition and Criticality Assignment

The following graphic plots the permanent way renewals against asset condition and location/operational criticality. As can be seen all planned FY23 renewals are either in an advanced state of wear or degradation.

Figure 76 Permanent Way – FY23 Scope Priority Ratings – Newlands System and GAPE



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic

Permanent Way FY23 Program – Options Considered

In FY23 the permanent way assets identified for renewal have an average condition rating of 3.93, which is at or near the point of renewal identified in the Asset Maintenance and Renewal Policy

The assets in this class degrade in condition based on usage and wear, as such a decision to defer or not do the renewal does not stop the wearing of the asset and the further degradation of condition. Deferral or removal of this scope increases the risk of the asset failing requiring an unplanned rectification. As outlined in Part B, the approach to renewals is to affect an asset renewal ahead of an asset failure to minimise the disruption to the network, reduce the mix of reactive works and maintain system throughput.

Table 160 Permanent Way Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	This scope is typically completed within existing integrated closures. Turnout components and removals are not complete renewals and can be carried out in the shadow of other activities within integrated closures	Low	The renewal or upgrade will provide enhanced system reliability through the avoidance of unplanned outages and re-life the renewed assets. Component renewal will extend the life of assets. Removal of surplus or redundant assets will reduce the associated maintenance costs for the inspection and service of assets.
Defer some of the proposed scope	Deferral of worn components could result in asset failure that requires unplanned rectification and added delay. Given these works are often completed in the shadow of other major tasks or between trains there would be little increase in throughput. Where there is a capacity impact and deferred works are moved to the next	Medium	Deferral of the renewal of worn components can lead to unplanned failure and will need to be renewed in a future year. This option will incur additional ongoing maintenance costs.

Option	Description	Risk of Asset Failure	Impact
	available period any capacity gain through deferral is potentially eroded by having to complete the scope later.		
Do not complete proposed scope	Worn components that are not replaced will eventually result in failure, unplanned rectification, and delays. The benefit of any short-term access reduction is likely to be offset by the impact of future unplanned closures in the event of asset failure.	Medium to High	Failure to renew worn components will lead to unplanned failure. This option will incur additional ongoing maintenance costs.

Options for the delivery of Permanent Way renewals

Always replace both rails	Limited impact on throughput as time taken to replace both rails is minimal within the closure required. Replacing both rails would negate the need to go back to the same site in a future year to replace the other rail The lower rail in a curve wears at a higher rate given the loads are increased on the lower rail due to imperfect balance of speed and cant. That is, trains are travelling at slower speeds than that which the track is canted for. Current practice is to renew the rail closest to the wear limit and assess the other rail to determine its remaining life.		Replacing both rails will have the effect of replacing some rail prematurely in that rail would be replaced that had remaining life. There is an opportunity to cascade this rail to yards and low speed locations but would require freight charges to reposition the rail.
---------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Civil Assets – Ballast Cleaning & Renewals

Ballast Cleaning Renewal Program

In FY23 Aurizon Network proposes to undertake \$4.3m of Ballast Cleaning in the Newlands System and GAPE. Table 161 below summarises the scope and budget for each relevant renewal item.

Table 161 Ballast Cleaning Program – Newlands System and GAPE

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Mainline Undercutting	5.9	Km	3.1	Scope delivery for FY23 assumes the use of both the high production BCM and excavator undercutter.
ii. Turnout Undercutting	3.0	Unit	0.4	Ballast cleaning in turnouts and level crossings or in shorter locations to reinstate the drainage properties of the ballast
iii. Bridge Rollout	230.0	Metres	0.9	Full renewal of ballast on bridge structures to reinstate the drainage properties of the ballast
TOTAL			4.3	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Mainline Undercutting

The FY23 mainline undercutting program will see 5.9Km of scope delivered for a forecast cost of \$3.1m in aggregate. The scope will be delivered using the BCM (C01) and excavator undercutter (C14).

An allowance of mainline undercutting has been added to account for ballast renewal at the lead in and out of the planned turnout undercuts. These areas are highly fouled and difficult to access.

Table 162 Mainline Undercutting – Newlands System and GAPE

Scope	FY23 Scope	Scope Unit	FY23 Budget (\$m)
BCM (C01)	3.6	Track Km	1.7
Mainline Excavator Undercutting (C14)	2.3	Track Km	1.4
TOTAL	5.9		3.1

The location and extent of these works for FY23 are outlined in the following table.

Table 163 Location of Mainline Undercutting – Newlands System and GAPE

Track Section		Start Km	End Km	Length (Km)		GAPE [^]
BRIABA	ALMOOLA	71.400	71.850	0.450	MAINLINE UNDERCUTTING	✗
BRIABA	ALMOOLA	64.832	66.050	1.218	MAINLINE UNDERCUTTING	✓
COLLINSVILLE	COLLINSVILLE	75.603	76.400	0.797	MAINLINE UNDERCUTTING	✗
COLLINSVILLE	MACNAUGHTON JCT	76.602	77.750	1.148	MAINLINE UNDERCUTTING	✗
BINBEE	BINBEE	45.600	45.950	0.350	EXCAVATOR UNDERCUTTING	✗
BUCKLEY	ARMUNA	15.400	15.800	0.400	EXCAVATOR UNDERCUTTING	✗
BINBEE	BINBEE	Adjacent to Two Turnouts		0.253	EXCAVATOR UNDERCUTTING ADJOINING TURNOUT	✓
UNALLOCATED SCOPE				1.290		
TOTAL				5.906		

[^] Identifies scope relating to the replacement of assets constructed as part of the GAPE infrastructure enhancements.

The scope of ballast cleaning is based on the identification of track sections with fouling above the Acceptable Fouling Limit (AFL). The AFL is expressed as a percentage of void contamination (PVC). At a level of over 38% PVC fouling, the ballast draining properties are diminished and the wet weather performance of track is impaired.

Aurizon Network utilises Ground Penetrating Radar (GPR) to determine the level of fouling. The review and analysis of the FY22 GPR run data is currently ongoing. These results will be used along with local condition data from field teams to determine scope for FY24 ballast renewals.

Through the likelihood of change review in the development of the FY23 proposed scope, it was noted that site specific test pit digs had not been completed at the sites identified for Mainline Undercutting. As such the fouling rate

and return rates of ballast are based on the average rates. Prior to works these test pits are dug to better understand the fouling rate on site. A higher fouling rate will result in a less efficient return rate and the possibility that not the full scope can be achieved in the allotted time.

Scope Comments:

- Excavator Undercutting (C14) adjoining turnouts adjacent to 2 turnouts at Binbee are short ballast replacements on the lead in to and out of the planned turnout undercuts. Due to the dynamic forces applied by trains, these locations have an accelerated fouling rate. Historically, Aurizon Network has taken the opportunity to undercut these locations with the excavator during turnout undercuts. In the FY23 Final Draft Proposal, Aurizon Network is presenting this scope as excavator undercutting (C14) for transparency. This unallocated allowance for excavator undercutting (C14) has been reduced by the equivalent amount.
- The 6.1 kilometres of ballast being cleaned in this program and Bridge Rollout scope equates to 1.9% of the total ballast in the Newlands System (316 track Km).
- An unallocated scope of 1.29Km has been added to the FY23 program. This is to react to sites that require ballast cleaning as sites degrade ahead of expectation or present with little notice. In prior years the planned scope was changed to accommodate the fix on fail sites. In FY23, the plan for the identified sites is planned into closures and will not be disrupted in the event of a fix on fail scope site presenting. Rather excavator undercutters or the BCM will be deployed, dependant on the availability of plant and the location of the failed section.

The current mainline scope is based upon data up until the 2020 GPR run and the historical performance of the Newlands system. In 2021, a further GPR run was completed and provides for a further data set to compare against, to determine the rate of coal fouling throughout the CQCN. It is expected that the results of this GPR run will be presented to the Ballast Working Group in the third quarter of FY22.

In FY22, Aurizon Network, along with members of the Rail Industry Group and rollingstock operators, have established the Ballast Working Group to investigate, quantify and implement options for mitigating coal entering the ballast. The Ballast Working Group also continues to discuss the efficient delivery of the current ballast cleaning task across the CQCN.

ii. Turnout Undercutting

Aurizon Network expects to undercut 3 turnouts via the excavator undercutter in FY23. The location of these works for FY23 are outlined in the following table. Due to the level of unpredictability of turnout ballast performance at the current planning horizon, one turnout has been allocated for reactive turnout undercutting.

Table 164 Turnout Undercutting Locations – Newlands System and GAPE

	Turnout Location	Point	GAPE [^]
1	BINBEE	44.453	✓
2	BINBEE	46.215	✓
3	Reactive Turnout	-	-

[^] Identifies scope relating to the replacement of assets constructed as part of the GAPE infrastructure enhancements.

iii. Bridge Rollout

The proposed FY23 program for bridge rollouts in the Newlands System and GAPE is 1 bridge for a total of 230 metres. The location and extent of the work for FY23 are outlined in the following table.

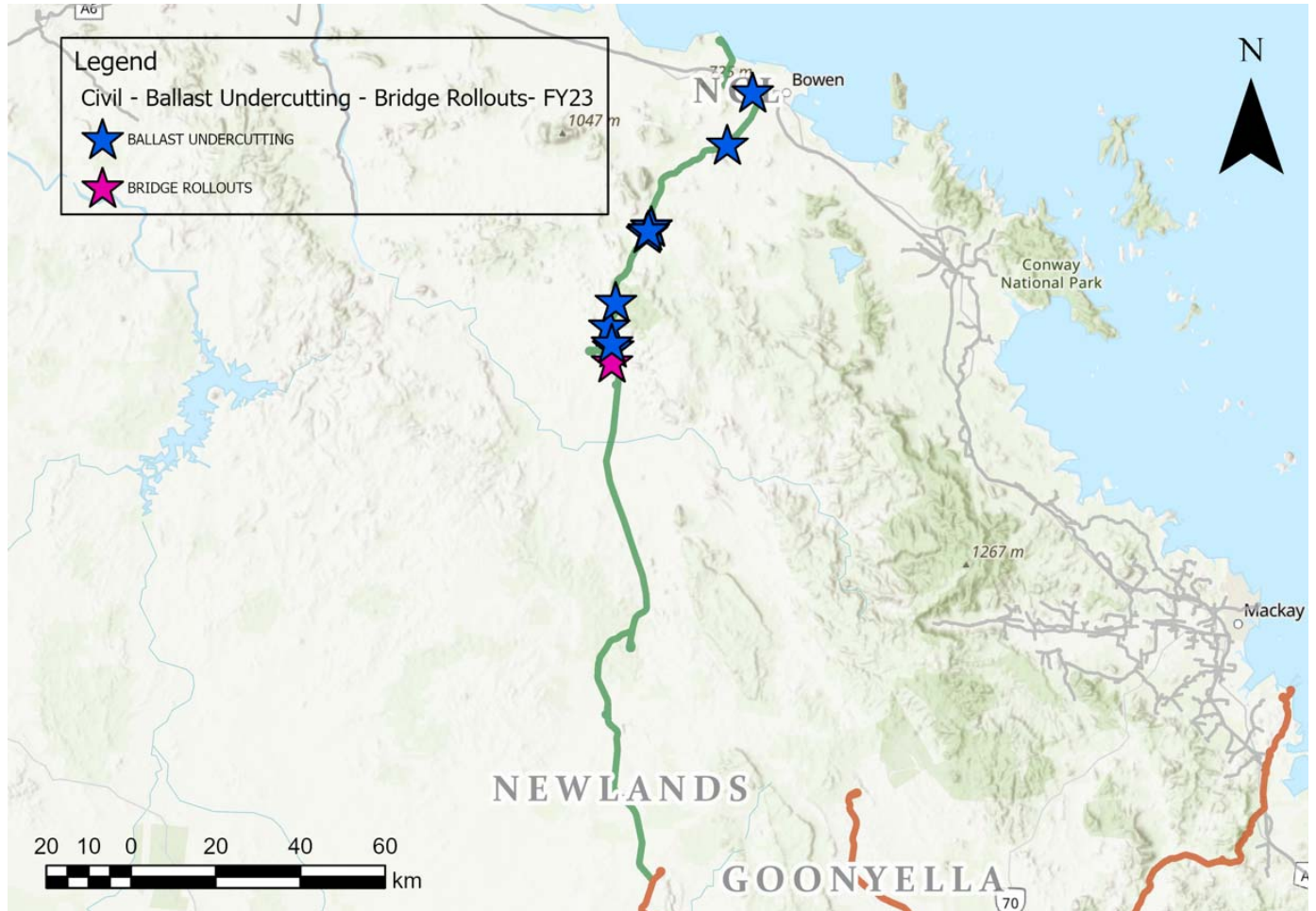
Table 165 Location of Bridge Rollout – Newlands System and GAPE

Start Station	Start Km	End Km	Length (metres)
Bridge 80.430Km CESA Pelican Creek	80.210	80.440	230

Scope comments:

- This is one of the longer bridges on the Newlands System, which both due to height above the ground and length is difficult to maintain due to access and fall risks. Given the size of the bridge, long-term planning is required to secure resources and adequate track closure times.
- The ballast on this bridge was last renewed in 2012. Coal fouling is now impacting the ballast drainage properties and leading to poor track geometry.
- When the bridge was renewed in 2012 the ballast utilised was of a smaller particle size than standard and was utilised under an Engineering Derogation for Standard. Ballast is a manufactured rock product from natural sources, as such there is variability between quarries.
- The smaller particle size when recorded by the GPR since 2016 has shown this bridge to have moderate to severe fouling levels across the bridge.
- Aurizon Network uses GPR as an asset condition information source coupled with track section defect occurrence and local maintainer section knowledge to determine renewals.
- The reliability of the bridge has been monitored through maintenance effort, for example; maintenance teams replaced a small section of ballast in 2017 to extend the life of the bridge ballast asset. The bridge has undergone resurfacing and occasional crib ballast replacement between 2017 to 2021. The maintenance free period of this bridge, 2012 to 2016 is shorter than expected. Due to the length and height of the bridge, it has poor maintainability and higher dynamic forces which is the likely cause of the deterioration.

Figure 77 Ballast Cleaning & Bridge Rollout Sites - Newlands System and GAPE FY23



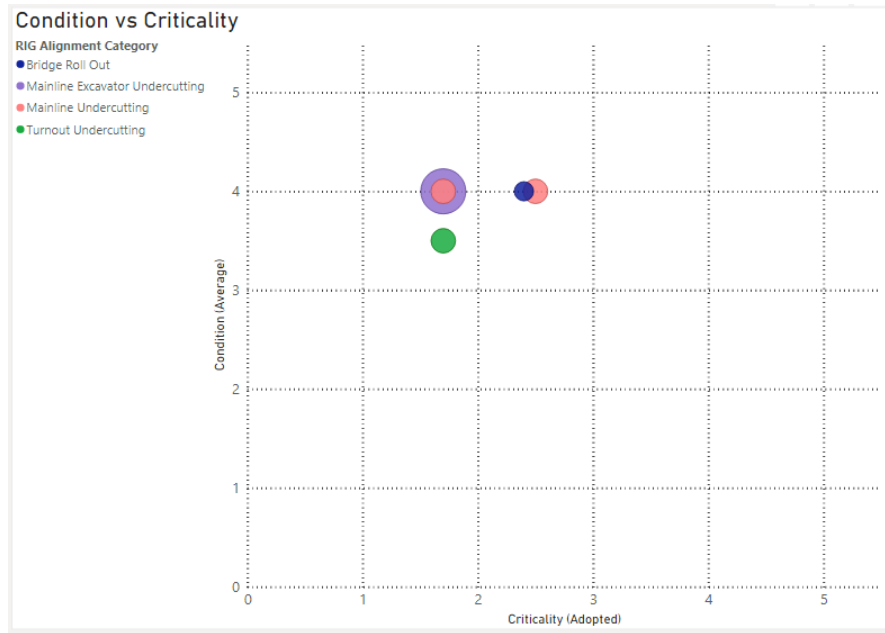
Ground Penetrating Radar

Given the general condition and current understanding of ballast with regards to fouling rates, there is no requirement to include the Newlands System and GAPE in the FY23 GPR inspection that will occur in other coal systems. A reassessment of data quality and asset performance will be performed for consideration of a FY24 GPR survey.

Ballast Cleaning FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots ballast renewals against asset condition and location/ operational criticality. This illustrates that all identified scope has a current condition of 3.5 or above with advanced fouling and will degrade further without intervention.

Figure 78 Ballast Cleaning – FY23 Scope Priority Ratings – Newlands System and GAPE



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Ballast Cleaning FY23 Program - Options Considered

Failure to remove fouling from the ballast results in drainage issues that affect formation condition resulting in track alignment defects. These defects manifest as temporary speed restrictions in place until a track resurfacing or track tamping is conducted as part of the General Maintenance activity. Therefore, the options of deferring or not completing ballast cleaning works on identified locations, increases the risk of these track alignment defects propagating.

Other options are available in the delivery of the undercutting process and are assessed for the cost of doing the alternate activity and the time required to complete against the long-term asset condition benefits.

Table 166 Ballast Cleaning Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	Proposed scope has been in the system-wide planning process to balance system throughput with scope requirements.	Low	All identified scope has a current condition of 3 or above with advanced fouling and will degrade further without intervention. The Risk of Asset Failure categorisation is somewhat subjective but has been assessed based on the proposed and planned scope and available data at the time of preparation. The cleaning of each site as per the proposed plan will remove the most fouled locations whilst balancing production rates and track time of the undercutting activities against throughput capacity demand.

Option	Description	Risk of Asset Failure	Impact
Defer some of the proposed scope	<p>Deferral of works will push requirement into future years with ballast condition becoming more fouled in deferred locations.</p> <p>Some throughput would be returned to the supply chain, where ballast cleaning is the critical scope for possessions, but this would be eroded by operational restrictions and unplanned delays caused by degraded ballast condition</p>	Medium	<p>Locations identified for cleaning are already at a high level of fouling. Deferral will see condition worsen resulting in increased reactive maintenance and increased TSRs ahead of possible unplanned full replacements.</p> <p>The condition could worsen through the development of mud-holes and compromised track geometry, leading to speed restrictions.</p>
Do not complete proposed scope	Not completing the scope will see the ballast continue to foul and the associated impacts increase. This will lead to unplanned outages and delays that will reduce system capacity at the planned renewal sites	Medium	Locations identified for cleaning are already at a high level of fouling. Not completing the works will see condition worsen, resulting in increased reactive maintenance and increased TSRs ahead of possible unplanned full replacements.

Options for the Delivery of Ballast Cleaning

Move to 100% ballast replacement	This option would result in a slightly higher production rate of the mainline undercutter as ballast would no longer be screened and returned. It would require additional ballast at undercut sites with additional ballast train (work train) hauls to deliver or stockpile the ballast.		<p>The mainline undercutter consist includes several ballast spoil wagons but these would be filled quickly, and the rest of the ballast would be ejected to track side to be stockpiled for future removal. The increase in ballast spoil management is not accounted for in the ballast cleaning unit rates, and therefore would cause an increase in cost.</p> <p>Failing to remove spoil from the corridor or stockpiling adjacent to the track can create drainage, access and maintenance issues.</p>
Slab track all bridges to reduce Bridge ballast replacement	<p>Slab track design and installation is both expensive and time consuming to execute. It will however eliminate the need to renew ballast on bridge decks and has positive capacity benefits in the long-term due to reduced renewal and maintenance activity.</p> <p>Aurizon Network has installed Slab Track on the Cooling channel bridge in Gladstone and continues to look at this as an option for other critical bridges.</p>		If the bridge and/or slab track infrastructure is structurally damaged through derailment or bridge strike (e.g., from an over-height vehicle), the ability to recover from such an event is heavily compromised and would require new reconstruction techniques and stocks of large inventory items (e.g., slab track panels or bridge girders)
Shoulder Cleaning	Shoulder cleaning would provide, in the short-term reduced throughput impact to execute work (i.e., higher production in a given time) and in the medium-term risk to throughput impacts due to potential TSRs from ballast fouling immediately beneath track.		Shoulder cleaning has been shown to provide short-term benefits however the intervention thresholds are very narrow, intervening too soon may result in benefits not being realised, whilst intervening too late will result in wasted effort and loss of capacity due to the need to execute a full undercut and the likely imposition of TSR's to manage the short-term geometry degradation.
Cleaning of turnouts using a Vacuum Truck	Vacuums of turnouts is appropriate in certain areas. It remains a slow process and in areas of high fouling is used to manage the otherwise high likelihood that components will be unable to be		Vacuums of turnouts does not address the underlying level of fouling and will not negate the need to undercut ballast in turnouts but rather ensure that components are able to be

Option	Description	Risk of Asset Failure	Impact
	inspected and unplanned failure rates will increase.		<p>inspected and remain lubricated and functional.</p> <p>Aurizon Network is aware of Plasser's and other vacuum-based technologies which include on-track vacuum machines, with the ability to remove all fouled ballast, and off-track vacuum trucks which do not have this capability and, therefore, can only manage surface contamination. Aurizon Network does make use of off-track vacuum-trucks to manage heavy surface fouling at critical locations.</p> <p>Enquires in relation to this technology identified that a bespoke on-track machine would likely need to be designed and manufactured for Aurizon Network's narrow gauge railway, requiring investment in new plant. Aurizon Network also understands that the production rates of vacuum machines are lower than excavator undercutters. On-track machines will also face constraints such as the ability to store the necessary spoil.</p> <p>Essentially, use of such a machine would result in increased cost (investment in new plant either Network-owned, Leased or Contracted Machines and Labour) for a negligible change in production rate relative to the existing excavator undercutter approach.</p>

Civil Assets - Structures Renewals

Structures Renewal Program

The Newlands System and GAPE has a total of 50 bridges and 664 culverts which are designed to allow the natural flow of water through the rail network. In FY23 Aurizon Network proposes to undertake \$5.2m of structures renewal works in the Newlands System and GAPE. The location and extent of these works for FY23 are outlined in the following table.

Table 167 Structures Renewal Program – Newlands System and GAPE

Renewal Item	FY23 Scope	Scope Units	FY23 Budget (\$m)	Comments
i. Bridges	3.0	Bridges	4.4	Upgrade of 3 Short Span bridges currently holding long term speed restrictions.
ii. Culvert Renewal	1.0	Site	0.5	Equates to 0.1% of culverts in the Newlands System.
iii. Culvert Design	6.0	Sites	0.3	Release of design packages for identified sites to be renewed in future years
TOTAL			5.2	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Bridges

Aurizon Network proposes to undertake renewals or repairs of 3 bridges in the Newlands System as part of its FY23 Final Draft Proposal.

There are 10 short span bridges on the Newlands System between the 16.200 and 6.600 point with long-term speed restrictions in place, (5Km at 40kph and 4.6Km at 50kph). These restrictions are in place to manage the asset condition and allow current rollingstock configurations to safely traverse these bridges. Of the three bridges programmed for renewal in FY23, 2 are condition state 3.5 and one condition 3.0.

The renewal of the proposed structures in FY23 is part of the multi-year approach to address the underlying asset condition and remove the long-term speed restrictions by FY26.

The bridge at 11.320 is the worst regarding condition (Condition 3.5) amongst the 10 with advanced pier degradation. The bridges at the 6.640 (Condition 3) and 6.700 (Condition 3.5) will allow for the current operating restrictions to be reduced by 50% (restriction length).

A driver to renew these structures is strategic, to improve asset condition and allow the removal of long-term speed restrictions. This will enable an improvement to cycle times by returning the track section to normal operating speed of 80kph.

Based on high level information supplied by the Aurizon Network Planning and Scheduling team, in these sections there is a theoretical improvement that loaded trains will take half the current time to get through these sections once all speed restrictions are removed. The restrictions are boarded speed restrictions to loaded trains for two sections of the track 16.2- 12.2km (40kph) and 6.7km (50kph) for the two bridges in this location.

The benefit of doing the two bridges at Sandy Creek near the 6.7km in FY23 is that this 50 kph speed restriction can be removed in FY23 once both bridges have been replaced. Improvements to the performance of the rail infrastructure can be realised more quickly by doing these two bridges first.

The strategy is to reduce the restricted section from the north to south over the next 4 financial years by replacing the short span bridges with large unicell box culverts.

This work will also minimise potential track washouts because of removing the existing propping (which serves to catch debris and blocks the waterway) and importantly, minimises the likelihood of flooding upstream properties.

Table 168 Bridge Renewals – Newlands System and GAPE

Location	Start Km
Bridge 11.320Km Dinner Creek	11.320
Bridge 6.640Km Sandy Creek	6.640
Bridge 6.700Km Sandy Creek	6.700

Scope comments:

- These 3 bridges are currently holding speed restriction to manage the risks associated with the bridge carrying loads above the original design rating. The completion of this scope and the remaining 6 similar bridges in future financial years will result in the TSR being removed.
- The bridge renewals have indicative estimates based on construction experience and prior similar work completed on the network. The sites will have detailed design completed during FY22. Once this is completed the works will be put to tender and a bottom-up estimate finalised. Any change because of the detailed estimate will be addressed through the change management process.

- The 3 bridges being renewed in this program equate to 6% of the total number of bridges in the Newlands System (50 bridges).

ii. Culvert Renewals

The culverts used in the railway are typical of concrete culverts and corrugated metal pipes used in civil construction and maintenance in other heavy civil uses (roads, mines, airport runways etc). Given this, the design activity for culvert renewals is outsourced to design houses with demonstrated experience in site specific design matching standard units to local conditions to achieve the required hydrology functionality.

In FY23, one culvert renewal is proposed in the following location:

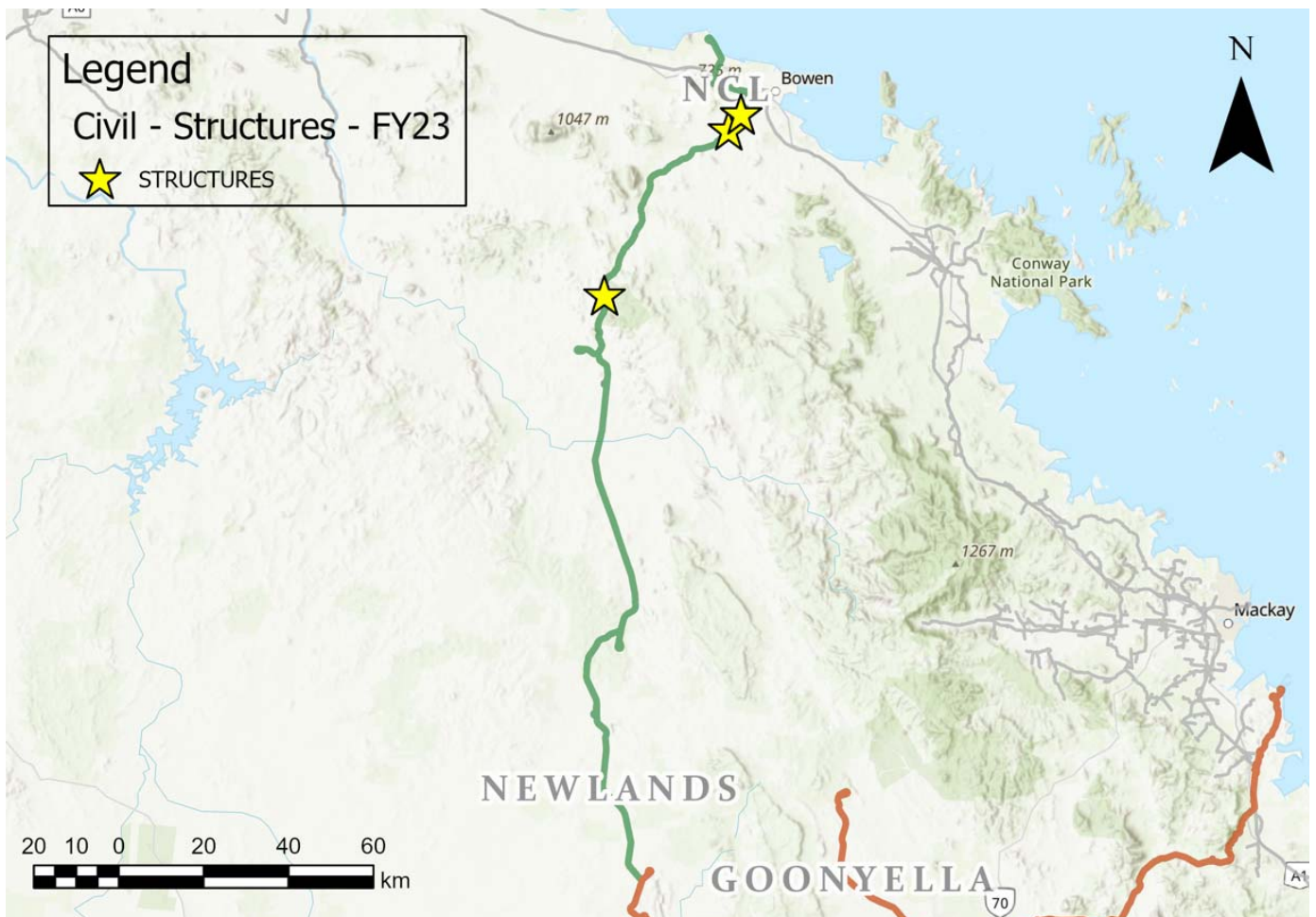
Table 169 Culvert Renewals – Newlands System and GAPE

Culvert Renewal Location		Km Point
1	Culvert 63.650Km BAAL Unknown	BRIABA-ALMOOLA 63.650

Scope comments:

- The proposed scope relates to the removal and replacement of a failed and degraded concrete culvert.
- This culvert being renewed in this program equates to 0.1% of the total culverts in the Newlands System (664 culverts).

Figure 79 Structures Renewal Sites Newlands System and GAPE FY23



iii. Structures Design

Aurizon Network also proposes to undertake culvert design works at 2 locations and bridge design at 4 locations in the Newlands System for future years construction. The location of the culvert is outlined in the table below.

Table 170 FY23 Culvert Design Scope Location – Newlands System and GAPE

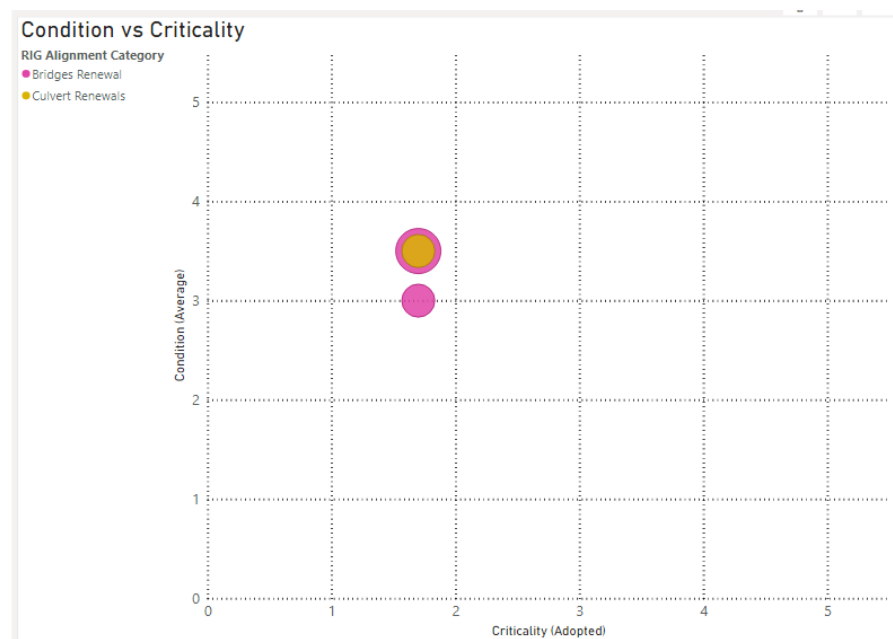
	Culvert Design Location	Km Point	For Renewal
1	BRIABA-ALMOOLA	62.180	FY24
2	DEP RD MCNAUGHTON MINE	85.350	FY24
	Bridge Design Locations	Km Point	For Renewal
1	BUCKLEY	12.200	FY24
2	BUCKLEY	12.230	FY24
3	BUCKLEY	13.510	FY25
4	BUCKLEY	14.050	FY25

The four bridge renewals being designed are a continuation of the removal of short span bridges holding long term speed restrictions.

Structures FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Structures against asset condition and location/ operational criticality. As can be seen all planned FY23 renewals have poor to near end of life condition with an average condition for the FY23 program of 3.6.

Figure 80 Structures – FY23 Scope Priority Ratings – Newlands System and GAPE



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Structures FY23 Program – Options Considered

All the structures in the proposed FY23 scope are condition rating 3.5. As such they are at or near a condition state that the next condition will be asset failure. As such deferral or not completing the scope introduces a higher risk of asset failure that would require an unplanned intervention to correct.

Table 171 Structures Renewal Program Options

Option	Description	Risk of Asset Failure	Impact
Complete the proposed scope	<p>Renewing in a planned manner allows for optimal access planning and track occupancy for the required renewal works.</p> <p>Where applicable Aurizon Network sleeves pipe culverts so the renewal works can occur under traffic not requiring a possession.</p> <p>Renewing in a planned manner allows for optimal access planning and track occupancy for the required renewal works.</p> <p>Where appropriate Aurizon Network seeks to sleeve pipe culverts so the renewal works can occur under traffic not requiring an extended track possession.</p>	Low	In order to renew a culvert or upgrade an element of the culvert, as is the scope in FY23, the culvert is required to be in good alignment, and not heavily deformed and out of shape. The planned culvert renewal in FY23 is currently in a condition that the proposed scope is achievable. Culverts that present as a risk, either structurally or hydraulically, create impacts which include load and speed restrictions and a higher likelihood of track washouts respectively,
Defer some of the proposed scope	Deferral will push the renewal requirement to a future year and increase the risk of failure during the period of extension.	Medium	<p>Deferral of renewal of worn components can lead to unplanned failure.</p> <p>Deferral can see further alignment degradation negating the opportunity for lining of pipes or element upgrades.</p>
Do not complete proposed scope	Failure to renew planned scope will leave faulty structures that if not treated will fail in the near term and effect the alignment of the railway such that emergency possessions will be required to remedy or a TSR would be required until a renewal could be planned.	High	Failure to renew worn components will lead to unplanned failure and increase derailment risk related to track misalignment at defective structure sites. The loss of hydraulic capacity of the culvert during the wet season could cause the track to washout.

Civil Assets - Civil Renewals

Civil Assets Renewal Program

In FY23 Aurizon Network proposes to undertake \$4.2m in renewals for these assets. Table 172 below summarises the scope and budget for each relevant renewal item.

Table 172 Civil Assets Renewal Program – Newlands System and GAPE

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Comments
i. Formation Renewal	1.0	Km	2.3	Equates to 0.3% of formation length.
i. Formation Reactive		Fix on Fail	0.5	Fix on fail scope allocation to accommodate formation that fails in a yet to be known location
ii. Level Crossing Renewals	2.0	Sites	0.8	Equates to 2.1% of level crossings in Newlands
ii. Level Crossing Other		Fix on Fail	0.2	Fix on fail scope allocation to accommodate level crossing elements that fail or reduce the safety of the road rail interface
iii. Access Roads & Access Points		Fix on Fail	0.2	Fix on fail to reinstate access roads and Corridor Access Points that are below standard due to local conditions or degradation
iv. Corridor Fencing & Security		Fix on Fail	0.2	Fix on fail allocation to reinstate required corridor fencing to separate the rail corridor from neighbouring land.
TOTAL			4.2	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

i. Formation

The location and extent of these works for FY23 are outlined in the following table.

Table 173 FY23 Formation Scope Locations – Newlands System and GAPE

Location		Start Km	End Km	Distance (Km's)
MCNAUGHTON JCT	SONOMA	79.260	79.900	0.650
PRING	PRING	5.500	5.865	0.365
TOTAL				1.015

Scope comments:

- The McNaughton Junction site is located within a cutting with minimal grade, meaning that drainage is constrained laterally by the rock face and the rainwater does not drain freely out of the cutting. The formation and ballast in the cutting remain wet for long periods of time which leads to a deterioration in track geometry and the necessary imposition of temporary speed restrictions
- The Pring location is on a section of poor subgrade soil that holds moisture and takes a long period to dry out that has resulted in several track alignment defects in the last 3 years
- Soil and geotechnical studies will be completed to determine the level of unsuitable material. Nearby formation renewal information has been utilised to facilitate estimates prior to soil testing.
- Estimated time to complete works, scope, and cost subject to minor change from current proposal based on soil testing results. Effect could be negative or positive.
- Studies to be completed by February 2022.
- The 1.015 kilometres of formation renewal in this program equates to 0.3% of the total formation in the Newlands System (316 track Km).

An allocation of \$0.5m has been made for fix on fail formation sites in Newlands.

- Each site is identified by the local Track Inspection staff in response to deteriorating condition and derailment risk. The formation renewal is validated by local Engineering via root cause analysis. A site estimate is developed and draws down of the fix on fail allocation.

ii. Level Crossing

There are 94 level crossings in the Newlands System and GAPE. Crossings with active protection require coordination into the localised signalling system and therefore require a level of design works.

The location and extent of these works for FY23 are outlined in the following table.

Table 174 FY23 Level Crossing Renewals – Newlands System and GAPE

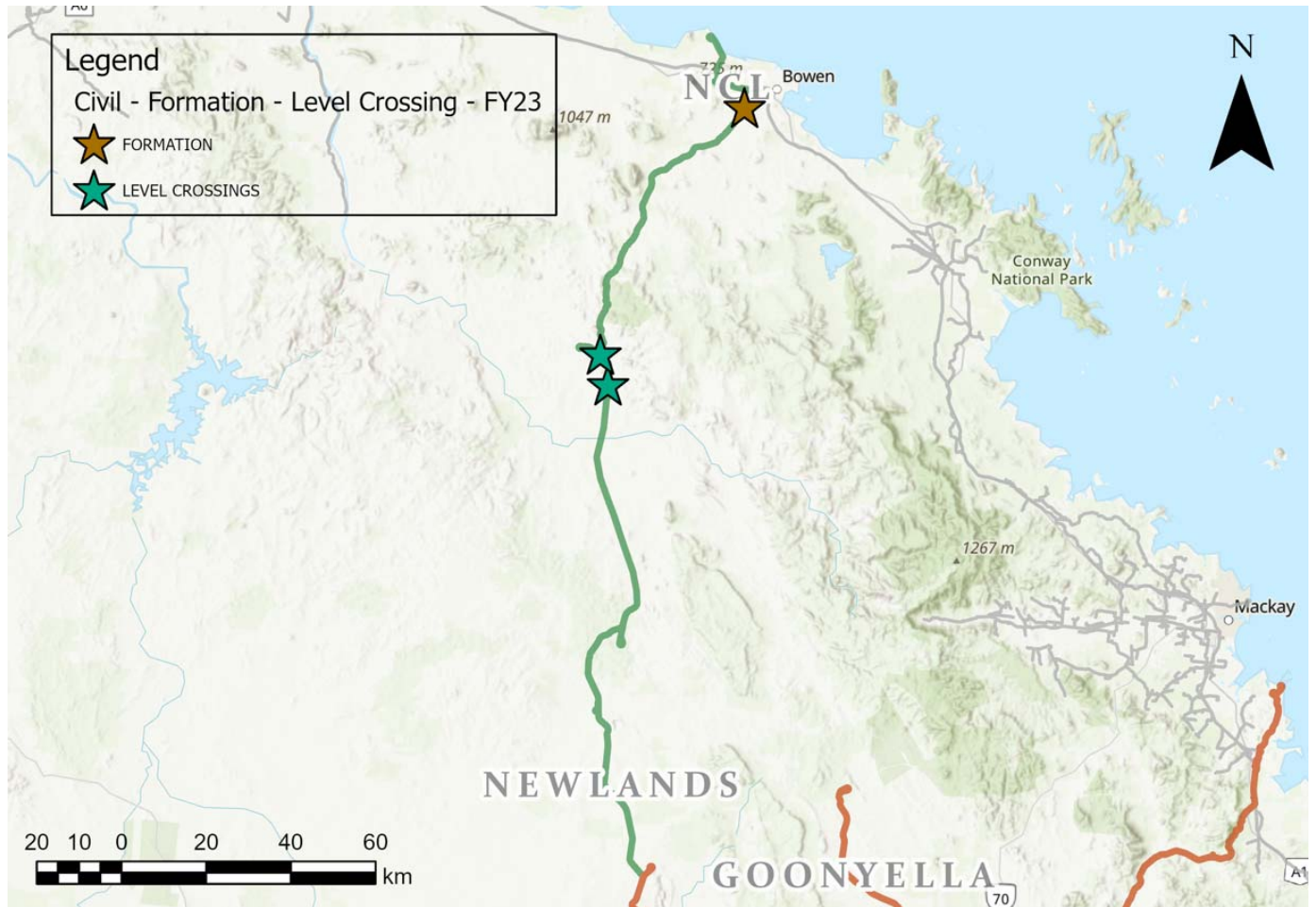
Scope	Location	Km point
MAJOR RENEWAL	LX3303.79.255KM Corduroy Creek Road	79.255
MAJOR RENEWAL	LX3310.87.250KM Sonoma Mine Access Rd	87.250

Scope comment:

- The upgrade at both sites relates to the rebuild of the track section through the crossing. This includes removal of existing track structure, formation rebuild, rail replacement and road resurfacing.
- Both crossings are currently protected with flashing lights, no upgrade to the active protection is proposed in FY23.

An allocation of \$0.150m has also been made for fix on fail or unplanned safety upgrades for level crossings in the Newlands System and GAPE.

Figure 81 Formation & Level Crossing Renewal Sites Newlands FY23



iii. Access Points and Access Roads

There are also 685km of rail access roads in the Newlands system and GAPE that provide passage along the rail corridor. They are utilised by maintenance and rail operations staff to access the rail corridor.

Corridor access points are locations where Train Crew and Aurizon Network workers and contract staff need to leave the public road network to access the rail corridor. These access points are turnoffs that intersect with public and private roads. “Drive to stay alive” is a critical safety commitment in the Aurizon Network business and ensuring safe access to the public road system from the rail corridor is part of the treatment of this risk.

There are approximately 800 known access points across the Newlands System and GAPE. Corridor access points are locations where Train Crew and Aurizon Network workers and contract staff need to leave the public road network to access the rail corridor. In Newlands the railway and the road network are quite aligned for most of the network except for the Newlands Junction to North Goonyella section. As such these turnoffs include turns at formed intersection and undefined turnoffs. These undefined or un-engineered turn off pose a significant risk. Aurizon Network has been working with local road authorities (DTMR & local Council) to better sign access points. A focus is to progressively eliminate unsafe or high-risk access points and to better define and identify the controlled access points.

Access Points Scope Comments:

- With the completion of access point upgrade and removals in past financial years, there is no planned scope for access point upgrades or removals in FY23, if a site becomes a safety concern it will be managed via change process.

Access Roads Scope Comments:

- Access Roads – an allocation of \$0.2m has been proposed for fix on fail access road works.
- Access roads deteriorate from rain events, heavy vehicle usage and general wear and tear. These sections are renewed by improving road surface condition, drainage paths and access road alignments to reduce maintenance and improve response time for train operations.

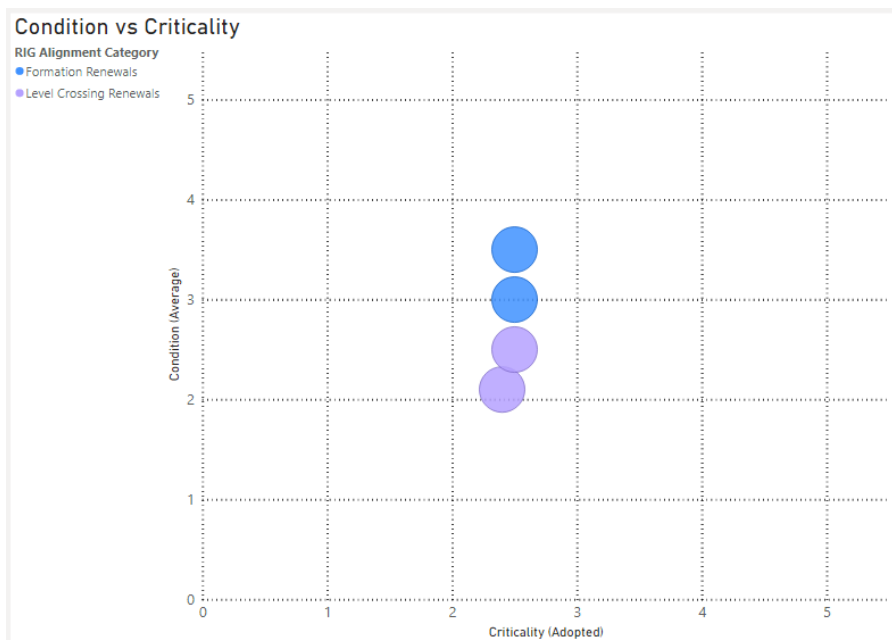
iv. Corridor Fencing and Security

There is 211Km of fencing in the Newlands System and GAPE. An allocation for fix on fail fencing has been made in the FY23 program of \$0.2m. Consistent with previous years, this will be allocated to address failed fencing in locations as identified by the local delivery teams or via Aurizon Network’s Community Engagement team in consultation with neighbouring land holders.

Civil Renewals FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the civil renewals against asset condition and location/ operational criticality. The condition of the two planned formation scopes is demonstrating a compromised performance through track geometry defects, this is being managed by mechanised resurfacing to mitigate TSRs.

Figure 82 Civil Renewals – FY23 Scope Priority Ratings – Newlands System and GAPE



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Civil Renewals FY23 Program - Options Considered

All the proposed FY23 Civil Assets scope, other than level crossings, is condition rating 3 or above. Not actioning these assets will increase the risk of asset failure leading to a requirement for an unplanned rectification. Level crossing renewals are selected due to asset condition and safety improvement opportunities

Not addressing formation requirements will result in additional track resurfacing requirements to maintain track alignment and avoid temporary speed or operating restrictions.

Level crossing and corridor access points are safety related upgrades to maintain the safety of Aurizon Network staff and the public.

Table 175 Civil Renewal Program Options

Option	Description	Residual Asset Risk	Impact
Complete the proposed scope	Formation renewals treat formation sections that have failed and are causing track alignment issues leading to speed restrictions and the need to complete resurfacing works. Completing the scope at these locations addresses the underlying formation issue avoiding future operational delays.	Low	Completing the scope will maintain the assets performance across these asset classes. Formation failure is a root cause defect which is treated by speed restrictions and resurfacing. Renewing the formation will remove the need to apply a speed restriction or increased resurfacing activities at the renewed site.
Defer some of the proposed scope	Deferral of identified scope could result in failure that requires unplanned rectification and added delay. Deferral of formation works will result in additional track resurfacing activity at these sites to restore track geometry and associated operational delays.	Medium	Failure to renew aged assets can lead to unplanned failure and speed restrictions.
Do not complete proposed scope	Not completing the scope will result in unplanned outages when these assets fail or require an extended period to rectify from faults.	High	Failure to renew the formation can lead to unplanned failure and speed restriction.

Options in the Delivery of Formation Works

Formation – Lime Slurry Injection	Aurizon Network has in the past used the injection of lime slurry that hardens to fill voids that were identified in the formation with some success.	Medium	Lime slurry injection only treats the visible issues, given the issues are mostly not visible it has only a limited effect in the short term. The more efficient process is to re-life the asset by removal and rebuild.
-----------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------	--------	--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Level crossing renewals and upgrades are proposed to maintain or increase the safety of the road rail interfaces at level crossings. Failure to complete the proposed scope will either retain a poor road condition or fail to increase the passive or active protection at these sites to the required condition.

Control Systems Assets

Control Systems Renewal Program

In FY23 Aurizon Network proposes to undertake \$3.7m of Control Systems renewals or enhancements in the Newlands System and GAPE. Table 176 below summarises the scope and budget for each relevant renewal item.

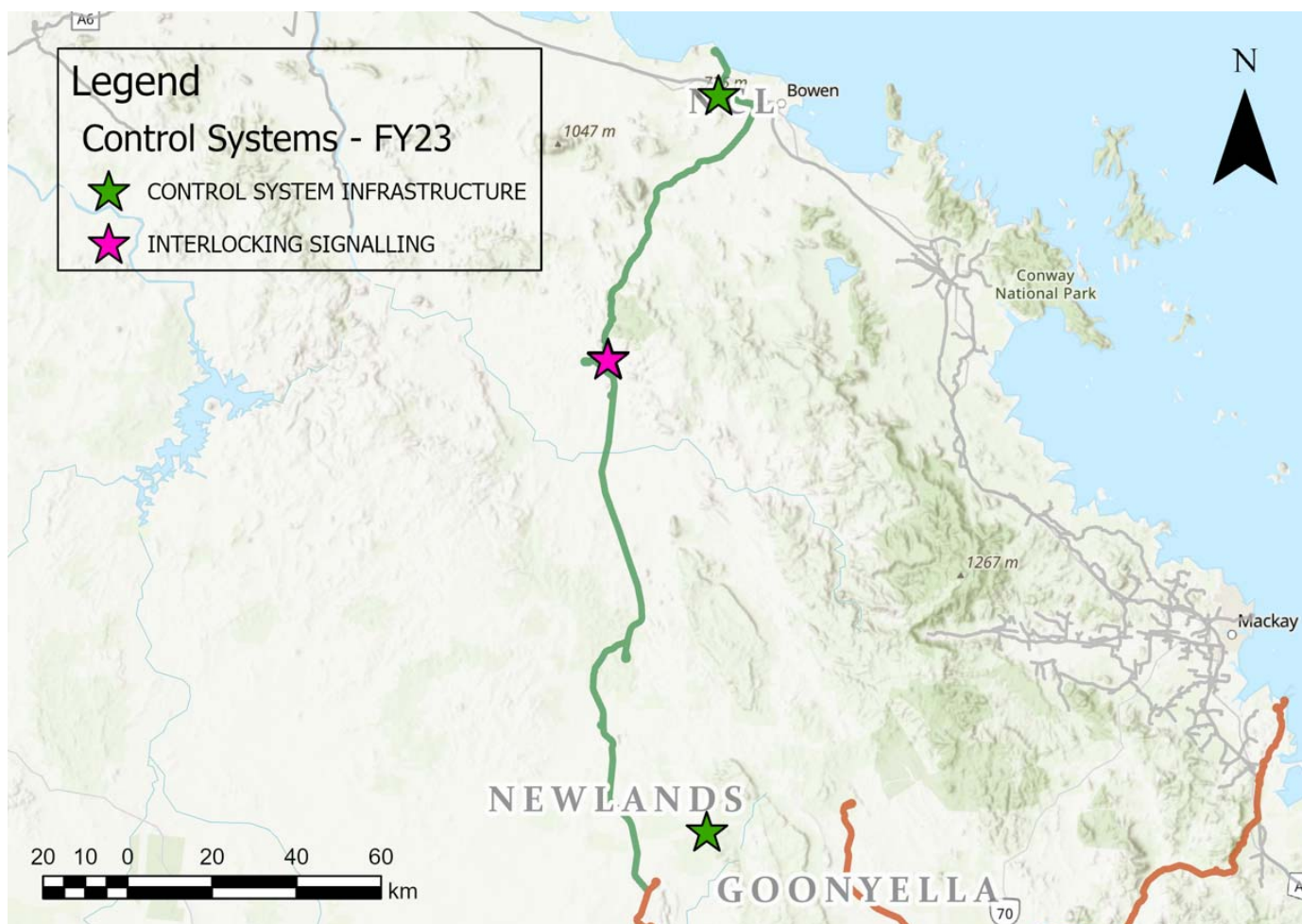
Table 176 Control Systems Program – Newlands System and GAPE

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
i. Safeworking Systems – Interlockings	1.0	Sites	1.3	Interlockings are an arrangement of signal apparatus that prevents conflicting movements through a track section, they form the critical decision and safety system for the rail signalling.
ii. Safeworking Systems – Minor		Unit	0.01	Upgrade of the Newlands System contribution to IAMPS (Centralised Application for providing alarms

Renewal Item	FY23 Scope	Scope Unit	FY23 Budget (\$m)	Description
				to Network Train Controller via UTC & advisory alarms for FCC checking and action)
iv. Transmission & Data Renewal	56.0	Sites	1.9	Back-up power supplies and Corridor Equipment Room (CER) Renewal
v. UTC/DTC Systems Upgrades	1.0	Sites	0.3	Upgrades for the train control system
vi. Other Control Systems Renewals		Sites	0.2	Design costs associated with Power Resilience and Interlockings. There is also an amount for items that fail unpredictably within the FY.
TOTAL			3.7	

The remainder of this section provides further details of the specific scope that Aurizon Network proposes delivering during the period.

Figure 83 FY23 Control Systems Renewals



i. Safeworking Systems – Interlocking Upgrades

There are 22 interlockings in the Newlands system and GAPE. The signalling system, including interlockings, in the Newlands system went through a modernisation as part of the GAPE project in 2012. Several systems original Relay Based Interlockings still remain in the population. The proposed interlocking scope in Newlands and GAPE in FY23 is to renew one of the remaining 2 relay based interlockings with a processor based interlocking. The final relay-based interlocking at McNaughton is planned for renewal in FY25.

The location and extent of these works for FY23 are outlined in the following table.

Table 177 Interlocking Upgrades – Newlands System and GAPE

Scope	Location	Qty	Unit
RELAY INTERLOCKING TO PBI	COLLINSVILLE	1	STATION

Scope comments:

- This interlocking was installed in 1990. A relay-based interlocking is reliant on the safe and reliable operation of electro-mechanical relays which have an operational life, depending on usage of between 20 to 40 years
- When a relay fails it is typically replaced with a spare. The relay components of these units are no longer supported by the vendor and critical spares are reducing
- A replacement with a processor-based interlocking minimises closure time need to commission the interlocking on site and provides a cost effective renewal. Combining with Power System renewal and monitoring feature of processor-based interlockings improve remote diagnosis and availability of interlocking

ii. Safeworking Systems – Minor

The FY23 program is an upgrade to the Integrated Asset Monitoring & Protection system. The system consolidates alarms from multiple wayside protection systems to present to Train Controller via the Universal Traffic Control (UTC) system. Scope is various minor updates.

Table 178 Minor Safeworking System Renewals – Newlands System and GAPE

Scope	Description	Qty	Unit
IAMPS	Integrated Asset Monitoring and Protection System - consolidates alarms from multiple systems to present to UTC. Scope is various minor updates.	1	UNIT

iii. Transmission & Data Network Renewals

Transmission & Data Networks consist of:

- Control Systems Infrastructure – the physical buildings, towers and equipment rooms that support the Control Systems assets
- Transmission – digital and microwave radio systems
- Data Network - the infrastructure and electronics required to provide the data network across the CQCN

In FY23, Aurizon Network proposes to undertake \$1.9m of asset renewals in the Newlands System and GAPE for Transmission & Data Network renewals. The location and extent of these works for FY23 are outlined in the following tables.

Table 179 Control Systems Infrastructure Renewal – Newlands System and GAPE

Scope	Qty	Unit	Location
CONTROL SYSTEMS INFRASTRUCUTRE			
1	EQUIPMENT ROOM REPLACEMENT	1	SITE KAILI

Scope	Qty	Unit	Location	
2	DEHYDRATOR		1	SITE BOVEY'S LOOKOUT
3	DEHYDRATOR AND RADOME		3	SITE SUMMER HILL
4	GENERATOR		1	SITE COLLINSVILLE
5	BATTERY BANK UPGRADE		2	SITE
DATA NETWORK RENEWALS				
1	ROUTERS SWITCHES FIREWALLS		44	UNIT Various
TRANSMISSION RENEWALS				
1	NMS		1	SYSTEM
2	SDH TO IP		1	SYSTEM
3	TETRA SYSTEM		1	SITE
4	TRANSMISSION – TETRA CYBER SECURITY UPGRADE		1	SYSTEM SYSTEMWIDE

Scope comments:

- Infrastructure – equipment buildings that house signalling equipment are air conditioned to maintain equipment operating temperatures and have back up power supplies. The infrastructure scope in FY23 is:
 - Renewal or air conditioning hydrators Bovey's Lookout and Summer Hill
 - Renewal of track side equipment room at Kali
 - Renew the backup power battery bank and generators at two sites.
- Data Network – replace 44 life expired data communications switches used for operating signalling and radio network
- Transmission – the FY23 scope is for the upgrade of TETRA radio bases, batteries, generator and contribution to Network Management System, and cyber security upgrade for the TETRA radio system.

iv. UTC/DTC Systems Renewals

In FY23 Aurizon Network proposes to undertake \$1.0m of asset renewals in the Newlands System and GAPE Universal Traffic Control (UTC) systems. This includes in field digital modernisation of the life expired analogue telemetry that receives the control message via the train control system and safety and application enhancements to the UTC system. These upgrades are scope prioritised by the Train Control team to improve the safety functions of UTC or to reduce potential scheduling and process errors.

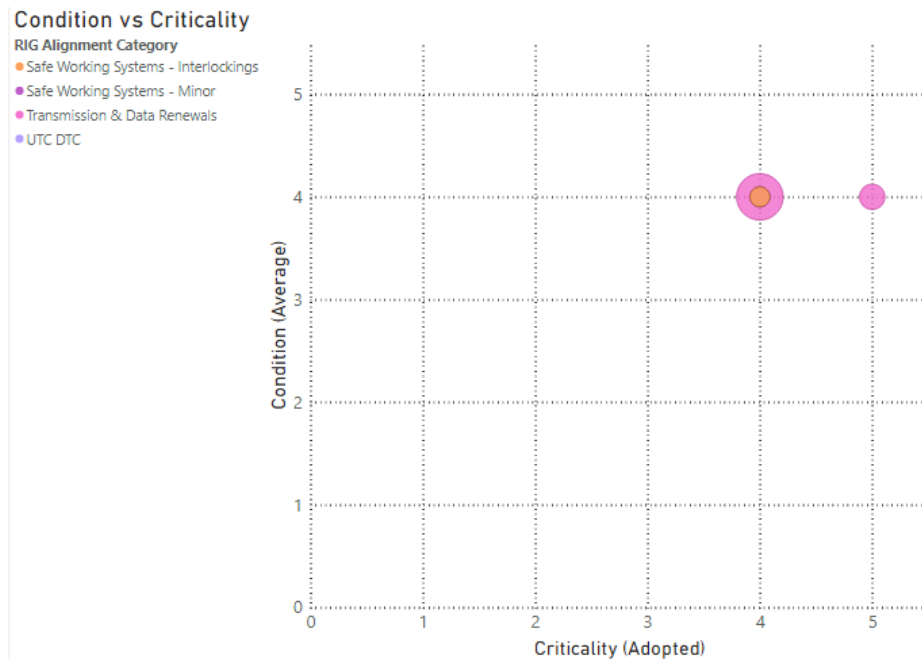
Table 180 UTC / DTC System Renewals – Newlands System and GAPE

Scope		Location	Qty	Unit
UTC CODE AND SAFE WORKING	RENEWAL	Newlands	1	SYSTEM

Control Systems Renewals FY23 Scope - Asset Condition and Criticality Assignment

The following graphic plots the Control Systems renewals against asset condition and location/ operational criticality. All scope items across all items are listed as condition rating 4. This reflects the age of assets targeted for renewal in FY23. Control Systems assets are mostly electronic, so renewal is a trigger of support, spare parts, or software obsolescence. As such condition is more a matter of asset age against design life rather than a physical demonstration of wear.

Figure 84 Control Systems – FY23 Scope Priority Ratings – Newlands System and GAPE



Interpretation:

This chart represents the current condition and criticality of assets targeted for renewal in FY23. For each scope item:

- *The location of the bubble indicates the Scope Priority Model ranking for Asset Condition and Location/ Operational Criticality; and*
- *The size of the bubble represents the number of sites / tasks.*

Chapter 11 of the FY23 Draft Proposal provides further detail on how Asset Condition and Criticality is used to determine whether scope is Critical, required for System Reliability or Strategic.

Control Systems Assets FY23 Program - Options Considered

All the proposed renewal scope for Newlands and GAPE Control Systems in FY23 is condition rating 4 or above and critical to system operations.

For the proposed FY23 Control Systems renewals the renewal driver is predominantly age of the assets and technological obsolescence. The assets identified for renewal are at the end of their useable lives and in some instances operating beyond design life. Systems are unsupported by the original vendor and spares to maintain systems are rare.

As a result, the options considered are centred around the speed of renewal or the technology choice to replace.

Table 181 Control Systems Program Options

Option	Description	Residual Asset Risk	Impact
Plan scope over a multi-year program, managing asset performance risk	Planning objective is to maintain or reduce network service delays relative to current levels. The proposed scope can be completed within planned possession constraints.	Low	The proposed scope nominally targets this level of obsolescence risk. Other options are considered only when other factors (opportunities or costs) associated with the practicability of program implementation outweigh the capacity benefit associated with this renewal objective.
Defer some or all the proposed scope, taking asset performance risk	Deferral may increase the near-term risk of unplanned disruption due to increasing failure frequency, or delay to return to service after failure. A future acceleration of renewal to redress the deficit may require	Medium	This option is considered for assets where asset performance remains satisfactory, and where spares inventory can be sustained through a recover and reuse strategy to ensure return to service upon failure. It is used to reduce the demand for track possessions to within target levels in the planned

Option	Description	Residual Asset Risk	Impact
	an increase in the number or duration of possessions.		year, or to moderate demand for finite execution resources.
Accelerate scope, to eliminate obsolescence risk	While the availability of assets may improve, any significant acceleration may require an increase in track possession beyond the annual budget, eroding annual throughput.	Low	This option is typically considered when there is an efficiency associated with the bundling of renewals within a geographical location, or to remove a category of equipment from a maintenance district (possibly supporting deferral of renewal in another district through replenishing of obsolete spares). It may also be used where a capacity impact is observed from a previous deferral of renewals.
Modernisation	Reduce delays due to failures through deployment of resilient systems and architectures using modern technologies	Low	In conjunction with the scheduling of asset renewals, alternative modern technologies and resilient system architectures are considered to ensure advantages of networked digital assets.
5G mobile data network	Not practicable	N/A	5G options were not deemed appropriate as the 5G network is not commercially available for use in the CQCN.

Technology Projects

Technology Projects

As detailed in Chapter 3 of this FY23 Final Draft Proposal, Aurizon Network is progressing several technology projects to renew existing systems or better understand, analyse, and identify scope across the CQCN assets. These projects improve Aurizon Network's ability to make data driven decisions regarding the management of the rail assets on the behalf of customers, stakeholders and safety regulators.

In FY23, Aurizon Network intended to progress a number of these initiatives and will seek support from the RIG to invest in these systems to enhance the maintenance and renewal programs for the CQCN.

Two items are proposed to be progressed in FY23:

- ATIS – Automated Track Inspection system (ATIS) is a combination of autonomous measurement devices that provide frequent measurement of track and overhead geometry, pantograph interface and forward facing track vision. ATIS will provide Aurizon Network with increased understanding of track and overhead alignment, moving decisions of rail and overhead alignment management from qualitative decisions to quantitative data driven assessments. Currently Aurizon Network is finalising the trail of the Wire Geometry Measurement system (WGMS) and the Pantograph Collision Detection System (PCDS) in the Blackwater and Goonyella systems ahead of presenting the full business case for investment. This business case will be discussed with the RIG and seeking customer support in Q3 FY22.
- As the standardisation of the OneSAP system is completed across Aurizon Network some system functionality gaps may become evident requiring investment in SAP modules or system architecture changes. No allowance has been included in the FY23 Final Draft Proposal. If an investment is required, then Aurizon Network will engage with the RIG on the required level and timing of investment.

8.5 Identification and allocation of costs between Newlands and GAPE Train Services

UT5 provides for separate Allowable Revenues and Reference Tariffs for Newlands System and for GAPE End Users. GAPE is not, however, a geographically distinct coal system. In addition to the construction of greenfield track between North Goonyella Junction and Newlands Junction (GAPE Link), the scope of the GAPE Project included significant upgrades and renewal of Newlands System Rail Infrastructure (Newlands System Enhancements). As such, information in relation to the Newlands System and GAPE has been presented together in this FY23 Final Draft Proposal.

To enable a separate vote on the FY23 Final Draft Proposal for each of the Newlands System and GAPE End User groups under 7A.11.3 of UT5, Aurizon Network has separately identified the location of individual renewal projects in 8.4.3 and provided additional information in this Chapter, including:

1. An estimated share of the proposed Maintenance Budget which would be recovered from each of the Newlands System and GAPE under current pricing arrangements (Maintenance Indicator); and
2. A summary in principle of the extent to which assets in the proposed Renewals Budget would be allocated to each of the Newlands System and GAPE RABs (Capital Indicator).

Aurizon Network believes that the current treatment of Asset Replacement and Renewal Expenditure for common-user Rail Infrastructure in the Newlands System results in economically efficient Allowable Revenues and Reference Tariffs for both Newlands and GAPE Train Services. Nevertheless, as outlined in section 3.1.5 above, Aurizon Network has delivered upon our commitments to engage with GAPE and Newlands System End Users in relation to the allocation methodology for asset replacement and renewals expenditure on the shared Newlands rail corridor.

A working group was established by Aurizon Network, and regular meetings have taken place to progress the relevant issues. As of 21 January 2022, a resolution has not yet been reached and stakeholder engagement will continue. Aurizon Network has provided Newlands and GAPE End Users with estimated, non-binding capital and maintenance indicators for Newlands and GAPE under an alternate engineering-based approach to support the approval process and to address End User concerns regarding the allocation of costs between the Newlands system and GAPE,

Importantly, Aurizon Network confirms that End User approval of the FY23 Final Draft Proposal will not be considered as endorsement of the current or future allocation and pricing methodology.

Additional information in relation to the Newlands System and GAPE

- **Maintenance Indicator**

- The estimated allocation of the FY23 Maintenance Budget to Newlands System and GAPE has been determined in proportion to GTK forecast for Newlands and GAPE Train Services, with the GTK for GAPE Train Services being measured from North Goonyella Junction to Abbot Point.

- **Capital Indicator**

- Scope relating to the replacement of assets constructed as part of the GAPE infrastructure enhancements between North Goonyella Junction and Newlands Mine Junction (the GAPE Link) has been identified and these costs are included in the GAPE Capital Indicator. Specifically, civil design costs for two turnouts located at Eaglefield Creek;
- Scope relating to the replacement of assets constructed as part of the GAPE infrastructure enhancements on common-user Rail Infrastructure geographically located in the Newlands system (i.e., the Newlands System Enhancements) has been identified and these costs are included in the GAPE Capital Indicator. Some of these works include rail renewal and mainline undercutting along the Briaba Duplication, rail renewal between Collinsville and McNaughton Junction and turnout undercutting at Binbee; and
- All remaining Asset Replacement and Renewal Expenditure on common-user Rail Infrastructure geographically located in the Newlands system, have been identified and included in the Newlands System Capital Indicator.

- **This approach results in the following allocations of Maintenance and Renewals expenditure**

Table 182 Proposed allocations of Maintenance Indicator and Capital Indicator

	Maintenance Indicator (\$m)	Capital Indicator (\$m)
Newlands System	4.3	20.3
GAPE	8.9	2.2
• Total	13.2	22.5

9. Four-year forward indicative cost forecast

This chapter outlines Aurizon Network’s indicative cost forecasts for Maintenance and Asset Renewal activity in each Coal System. Information is provided for FY23 (as outlined in this FY23 Final Draft Proposal) plus a forecast period of a further four-years; i.e., FY24 – FY27.

The FY24 – FY27 indicative cost forecasts are provided to increase transparency on forward looking asset renewals and maintenance expenditure. It is a high level estimate based on currently available information. The forecast will be progressively refined as further information about asset condition, viability of alternate multi-year asset management approaches and increasing certainty on design is developed.

Total Expenditure for the outlook period is forecast to increase by 4% in real terms from FY23 to FY27 or by \$17.6m. The movement in cost is predominantly driven by Turnout, Control Systems and Electrical asset renewals in Blackwater and Goonyella. Prior to FY21, maintenance costs did not include ballast undercutting plant depreciation, which was a key driver of the increase between FY21 and FY22.

Figure 85 Total Expenditure FY18 - FY27 (Real \$FY21)

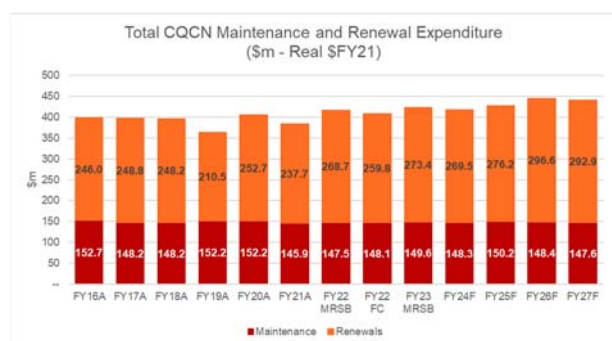
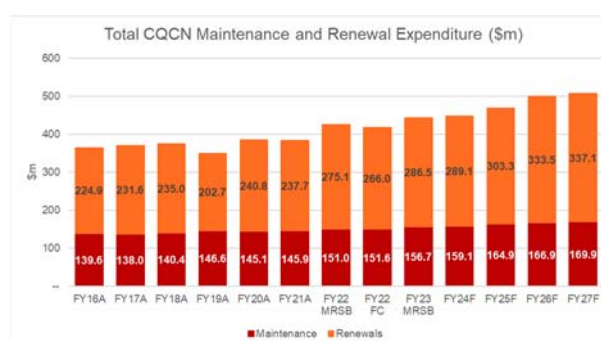


Figure 86 Total Expenditure FY18 - FY27 (Nominal)



9.1 Blackwater System – Four-Year Forecasts

Table 183 Blackwater System – FY23 plus four-year Maintenance Cost Forecast

Blackwater System		FY23	FY24	FY25	FY26	FY27
Maintenance Item (\$m)						
Resurfacing		9.2	8.7	9.7	8.9	8.8
Rail Grinding		8.6	8.9	9.0	9.7	10.1
General Track Maintenance		22.6	23.1	23.7	24.3	24.8
Structures & Facilities Maintenance		2.3	2.3	2.4	2.5	2.5
Other Civil Maintenance		2.4	2.4	2.5	2.6	2.6
Signalling & Telecommunications Maintenance		10.2	10.5	10.7	11.0	11.3
Trackside Systems Maintenance		0.8	0.8	0.8	0.9	0.9
Electrical Maintenance		6.1	6.3	6.4	6.6	6.8
Other General Maintenance		2.5	2.6	2.6	2.7	2.8
Total Direct Maintenance Costs (excl. Ballast Undercutting Plant Depreciation)		64.8	65.7	68.0	69.1	70.5
Ballast Undercutting Plant Depreciation		3.3	3.3	3.2	3.2	3.2

Blackwater System					
Maintenance Item (\$m)	FY23	FY24	FY25	FY26	FY27
Total Direct Maintenance Costs	68.0	68.9	71.2	72.3	73.7
Non-Coal Allocation	(1.3)	(1.3)	(1.3)	(1.4)	(1.4)
Total Direct Maintenance Costs	66.8	67.6	69.9	70.9	72.3

Table 184 Blackwater System – FY23 plus four-year Renewals Cost Forecast (\$m)

Renewals Item (\$m)	Assets Include:	FY23	FY24	FY25	FY26	FY27
Civil Assets		98.5	97.4	95.0	96.4	99.7
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	31.0	37.8	34.8	35.1	35.9
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	41.0	40.1	40.6	40.6	42.4
Structures	<i>Culverts, Bridges</i>	12.0	12.3	12.1	12.4	12.7
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	14.4	7.2	7.5	8.3	8.6
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission, Optical Fibre</i>	21.8	16.9	24.3	15.6	20.4
Electrical Assets	<i>Overhead and Goonyella Ports OHL Renewal, Power systems, Traction Substation Renewals</i>	5.6	9.7	12.0	21.9	27.2
Total		125.8	124.1	131.3	134.0	147.2

Notes:

- The increase in Permanent Way forecast is primarily driven by Turnout Renewals in FY24 including the major Callemondah Turnout Renewal Program.
- The Optical Fibre Renewal program is focussed on the Blackwater System in FY25 with a forecast of \$11m (\$5.2m, \$11.0m, \$2.0m, \$6.5m, each year respectively from FY24)
- The forward forecast for Traction Substation renewals is based on preliminary estimates from a consultant assisting in the development of concept deliverables for this program. The concept phase for the Traction Substation renewals commenced in FY21 and will continue in FY23. The deliverables will include more comprehensive estimating. The results of the concept phase will be shared with the RIG as part of the annual process of engagement.

9.2 Goonyella System – Four-Year Forecasts

Table 185 Goonyella System – FY23 plus four-year Maintenance Cost Forecast

Goonyella System Maintenance Item (\$m)	FY23	FY24	FY25	FY26	FY27
Resurfacing	9.9	9.3	10.4	9.5	9.4
Rail Grinding	9.1	9.7	9.7	10.5	10.8
General Track Maintenance	16.4	16.8	17.2	17.6	18.0
Structures & Facilities Maintenance	2.0	2.1	2.1	2.2	2.2
Other Civil Maintenance	2.6	2.6	2.7	2.8	2.8
Signalling & Telecommunications Maintenance	10.0	10.3	10.5	10.8	11.0
Trackside Systems Maintenance	1.7	1.7	1.7	1.8	1.8
Electrical Maintenance	6.2	6.3	6.5	6.6	6.8
Other General Maintenance	2.3	2.4	2.5	2.6	2.6
Total Direct Maintenance Costs (excl. Ballast Undercutting Plant Depreciation)	60.2	61.2	63.4	64.3	65.5
Ballast Undercutting Plant Depreciation	2.5	2.4	2.5	2.6	2.6
Total Direct Maintenance Costs	62.7	63.6	65.8	66.7	67.9
Non-Coal Allocation	(0.1)	(0.0)	(0.0)	(0.1)	(0.0)
Total Direct Maintenance Costs	62.6	63.6	65.8	66.7	67.9

Table 186 Goonyella System – FY23 plus four-year Renewals Cost Forecast (\$m)

Renewals Item (\$m)	Assets Include:	FY23	FY24	FY25	FY26	FY27
Civil Assets		88.8	92.4	95.4	98.4	101.0
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	36.3	36.5	37.4	37.7	38.6
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	35.9	41.1	42.7	44.1	44.9
Structures	<i>Culverts, Bridges</i>	7.3	7.2	7.4	8.1	8.8
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	9.3	7.7	7.9	8.5	8.7
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission, Optical Fibre</i>	22.3	15.7	12.2	16.8	15.0
Electrical Assets	<i>Overhead and Goonyella Ports OHL Renewal, Power systems, Traction Substation Renewals</i>	11.3	16.7	26.2	43.6	33.6
Total		122.4	124.9	133.7	158.9	149.7

Notes:

- Optical fibre scope renewal is focused in Goonyella in FY23, with the FY24 forecast returning to steady state levels.
- The forward forecast for Traction Substation renewals is based on preliminary estimates from a consultant assisting in the development of concept deliverables for this program. The concept phase for the Traction Substation renewals commenced in FY21 and will continue in FY23 and the deliverables will include more comprehensive estimating. The results of the Concept phase will be shared with the RIG as part of the annual process of engagement.
- Goonyella Ports OHL renewal of \$28.0m between FY23 and FY27 is included in the forecast.
- Building on the investigation and analysis, Aurizon Network has developed a new OHL Asset Management Strategy and conducted a review of the OHL configuration at the Goonyella Ports. Several key observations have been made which are pertinent to the Goonyella Ports:
 - The levels of corrosion in OHL supporting steelwork are very high due to its coastal, high corrosion environment, and if not addressed will substantially reduce the reliability, safety, and service life of the traction asset in this region.
 - The 7-strand catenary wire used in the original construction is prone to premature breakage of individual strands. This defect is difficult to detect and is the leading cause of failure for the Electrical assets.
 - There is an inherent weakness in the original OHL configuration design for this region, specifically the mechanical coupling between adjacent roads due to the configuration of wire-runs, results in two disadvantages. Firstly, single line isolations which can make effective use of small access windows are difficult to achieve given the high level of utilisation of this infrastructure for the operation of trains and train stowage during closures. Secondly, the operational impact of a dewirement can be quite extensive (as experienced in November 2018) with serious impacts on train operations.
 - Renewal Options - The Goonyella Ports is one of the most complex parts of the CQCN electrified infrastructure, and also one of the most critical for operations. The investigation and analysis of root cause of OHL failures has culminated in the development of the new OHL asset management strategy this year and identification of the following two renewal options:
 - Preferred Option
 - A reconfiguration of the Goonyella Ports OHL infrastructure which addresses the OHL supporting steelwork corrosion that will facilitate single line isolations for work. In key areas the 7-strand catenary wire will be replaced with a "tramway" system that has no catenary and therefore reduces the number of components that may give rise to a failure. Adopting this option will "reset" the Goonyella Ports OHL, addressing known defects and design deficiencies so that it can continue to deliver reliable service with minimal maintenance for the next 30 years
 - Cost: \$28.0m over 5 years, with an estimated \$3.5m spend in FY23
 - Alternate Option Considered
 - Like-for-like renewals of corroded components, and where necessary replacement of the existing catenary wire. Adopting this option will address the OHL supporting steelwork corrosion issues and, where evident, the defective 7-strand catenary wire. This option reflects the approach Aurizon Network has taken historically. Over the past 10 years there have been 88 dewirements in the CQCN, with most resulting in significant train cancellations and delays. In November 2018, a dewirement (failure of

the overhead wiring) occurred at DBCT on Departure Road 2. This single event resulted in 18 train service cancellations, 11,976 minutes of train service delays and closure of the Dalrymple Bay Coal Terminal. Continuing with the current approach is a lower cost option but does not provide opportunity to mitigate impacts from failure events and the constraints in gaining single line isolation access. The consequence of dewirement events will likely remain consistent with historical trends and may escalate as the component parts fail at increasing rates over time. Detailed estimating has not been undertaken for this option.

- An indicative cost is \$10.5m over 5 years, with an estimated \$2.5m spend in FY23
- Changes to the multi-year strategy once commenced may result in additional total costs to the supply chain. For example, if the fix on fail approach (alternate option) is progressed in FY23 with a decision in FY24 to transition to the preferred option, some of the assets or components installed in FY23 may not be a requirement in the preferred option and therefore an imprudent use of capital.
- In the FY23 Final Draft Proposal, Aurizon Network is recommending the preferred option as we consider this approach best meets the long-term requirements for this area of the network and for the supply chain. As such, the works proposed for FY23 include some mechanical separation of wire-runs, new mast foundations and detailed design works for construction in subsequent years. The delivery of this option over the next 5 years includes some opportunities to trade off cost, access and reliability in a way that meets the service level expectations of users of the Goonyella Supply Chain.
- Aurizon Network would like to consult with the Rail Industry Group to confirm the preferred option appropriately takes into consideration the service requirements of the Goonyella Supply Chain post submission of this draft Maintenance Renewal Strategy and Budget. In order to meet current planned outage requirements a final decision for FY23 is required by February 2022. Post this decision, Aurizon Network would then propose that this multi-year asset activity and the potential trade-offs in outer years be discussed in more detail with the RIG as part of the development of the annual engagement plan in early Q3FY22.

9.3 Moura System – Four-Year Forecasts

Table 187 Moura System – FY23 plus four-year Maintenance Cost Forecast

Moura System Maintenance (\$m)	FY23	FY24	FY25	FY26	FY27
Resurfacing	1.5	1.4	1.6	1.4	1.4
Rail Grinding	0.5	0.7	1.0	0.8	0.5
General Track Maintenance	5.1	5.2	5.3	5.4	5.6
Structures & Facilities Maintenance	1.0	1.0	1.0	1.1	1.1
Other Civil Maintenance	0.9	1.0	1.0	1.0	1.0
Signalling & Telecommunications Maintenance	3.0	3.1	3.2	3.3	3.3
Trackside Systems Maintenance	0.3	0.3	0.3	0.3	0.3
Other General Maintenance	0.5	0.5	0.5	0.5	0.6
Total Direct Maintenance Costs (excl. Ballast Undercutting Plant Depreciation)	12.8	13.1	13.9	13.8	13.8

Moura System Maintenance (\$m)	FY23	FY24	FY25	FY26	FY27
Ballast Undercutting Plant Depreciation	-	-	-	-	-
Total Direct Maintenance Costs	12.8	13.1	13.9	13.8	13.8
Non-Coal Allocation	(0.2)	(0.2)	(0.2)	(0.2)	(0.2)
Total Direct Maintenance Costs	12.6	12.9	13.7	13.6	13.6

Table 188 Moura System – FY23 plus four-year Renewals Cost Forecast (\$m)

Renewals Item (\$m)	Assets Include:	FY23	FY24	FY25	FY26	FY27
Civil Assets		12.5	10.5	9.7	10.3	10.0
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	5.2	5.0	4.2	4.4	4.5
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	1.9	2.2	2.0	2.1	1.7
Structures	<i>Culverts, Bridges</i>	2.4	1.5	1.6	1.6	1.7
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	2.9	1.7	1.9	2.3	2.2
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission, Optical Fibre</i>	3.3	5.4	2.2	2.3	2.4
Total		15.8	15.9	11.9	12.6	12.4

Notes:

- For Civil Assets, the Moura system forecast is based on steady state performance, some adjustment has been made in FY24 to account for identified scope based on condition. An increase to turnout undercutting has been proposed to account for undercutting two adjacent turnouts per year rather than a single turnout. This strategy is efficient for planning and cost as both ends of a passing loop can be renewed at the same time and treat the underlying ballast condition.
- In FY24, the Control Systems Renewal Program includes three weighers which require renewal at Callide, Moura, and Boundary Hill.

9.4 Newlands System and GAPE – Four-Year Forecasts

Table 189 Newlands System and GAPE – FY23 plus four-year Maintenance Cost Forecast

Newlands System Maintenance (\$m)	FY23	FY24	FY25	FY26	FY27
Resurfacing	1.8	1.7	1.9	1.7	1.7

Newlands System Maintenance (\$m)	FY23	FY24	FY25	FY26	FY27
Rail Grinding	1.7	1.7	1.7	1.8	2.0
General Track Maintenance	3.9	4.0	4.1	4.2	4.3
Structures & Facilities Maintenance	1.3	1.3	1.4	1.4	1.4
Other Civil Maintenance	0.2	0.2	0.2	0.2	0.2
Signalling & Telecommunications Maintenance	2.8	2.8	2.9	3.0	3.0
Trackside Systems Maintenance	0.3	0.3	0.3	0.3	0.3
Other General Maintenance	0.9	0.9	1.0	1.0	1.0
Total Direct Maintenance Costs (excl. Ballast Undercutting Plant Depreciation)	12.9	13.1	13.7	13.8	14.1
Ballast Undercutting Plant Depreciation	0.3	0.3	0.3	0.3	0.3
Total Direct Maintenance Costs	13.3	13.4	14.0	14.1	14.4
Non-Coal Allocation	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total Direct Maintenance Costs	13.2	13.4	14.0	14.1	14.4

Table 190 Newlands System – FY23 plus four-year Renewals Cost Forecast (\$m)

Renewals Item (\$m)	Assets Include:	FY23	FY24	FY25	FY26	FY27
Civil Assets		18.8	20.7	22.7	24.2	23.7
Permanent Way	<i>Rail, Track, Sleeper, Turnouts</i>	5.2	8.7	10.3	10.5	10.8
Ballast Cleaning	<i>Mainline and Turnout Undercutting, Bridge ballast</i>	4.3	4.4	4.0	4.7	4.2
Structures	<i>Culverts, Bridges</i>	5.2	4.6	5.3	5.4	5.0
Civil Renewals	<i>Formation, Level Crossings, Access Points</i>	4.2	2.9	3.2	3.6	3.7
Control Systems Assets	<i>Safe Working, Train Control and Detection, Interlocking, Telecoms, Power Resilience, Transmission</i>	3.7	3.7	3.8	3.9	4.0
Total		22.5	24.4	26.5	28.1	27.7

Notes:

- The reduction in FY23 actuals versus forecast for Civil Assets is due to the reduction in Turnout renewal spend associated with developing maturity in design and planning as well as a reduction in sleeper renewal spend. The forecast for FY24 to FY27 returns to a steady state planning.
- The four-year forecast for Control Systems Assets in the Newlands Systems aligns with historical steady state planning.

9.5 Comments relating to the forecast period by asset category

Table 191 Comments on the four-year indicative forecast

Activity	Comment
Civil Assets	
Permanent Way	<p>This program is forecast to maintain a steady state scope based on Network Strategic Asset modelling. Variation may arise from asset deteriorations or opportunities to integrate scope for cost efficiency.</p> <p>The Callemondah Turnout Renewal in FY24 will see increased spend in Blackwater. These works are being staged over multiple years to reduce impact.</p>
Ballast Cleaning	<p>Aurizon Network continues to review the GPR data to further determine future scope requirements across the CQCN. On completion of this analysis Aurizon Network will provide detail to the RIG on any change from the current forecast with regards to scope, capacity and cost changes.</p>
Structures	<p>Investment is relatively consistent for the period with bridge renewals being limited to 1 short span bridge in the Newlands System for each of the 4 future years.</p> <p>Blackwater has the oldest number of structures and as such attracts the highest level of scope and spend in comparison to the other systems. Goonyella structures are younger and are holding condition, increased spend is forecast in FY26 as some assets deteriorate</p>
Civil Renewals	<p>After an increase in FY23 for the major Level Crossing Renewals in Blackwater, this program will return to steady stage investment.</p> <p>Formation renewal remains constant with a move to reduce fix on fail scope and deliver more planned scope to achieve unit rate savings.</p>
Control Systems	
Optic Fibre	<p>Increases across the FY23 - FY25 period are associated with the continuation of the Optic Fibre renewal program and Interlocking renewals in Blackwater and Goonyella.</p>
Train Detection	<p>Investment in Train Detection (Track Circuits to Axle counters) in all systems except Newlands.</p>
Electrical	
Overhead	<p>Forecasting \$28.0m over 5 years commencing in FY23 for the Goonyella Ports OHL Renewal program.</p>
Power Systems	<p>Some increase to the OHLE and Power Systems programs with additional installation of motorised isolators and fault detectors to provide flexibility for fault management.</p> <p>In FY23 a scoping study will be completed for the renewal of the 8 Air-Insulated Switchgear traction substations which will reach the end of their nominal service life in the next 5 to 10 years. A forward forecast has been included based on an initial consultant's review.</p>
Future Programs	
	<p>In addition to the major renewal programs detailed in this submission for Power Systems Substation Renewal, the Goonyella Ports OHL Renewal and the ongoing Optic Fibre Upgrade, there are major renewal investment programs in development for Signalling Interlocking and Rail Grinding through Level Crossings. These programs are still in the early stages of development and Aurizon Network will seek to engage with the RIG members early across all these programs in the new year.</p>

PART B: Asset Management Framework



10. Guiding Principles and Context

This chapter presents the guiding principles of Aurizon Network’s approach to asset maintenance and renewal activities. Aurizon Network uses these principles and the needs of other Supply Chain Participants to inform what scope is required, when it will be undertaken and how it will be delivered. Information included is intended to address feedback from Customers who were seeking a greater understanding of Aurizon Network’s asset management strategy and to provide further information in relation to the characteristics and delivery of the specific maintenance and renewal tasks.

10.1 Guiding Principles

Aurizon Network’s asset activities are designed and managed to deliver Committed Capacity, maintain or improve reliability and deliver efficiency and rail infrastructure performance (each in the long and short term). The guiding principles of Aurizon Network’s asset management philosophy is outlined in Table 192.

Table 192 Guiding Principles of Aurizon Network’s Asset Management philosophy

Guiding Principle	Description
Minimise the impact of asset activity	<p>Aurizon Network has developed its FY23 Final Draft Proposal in support of Customers’ Committed Capacity being safely and sustainably delivered. To achieve this:</p> <ul style="list-style-type: none"> • Aurizon Network seeks to minimise the supply chain impact of major asset renewal activity by appropriately scheduling these works in a series of planned, integrated closures. • Aurizon Network engages with other Supply Chain Participants (including Access Holders, Customers, Railway Operators and destination Port Operators) to understand their respective shut-down timetables and, wherever possible, seeks to coordinate the delivery of planned maintenance and renewal works with these participants. • Aurizon Network aims to use critical path scope to plan closures and maximise the number maintenance and renewal activities planned for delivery during those closures, while also balancing essential plant and resources. Planned maintenance activities outside of closures are scheduled in such a way as to minimise impacts on the relevant supply chain and cross system access
Promote below rail asset reliability	<p>Aurizon Network’s asset management strategy is structured around a preventative maintenance regime, the goal of which is to identify, plan and rectify faults before they become asset failures or disrupt railway operations.</p> <p>Rail infrastructure is renewed based on the requirement for it to be in a fit for purpose condition and will be inspected, maintained and replaced to minimise unplanned failures.</p>
Cost Effective	<p>Maintenance and renewal activities are carried out in a way which seeks to maintain or improve cost, reliability and performance (both in the long and short term).</p> <p>Aurizon Network procurement is market-tendered to ensure competitive rates for outsourced labour, services and materials.</p>
Meet Legislative Requirements	<p>Aurizon Network is committed to safely meeting its contractual obligations to its Customers within the parameters set out by relevant legislative requirements including the <i>Rail Safety National Law (Queensland) Act 2017 (RSNL)</i>, the <i>Transport Infrastructure Act 1994 (Qld)</i>, the <i>Work Health and Safety Act 2011 (Qld)</i> and the <i>Electrical Safety Act 2002 (Qld)</i>. For more details on Aurizon’s legislative requirements refer to Section 9.2</p>

10.1.1 Maintenance and Renewal Activities

Aurizon Network applies a coordinated approach to managing the CQCN rail infrastructure by applying maintenance and renewal strategies that are designed to complement each other through each stage of the asset's life cycle.

The average age of the assets in the CQCN is approximately 30 years. This is driven by the majority of those assets being approximately 30 to 40 years of age that were constructed during the 1980s and the 1990s. The average is reduced by deviations, duplications and spurs/balloon loops being built during the 2000s and 2010s and the asset renewals undertaken each year which is a small percentage of the total network.

The Asset Maintenance and Renewal Policy uses the age or tonnage as an indicator of the design life expiry of the assets and allows monitoring and proactive activities, however it is the actual condition of the asset that determines when renewal is required.

As an example, the average age of structures in Blackwater, Goonyella, Moura and Newlands is 41years, 44years, 48 years and 31years respectively. Assets installed prior to 2000 have a design life of 50 years (post 2000, increased to 100 years). As these structures age, more maintenance is required to be fit for purpose and reach their design life, at which point renewals are required.

As outlined in section 2.2.3, Aurizon Network commits to continue to engage with the RIG throughout FY23 on asset strategy, multi-year and strategic assets. As part of the development of the FY24 MRSB, consideration will be given to the appropriate way to present the age and asset condition as part of the four-year forward indicative cost forecast.

Maintenance of rail infrastructure refers to the:

- Inspection, testing, identification of faults; and
- Subsequent adjustment or repair of the asset.

Renewal of rail infrastructure refers to the replacement of an asset that is either:

- Life-expired; or
- Obsolete and replaced or reconfigured with the modern-day equivalent asset.

There are a wide variety of assets that make up the Rail Infrastructure. These assets wear and degrade at differing rates due to a variety of factors, which may include:

- Location;
- Climate;
- Construction material;
- Use or movement (e.g., tonnage railed over a rail section);
- Movements of mechanical parts; and/or
- Obsolescence - either because of operating systems no longer being supported, a reduction in spare part availability or advances in alternate technologies.

To manage variability Aurizon Network applies several approaches to inspect, test, measure deterioration and ultimately, respond to asset condition in a manner that seeks to minimise disruption to Train Services.

10.1.2 Considerations towards asset management activities

Guided by the principles listed in Table 192, Aurizon Network's asset management approach is based around appropriately considering several factors when delivering asset activity. These considerations are described in Table 193.

At the core of this, Aurizon Network is committed to safely meeting its contractual obligations to its Customers. The level of asset activity proposed by Aurizon Network and the way in which it is delivered must be appropriate for

maintaining and operating a safe, fit-for-purpose rail network that can deliver the Committed Capacity in each Coal System.

Table 193 Asset Management Considerations

Factor	Description
Safety	Maintaining or renewing assets in a way that meets the requirements of Aurizon Network's Safety Management System, thereby ensuring the safety of track workers (both internal and external), rail operations and public interfaces.
Asset Condition	A change in asset condition could impact the reliability and performance of the Rail Infrastructure. It may be appropriate for condition between Coal Systems to vary to reflect the level of service, reliability and flexibility required by Customers.
Risk of unplanned Outage or Incident	Aurizon Network has varying levels of risk tolerance which take into consideration the condition, location and criticality of assets in each system. Aurizon Network considers this when setting asset management strategies for different asset types within each Coal System. At all times, Aurizon Network's approach seeks to mitigate the risk of rail incidents (such as derailment, dewirement or collision) that could result in serious injury, fatality or cause significant throughput disruption and recovery costs.
Planned Track Possessions	Aurizon Network manages the time required on track to deliver the required asset activity.
Cost	Aurizon Network strives to ensure that the level of expenditure required to deliver asset activity is appropriate in the context of the level of service and flexibility required by its Customers.

There is an inter-relationship between each asset management consideration listed in Table 193. While Aurizon Network endeavours to take each of these factors into consideration as part of overall asset management approach, Decisions are ultimately informed by data or qualitative information from experienced staff, available at the time of making the decision.

10.1.3 Asset management life cycle models

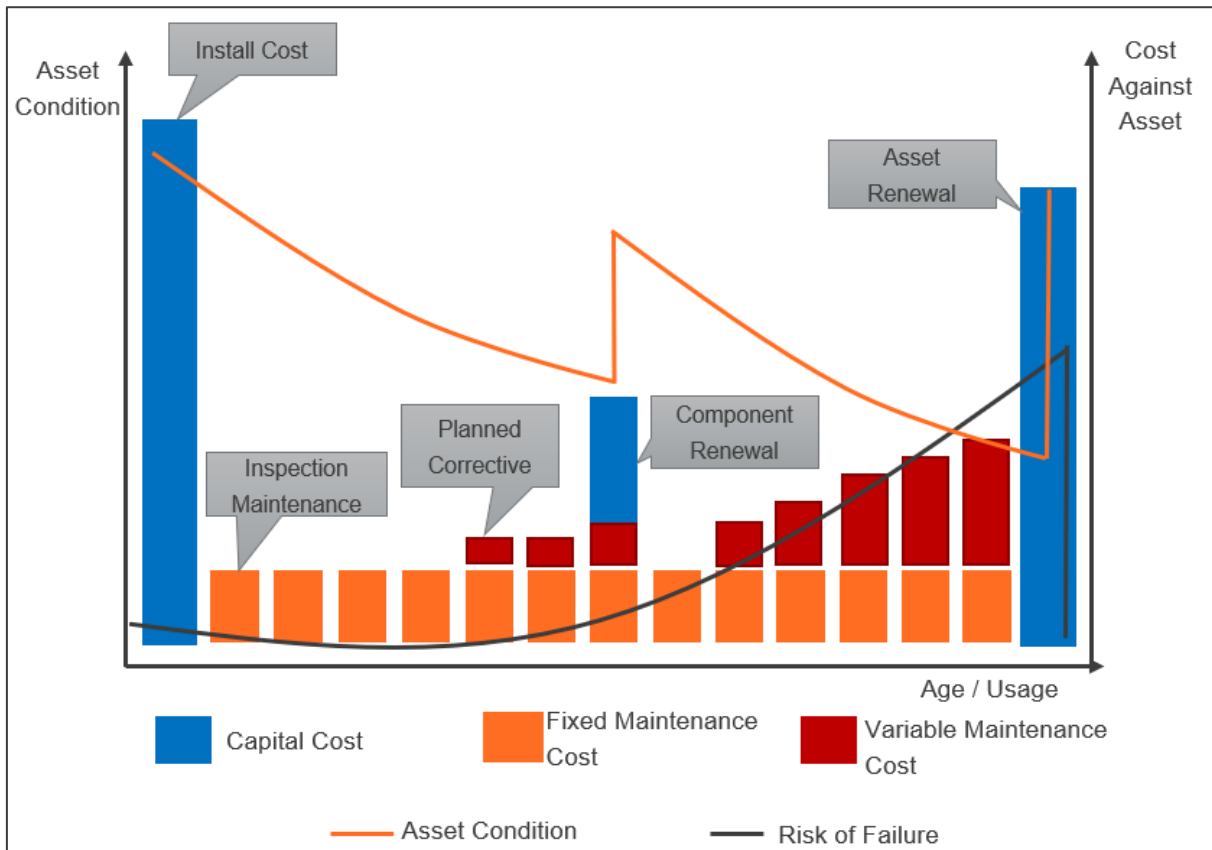
Aurizon Network designs and applies appropriate asset management strategies to match the characteristics of the various components of the Rail Infrastructure. In general, these strategies reflect two broad categories of asset life cycle models:

- Type 1 - Assets that gradually wear through use, e.g., Rail, sleepers, contact wire and turnouts
- Type 2 - Assets which operate until a point where there is a marked increase in asset failures, e.g., Electrical interlockings.

Aurizon Network's asset management strategy for Type 1 assets is focused on achieving the appropriate level of asset availability, at the most efficient cost of ownership, throughout the asset life cycle in accordance with the defined maintenance objectives.

Type 1 assets typically wear in a predictable manner over time and use, therefore, have a life cycle like that represented in Figure 87. Aurizon Network's asset management strategy for these assets is focused on identifying each asset's preventative maintenance requirements and planning the required intervention in a way that meets the supply chain objectives e.g., availability.

Figure 87 Type 1 asset management life cycle model showing failure risk

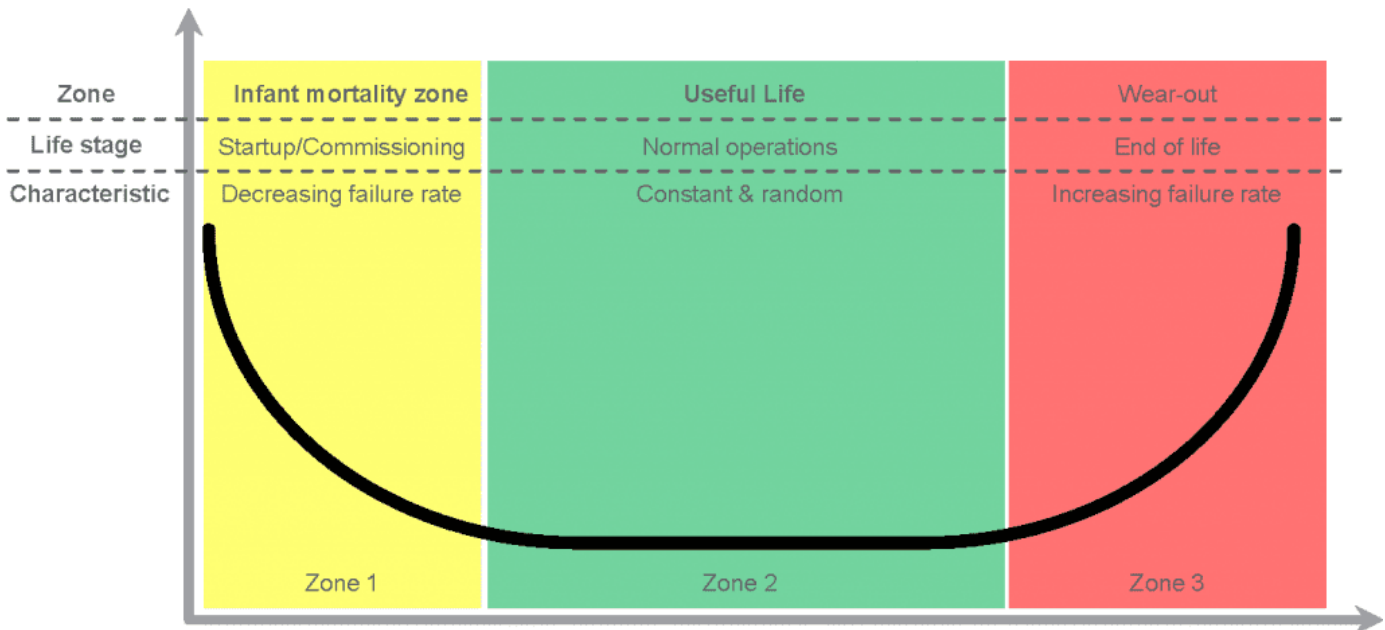


Aurizon Network’s maintenance strategy for Type 2 assets is focused on inspecting and maintaining the assets to prolong the useful life stage; and to monitor the assets to identify the commencement of the wear-out stage. The process begins with understanding the design life and Aurizon Network monitoring the asset condition through preventative maintenance inspections and historical failure trends.

Type 2 assets typically have a life cycle as represented in Figure 88. These assets are characterised by having a higher level of failure on install as latent defects are identified followed by a stable period where the rate of failure is relatively low and constant. As components wear out and reach the end of their service life, the rate of failure rapidly increases. Additionally, obsolescence of vendor supply support and componentry parts can trigger the end of life and the need to modernise the asset.

The inherent nature of these assets is such that the exact point of failure is unknown. To promote reliability of operations, a level of redundancy can be typically built into these systems. Renewals are targeted where the rate of failure increases to a point where unacceptable throughput losses may occur.

Figure 88 Type 2 asset management life cycle model showing failure risk⁶



10.2 Aurizon Network’s legislative and regulatory requirements

This section provides an overview of the legislative and regulatory requirements, which inform the scope of maintenance and renewals activity that Aurizon Network will deliver in each Coal System. This activity is informed by Aurizon Network’s:

- Legislative and regulatory obligations;
- Safety Management System (**SMS**), which it must maintain as a condition of its licence to operate the CQCN; and
- Asset Maintenance and Renewal Policy, which details how Aurizon Network gives effect to the SMS when delivering asset activity.

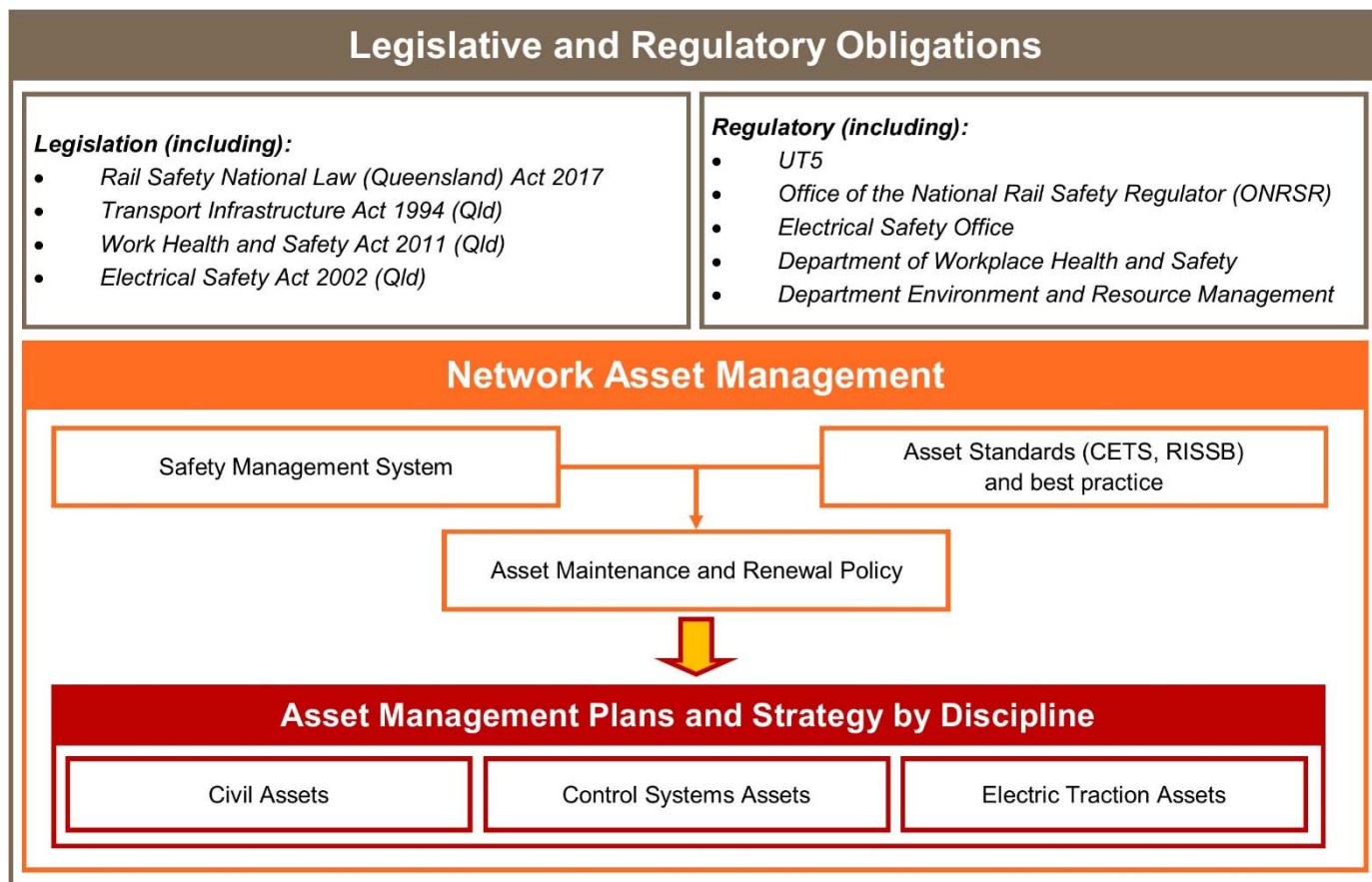
While the above provides the overarching requirements for determining the minimum level of asset activity to be delivered in each Coal System, Aurizon Network must consider the requirements of other Supply Chain Participants, and the specific requirements of rail infrastructure in each Coal System.

10.3 Legislative and regulatory obligations inform asset policies

Aurizon Network is the accredited RIM of the CQCN and is required to deliver maintenance and renewal activities in a manner that is consistent with its legislative and regulatory obligations. Aurizon Network’s asset management plans and strategies have been developed in such a way as to ensure compliance with these obligations. This process can be represented as follows:

⁶ Source: <https://blog.se.com/machine-and-process-management/2016/07/20/effective-maintenance-strategies-begin-understanding-assets-fail/>
 Accessed on 8 September 2020.

Figure 89 Aurizon Network’s approach to asset management is informed by its legislative and regulatory obligations



10.3.1 Legislative and regulatory obligations

In addition to complying with the provisions of UT5, Aurizon Network’s asset management approach is underpinned by relevant sections under the *Rail Safety National Law (Queensland) Act 2017 (RSNL)*, the *Transport Infrastructure Act 1994 (Qld)*, the *Work Health and Safety Act 2011 (Qld)* and the *Electrical Safety Act 2002 (Qld)*.

To undertake RIM tasks in the CQCN, Aurizon Network must be accredited by the Office of the National Rail Safety Regulator (**ONRSR**) and may only undertake such tasks in accordance with an SMS that has been approved by ONRSR.

Under the RSNL, Aurizon Network must ensure, so far as is reasonably practicable, rail safety is not affected by the carrying out of its prescribed railway operations.

A breach of Aurizon Network’s statutory rail safety duty as a ‘rail transport operator’ may lead to ONRSR determining to suspend, revoke or impose conditions upon Aurizon Network’s accreditation. Given that Aurizon Network may only conduct its railway operations in accordance with the terms of its accreditation, any such measures by ONRSR could bring Aurizon Network’s railway network to a temporary or permanent standstill or lead to regulator-imposed operational constraints or restrictions.

Any contractor performing rail safety work on behalf of Aurizon Network must also comply with the SMS, failure to do so can constitute an offence for both Aurizon Network and the relevant contractor.

10.3.2 Safety Management System (SMS)

Aurizon Network has safety duties under the RSNL, and its SMS provides, in part, the mechanism for Aurizon Network to meet its specific obligations. The detail for the safe design, construction, testing, commissioning and operation of the railway is contained in Aurizon Network’s SMS which, amongst other things, includes:

- Systems and procedures for eliminating, or reducing, the risks to safety caused by railway operations; and
- A documented set of engineering standards for monitoring, maintaining and repairing rail infrastructure.

Aurizon Network's SMS is subject to periodic assurance audits by ONRSR and annual review by the Electricity Regulator (as a prescribed Electrical Entity). In addition, Aurizon Network operates a targeted self-assurance program to assess the quality of delivered works against the SMS.

Consequently, Aurizon Network's FY23 Final Draft Proposal includes a level of asset activity that is consistent with its safety obligations and complies with the SMS that is statutorily applicable to Aurizon Network.

10.3.3 Asset Standards (Asset Maintenance and Renewals Policy)

Aurizon Network's Asset Maintenance and Renewals Policy (**AMRP**) is the manifestation of Aurizon Network's practical application of the SMS.

The AMRP is a collation of information about the maintenance and renewal processes that are relevant to each class of asset. This includes Aurizon Network's policies on how each asset will be managed through its useful life. Furthermore, the AMRP provides the rationale for the intervention frequency levels necessary for each activity. It should be noted that these intervention frequency levels may vary between individual Coal Systems to account for, amongst other things, the level of service (e.g., reliability) and flexibility that is required by Customers.

Defined intervention frequency levels can include:

- Usage-based, e.g., track resurfacing is required every 50 million gross tonnes;
- Time-based, e.g., for example, turnouts requiring weekly visual inspections and a detailed annual inspection;
- Age-based, e.g., 22.5 tonne axle load PSC concrete sleepers being replaced every 40 years; or
- Fix on failure.

All preventative maintenance activities and resulting asset operating parameters must conform to the AMRP, which was developed in accordance with the engineering standards and technical specifications necessary to ensure Aurizon Network's compliance with its legislative and regulatory obligations.

Ultimately, the underlying scope of asset activity (both maintenance and renewals) outlined in the FY23 Final Draft Proposal is a function of well-defined standards and processes, that have been designed to ensure Aurizon Network can comply with its safety, legislative and regulatory obligations and can deliver the Committed Capacity in each Coal System. Aurizon Network is continuously reviewing and improving our internal engineering capability, standards and processes to deliver increased throughput in a safe and reliable way.

11. The Use of OneSAP

OneSAP is Aurizon Network's SAP based Enterprise Asset Management (EAM) system. All work required on the assets either as planned maintenance, corrective maintenance or asset renewals are managed through the asset lifecycle in OneSAP.

New scope is identified and loaded to SAP as a Notification, the notification includes the relevant data required for the works planner to develop the execution of all work types within the constraints of available track time, safety and plant and resource availability.

The Notifications are converted to Work Orders and provided to the execution teams across all asset types. The Work Order includes the task list materials requirements and standard works plan for the identified work activity.

Once the work has been completed and the fault rectified, inspection compiled or renewal commissioned, the Work Order is set to PCOM (practical completions). PCOM is the indication that the planned work has been completed and the assets being maintained or renewed are fit for traffic.

Once all costs and materials are settled to the Work Order the status is changed to TECO (Technically completed) and the Work Order and corresponding Notifications are closed. Costs and works are settled against the asset and planned scope and costs against actual scope and cost recorded for variance reporting and presentation to the RIG as part of the Quarterly reporting process.



One team – the Network team all need to work together to manage most effectively the \$6b asset we work with. OneSAP is not a Finance system, Asset Manager system, Maintainer's system or Planner's system. We all have a role to play in the manage asset process be it scope, plan, execute, close or report. We need each other to do our bit well and set up the next person in the process to be successful

One system – We are an SAP business; SAP is the central technology system we use to transact work against our asset. All we do with regards to the asset needs to talk back through SAP or draw information from SAP

One way – standard use of the SAP transactions and process steps to remove the variability on information captured and to make sure we are all using the system in the best most efficient way. SAP is powerful with regards to reportability of effort on the asset and we need to make sure that we are getting the info into SAP in a standard way

12. How we identify and prioritise scope

This chapter outlines Aurizon Network’s key considerations when setting the scope for maintenance and renewal activity for a particular year.

The development of the maintenance and renewal strategies for each Coal System informs the forecast scope of asset activity that is expected to be delivered in the relevant year.

12.1 Asset Renewal Scope identification, Prioritisation and Planning

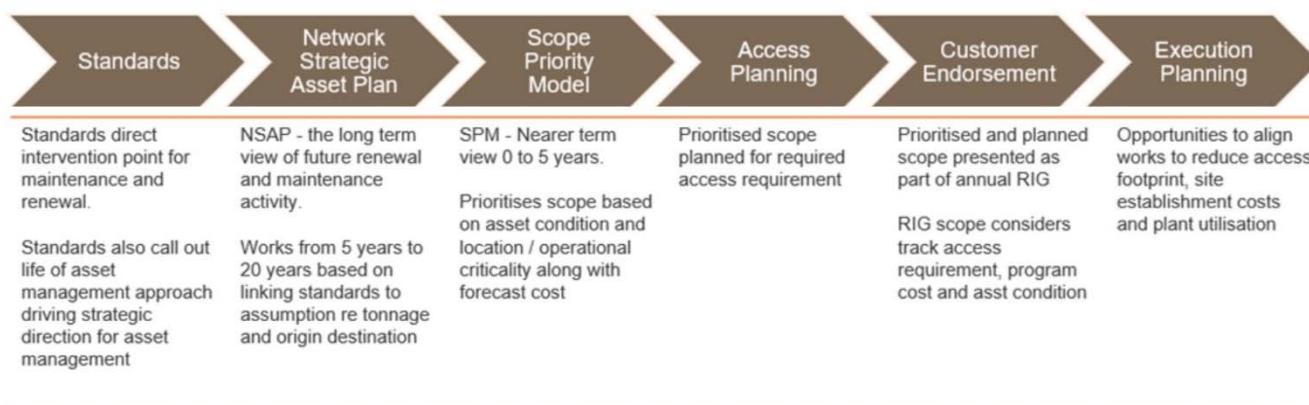
The development of scope for maintenance and renewal activities is an iterative process, which ensures that Aurizon Network can deliver both the Committed Capacity and the required level of maintenance and renewal activity in each Coal System.

The scope of maintenance and renewal activity in each Coal System is identified and prioritised through a process which takes into consideration supply chain requirements, asset condition, strategic principles, relevant standards, design processes, resource and access planning, detailed execution planning and delivery optimisation.

Furthermore, this process ensures that maintenance and renewal activities are planned in a coordinated manner, which promotes efficiency of cost and of delivery.

Figure 90 outlines the development process for maintenance and renewal activity, which ultimately provides the forward-looking “budget” for scope, track access and cost for each Coal System.

Figure 90 Maintenance and renewal activity development process



A description of each step in the process is discussed in further detail below.

12.1.1 Standards

Aurizon Network’s asset standards underpin the maintenance and renewal scope requirements through setting the minimum safety requirements and resulting Asset Policies set the relevant investment triggers for each asset activity. These triggers are summarised in Aurizon Network’s Asset Maintenance & Renewal Policy (**AMRP**) and are supported by asset-specific strategies and plans. Aurizon Network’s asset management documentation aspires to align to the Asset Management Council of Australia’s, Asset Management Body of Knowledge (**AMBoK**)⁷ and ISO55000: Asset Management.

⁷ <https://www.amcouncil.com.au/knowledge/asset-management-body-of-knowledge-ambok.html>

12.1.2 Network Strategic Asset Plan

Aurizon Network uses its Network Strategic Asset Management Plan (**NSAP**) to calculate a static, long-term forecast of future maintenance and renewal scope requirements in each year. Where possible the static scope for each year is combined with item unit rates to provide an indication of the long-term investment requirements for asset classes in each Coal System.

For renewal activities, NSAP initially estimates the expected renewal date for each asset as:

- **Installation Date + Expected Design Life = Indicative Renewal Date.**

The model also takes into consideration asset condition trends and, by applying these trends to the Expected Design Life, determines a **Condition-based Life**. It should be noted, however, that this approach can lead to some assets having a condition-based life which exceeds its design life (e.g., Air Isolated Switch Gear) and some assets with a practical life shorter than design life (e.g., 20 tonne axle load (**tal**) structures operating at 26.5tal).

Long-term investment profile across Coal Systems

Many assets were installed in a series of system expansions. As such, there are large populations of like assets with similar installation dates, resulting in significant renewal peaks as these similar assets become due for renewal at similar times.

Aurizon Network endeavours to identify the investment peaks early and smooth the ‘raw’ renewal scope of work over the longer term, which seeks to provide a level of consistency year-on-year in terms of track access and investment capital needs. This approach is an important consideration for ensuring Aurizon Network can deliver the longer-term renewal requirements and continue to meet Committed Capacity in each year. One such example of this is Aurizon Network’s rail renewal strategy, which sees a consistent rate of circa 115Km of rail renewed across the CQCN each year.

12.1.3 Scope Priority Model

Aurizon Network’s Scope Priority Model (**SPM**) is a report in OneSAP and is extracted from notifications entered in SAP. The SPM combines asset condition (informed by maintenance, inspections and engineering activities) and operational criticality scores to prioritise asset renewal scope in each Coal System.

Assessing asset condition as part of the Scope Priority Model

The identification and assignment of asset condition is the key prioritisation metric used for asset renewal scope selection. Asset condition provides a measure of how far away an asset is from the end of its useful life. Aurizon Network applies a 5-level rating system to assign condition ratings to assets. The assessment criteria for each condition state are described in Table 194.

Table 194 Description of Asset Condition Ratings within the SPM

Condition State Rating	Subjective Rating	Description of Rating
1	GOOD ("as new")	Free of defects with little or no deterioration evident. 100% of Asset Life remaining
2	FAIR (Preventive Maintenance)	Free of defects affecting performance, integrity and durability. Deterioration of a minor nature that is monitored via preventive maintenance activities.
3	POOR (Corrective Maintenance)	Contains defects that are beginning to affect the durability/serviceability, which may require monitoring and/or remedial action. Some components or elements show quantitative signs of advancing deterioration. Corrective Maintenance activities are normally required. Increase probability of asset failure due to condition.

4	VERY POOR (Action required)	Significant defects affecting the performance and structural integrity of the asset are present. Such defects require immediate intervention including inspection or Operational restrictions. Asset shows advanced deterioration and/or evidence that it is acting differently to its intended design mode or function. Very high likelihood of a failure of the assets primary function.
5	FAILED (Immediate action required)	The asset has failed or has impending failure to one or more primary functions. Asset integrity is severely compromised. The asset has reached the end of its useful life.

Location and operational criticality as part of the Scope Priority Model

The identification and assignment of locational and operational criticality is the second key prioritisation metric (also 1-5 rating) used for asset renewal scope selection. An asset’s operational criticality rating takes the following factors into consideration:

- Tonnage – the base Criticality rating is determined using Net Tonnes on a Track Segment;
- Traffic Purpose – the base Criticality rating will increase if the traffic over the Track Segment includes passenger trains (i.e., North Coast Line and Central West Line (Blackwater System)). This metric varies based on the maximum speed of those passenger trains over a Track Segment; and
- Capacity Impact – potential loss of throughput at reduced capacity caused by asset failure.

Condition / Criticality Ranking – CRA (Combined Risk Assessment) Rating

These two ratings are then applied in a CRA to enable prioritisation across all CQCN assets identified for renewal and application of asset management strategies. Prioritised assets can then be taken forward into the planning process to refine budget and access requirements for asset renewals and enable a risk-based approach to the communication of information affecting the CQCN between Aurizon Network to customers and stakeholders.

- Applying an asset condition rating is also an evaluation likelihood of condition-based failure per annum for individual assets;
- Applying an operational criticality rating is also an evaluation consequence associated with condition-based failures for individual assets given a particular location on the network;
- These two elements combined provide a CRA scope of 0.5 to 25 (0.5 being the lowest impact and 25 being the highest impact) for each asset proposed for prioritisation into the Asset Renewal program for a given year; and
- Condition is reassessed and updated, if required, at each subsequent planned asset inspection. Criticality assignment is reviewed as part of the review of Asset Location Criticality Manual. The last update was in FY21 with the next planned revision in FY27.

Figure 91 Asset Renewal Prioritisations CRA rating = Condition rating x Criticality rating (scoring 1-25)

Condition Rating	Operational Criticality Rating				
	1	2	3	4	5
0.5	0.5	1	1.5	2	2.5
1.0	1	2	3	4	5
1.5	1.5	3	4.5	6	7.5
2.0	2	4	6	8	10
2.5	2.5	5	7.5	10	12.5
3.0	3	6	9	12	15
3.5	3.5	7	10.5	14	17.5
4.0	4	8	12	16	20
4.5	4.5	9	13.5	18	22.5
5.0	5	10	15	20	25

The application of both the asset condition and operational criticality rating allow Aurizon Network to rank and prioritise asset renewal requirements into one of the three categories shown in Table 195. This provides the process through which asset renewal requirements for each Coal System are assessed for the year. This prioritisation process is being reviewed annually to improve and refine this methodology.

Table 195 Identify the rationale for renewal activities

Rationale for Renewal Activity	Description
Critical Activity	Renewal of this asset is critical. Asset is in a poor condition and in a critical location. If not renewed, the asset would be expected to fail in the near term. CRA Rating of 16-25 including reactive scope
Activity to promote Reliability	Renewal of this asset is required to promote system reliability. Assets in a moderate condition in a critical location that are not expected to break but if did would cause outage on critical track sections; or Assets that are in poor condition in a noncritical location that are expected to break but would still have an impact on one or more Customers. <ul style="list-style-type: none"> CRA Rating of 12 – 15.9, or a condition above 3.1 in Moura or key pre-work for future years e.g., design)
Strategic Activity	Investment of this asset is recommended for strategic reasons. For example, to smooth future peaks in investment or asset activity. For CRA review, this scope nominated as Strategic

12.1.4 Access Planning

Once the scope has been identified and prioritised through the SPM, it is then subject to a detailed review to align the required scope with the capability and capacity of Aurizon Network and its suppliers. This process considers the requirements of other Supply Chain Participants and assesses both the plant and indicative time-on-track requirements for completing the works.

During the access planning process, Aurizon Network identifies the critical items of scope that drive closure lengths and aligns these works with planned system closures wherever possible. Similarly, scope may shift between financial years where appropriate to do so. For example:

- Scope may be brought forward into an earlier year to align with a planned closure in a certain location. This allows Aurizon Network to package other activities in that same (or similar) location; or
- Scope may be deferred to a later year (if asset condition allows) so that Aurizon Network can appropriately manage the combined track access impacts of delivering Committed Capacity.

Aurizon Network must also consider any additional maintenance holding costs of deferring scope identified through the SPM including:

- Additional inspections;
- Temporary speed restrictions;
- Risk of failure and consequential impacts of failure if deferred; and/or
- Reliability, performance and impact to the Committed Capacity.

The Access Planning process is discussed in further detail in Chapter 12 of this submission.

12.1.5 Customer Endorsement

As part of the annual Maintenance and Renewals Strategy and Budget process, approval from the individual Coal System End Users is sought. The process allows for engagement at stages throughout the development of the strategy and budget to provide greater visibility of asset strategies and delivery options. Aurizon Network is seeking to increase this collaboration to extend earlier in the strategy development phase.

12.1.6 Execution Planning

As highlighted to Customers through the Access Planning customer forums, Aurizon Network undertakes several activities that are intended to inform and refine the scope of work prior to execution. These activities will take into consideration detailed design and delivery methods relevant at each specific job site.

It should be noted that there can be a substantial timing difference (of up to 18 months) between planning and execution of works. Considering it is expected that these refinements may result in variations between the scope of work presented to the RIG and the detailed scope that will eventually be delivered.

12.1.7 Understanding Scope Change

Aurizon Network notes that scope identification is an iterative process. Rail Infrastructure in each Coal System is exposed to extreme forces through the passage of rollingstock, climatic extremes, and localised geological and hydrological conditions. It is expected that asset condition will change over time and therefore, scope will need to be amended in line with those changes.

Change is understood across

- Cost – cost changes against forecast provided in MRSB
 - Increase / decrease due to contractor costs change on engagement
 - Increase / decrease due to procurement of materials
- Scope – change of scope location or size against proposed MRSB
 - Size of scope or distance of works at specific location changes. For example, a Bridge Rollout site distance is extended to take in beyond the bridge ends to clean the ballast not accessible by the BCM

- Location change – an asset considered for renewal in a future year is brought forward as it has degraded at an accelerated rate. This can result in additional scope added or a substitution of scope to not effect planned closure time or resourcing
- Track Access Time – change to the track access time as proposed in the MRSB
 - Effect of scope change on required time to complete additional task

The asset activities presented in the FY23 Final Draft Proposal may not be planned for execution for another 18 months. During that time, the scope and cost of the required activity may vary from the FY23 Final Draft Proposal, taking into consideration changes in asset condition, or because of other activities that are undertaken to refine the scope of work at each specific location prior to execution.

A summary of the activities undertaken closer to the execution of works is outlined in Table 196 below.

Table 196 Activities that may impact scope

Scope Refinement	Potential scope impact
Finalisation of detailed design	Completion of detailed design work may impact the assumed scope delivery method. For example, the initial design assumptions for a structure renewal may indicate that 4 cells of a culvert need to be renewed. The detailed design for the specific culvert may indicate that the renewal of 5 cells is required.
Site walkouts	Site walkouts may identify access issues/opportunities specific to the worksite. For example, the condition of access roads may be poor and require an upgrade to accommodate materials being transported to site. Alternatively, Aurizon Network may need to reach an agreement with private landowners prior to the works being completed.
Constructability review	Assumptions relating to the construction methodology and works plan may require amendment. For example, a turnout can be built within the track, or it could be built alongside the track and then lifted into place via franna cranes. Differences in construction methodology can impact resource requirements.
Sub grade (soil) and hydrology assessments	A variation in the expected sub grade and soil conditions compared with design assumptions may impact site access and construction methodology assumptions.

As part of the development of the FY23 MRSB, Aurizon Network undertook a likelihood of change review of the identified scope. This process assigned the likelihood of change against each scope item to determine where the opportunity for change exists and what processes need to be completed ahead of execution to reduce the likelihood of change.

In all these change instances the change may be an increase or decrease to whether scope, cost or time.

The output from this likelihood of change review is summarised in Table 197 below. Detail of individual scope items with a high likelihood of change are called out in the System-specific sections of Part A.

Table 197 Output of Likelihood of Change Review FY23

System	Metric	Likelihood of change			Total
		High	Medium	Low	
Blackwater	Scope Items	18	132	223	372
	% of total Scope	5%	35%	60%	
Goonyella	Scope Items	25	52	236	25
	% of total Scope	8%	17%	75%	
Newlands	Scope Items	14	20	32	66
	% of total Scope	21%	30%	49%	
Moura	Scope Items	8	30	38	76
	% of total Scope	10%	40%	50%	

An example of this desire to reduce change in the program has been the deferral of Turnout scope in FY23. In prior years Aurizon Network has proposed scope for turnout renewal without the completion of full site design. Turnouts are a complex asset and detailed design is required to ensure the integration between the Civil, Control Systems and Electrical assets is fully understood and accounted for. In the absence of this full design, the uncertainty of cost, and time to complete task introduces a high likelihood of change is high.

Program change is managed through a structured Change Management process and approved under a tiered review system. This tiering has been discussed with the Rail Industry Group and change is reported as part of the quarterly Rail Industry Group report.

In the event of significant change due to factors outside Aurizon Network control such as weather impacting planned closures, Aurizon Network will engage with the RIG to determine options to complete the tasks effected.

12.1.8 Future renewal activities that may require profile smoothing

Table 198 below provides additional information on specific infrastructure programs where Aurizon Network considers it may be prudent to smooth the investment and related access impact instead of being subject to peaks and troughs between years. During FY23, Aurizon Network will be developing the tactical renewals plans for the below mentioned assets with the objective to appropriately manage current condition, future scope requirements and size of the investment.

Table 198 Future renewal activities that may require smoothing

Program	Investment trigger / Requirement
Autotransformers	<p>In recent years a condition-based Autotransformer (AT) renewals strategy has been applied which resulted in approximately 4 AT renewals each year. However, as of June 2021, 26% of Aurizon Network's 249 ATs are aged between 31-40 years. When these ATs reach the end of their service life it is likely to create a large uplift in renewals investment over a short period of time. To smooth this uplift Aurizon has revised its strategy and now intends to renew 6 ATs per year, commencing in FY24.</p> <p>Renewals will continue to be prioritised based on condition and utilising Aurion Network's in-house Dissolved Gas Analysis (DGA) and condition analysis tools.</p>

Program	Investment trigger / Requirement
CQCN Structures	<p>Across the CQCN there are 357 bridges and 4,030 culverts. These structures can be categorised by their design load ratings. The installation dates of these structures range from the early 1960's (Blackwater) to recent installations because of system expansions and renewals.</p> <p>These assets are concrete structures and, as such, have design lives of up to 100 years. An emerging issue is a number of these structures are operating above their design load capacity. Each Coal System is currently a 26.5tal operation (110t wagon across 4-wheel sets = each axle loaded at 26.5tal). Structures have load ratings from as low as 15tal to 22tal on culverts and bridges throughout the network.</p> <p>This overloading of structures increases the rate of deterioration to the asset, which Aurizon Network is monitoring. As with all structural assets the condition of the asset is still the primary driver for renewal.</p> <p>In FY23 Aurizon Network will continue its condition assessment of aged structures to develop a renewal plan of these assets operating above design load capacity.</p>
Callemondah Turnouts	<p>Callemondah rail yard is located near Gladstone. Blackwater and Moura train services traverse the yard and are staged into the RG Tanner coal export terminal. While the yard has expanded over time as tonnages have increased, it is land-locked by waterways and Gladstone Airport. Therefore, the yard can experience significant congestion.</p> <p>Any infrastructure works in the yard precinct require closure of the road that is being renewed as well as adjacent roads to maintain safe working conditions. In addition, the electrical circuiting and signal interlockings are such that taking an isolation of either will remove power or signalling from significant areas of the yards. Again, this has the effect of reducing throughput capacity for the duration of the works.</p> <p>Aurizon Network has identified that 4 turnouts require renewal and the 1970's relay-based signal interlocking requires an upgrade.</p> <p>The separate delivery of these activities would cause substantial operational interruption. A delivery plan has been developed for all required scope while minimising the supply chain impact of the yard outage. The delivery plan integrates all activities into one plan for efficiencies. Works are spread over multiple years to complete coordinated preparation works like an Ergon Pole Relocation, rail and formation works for the turnout renewals as separated activities working toward completion in FY24.</p>
Signalling Interlockings	<p>Aurizon Network uses both Relay Interlockings and Processor Based Interlockings (PBI). Relay interlockings are typically the more aged interlockings in the system and have a nominal life of 35 years. They have been proven in the Aurizon Network context to operate with minimal disruption out to 40 years. Relay interlockings and the older PBI interlockings installed in the 1990's is currently under review for renewal having reached their nominal service life.</p> <p>Failure of these assets will have a significant throughput impact on the affected section that the interlocking manages. The work around would see trains having to travel on manual proceed authority (forms), which would have adverse operational impacts compared to the interlocked system. Additionally, the time to remedy is approx. 6 weeks to 3 months to procure install and commission the replacement assets.</p>

12.2 Maintenance approach

Aurizon Network's approach to maintenance is based on the concept of Reliability Centred Maintenance using qualitative and quantitative data, which seeks to minimise unplanned response or intervention and, consequently, provides the best opportunity for Aurizon Network to deliver Committed Capacity. Maintenance processes are regularly refined to build on practical, results-based continuous improvement.

12.2.1 Maintenance approach differs by asset type

There are a wide variety of assets that make up the rail infrastructure in each Coal System and they degrade at differing rates due to their construction materials and their location. To manage the variability in asset degradation, Aurizon Network applies several maintenance approaches to minimise supply chain disruption due to asset condition.

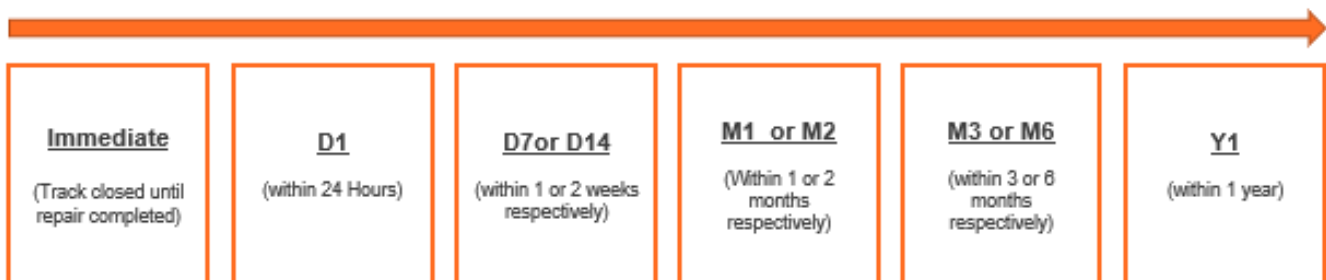
Preventative maintenance is conducted at the intervention levels specified in Aurizon Network's AMRP, which are based on intervals of time, condition and usage. Due to their predictive nature, Aurizon Network seeks, wherever possible, to align the delivery of preventative maintenance activities with the requirements of the supply chain.

As a result, preventative maintenance generally has a 'less-intrusive' impact on the supply chain, due to its planned and coordinated nature. Planned maintenance activities are packaged to maximise the amount of scope completed during planned closures in each location, which in turn can create access, delivery and cost efficiencies.

Not all activities can be planned. The forces exerted through the passage of rollingstock, and Queensland's weather extremes will, on occasion, create the need for unplanned interventions. Unplanned maintenance includes fix-on-fail incidents or corrective maintenance that may occur during operations of the network.

Aurizon Network prioritises corrective maintenance activities based on tonnage, traffic purpose and capacity impact, which informs the rectification timeframe options as outlined in Figure 92 below.

Figure 92 Timeframes associated with corrective maintenance activities



Due to the unpredictable and, reactive in nature of these events, the maintenance budget is generally based on historical observations, more information is located in Chapter 13.

Apart from mechanised maintenance activities, such as Rail Grinding and Resurfacing where scope can be clearly defined based on tonnage-based intervention rates, the forecast maintenance task for other corrective activities is highly variable. As specific scope items for most non-mechanised maintenance activities are unable to be identified prior to the commencement of a year, no definitive scope is provided for these maintenance items.

Further information on Aurizon Network's maintenance approach for different asset types is provided in Table 199 below.

Table 199 Maintenance approach

Maintenance Approach	Description	Applied to Assets	Maintenance Activity
Condition or Tonnage based intervention	Maintenance programmed to occur once a usage threshold is met. Maintenance can be programmed ahead of time due to forecast traffic movements.	Rail, turnouts and ballast.	Rail grinding – of both track and turnouts to return the rail profile to design and remove any minor faults Resurfacing – of both track and turnouts to maintain track to the design geometry and ensure track alignment
Planned Inspection and Service (Preventative Maintenance)	Periodic inspection of assets to understand condition and identify items that may cause a future fault. Period of inspection is known and can be planned.	Rail, sleepers, turnouts, ballast, formation, culverts and bridges	Track geometry recording – specialised track vehicles or ATIS, to measure geometric characteristics of track alignment Ultrasonic rail testing – non-destructive testing to identify internal rail defects On track inspection – road rail vehicle inspection of the rail corridor Structures inspection – inspection of critical elements of the structures to categorise defect type and quantify severity – ultimately providing an overall condition rating. Ground Penetrating Radar – specialised non-destructive testing employed to help understand and quantify ballast fouling severity. This data complements other contributory datasets (e.g., track geometry) to develop and determine ballast cleaning scope more accurately.
		Signals, interlockings, level crossing protection, optic fibre, standby power system, SCADA system, radio system	Control Systems planned periodic inspection and minor servicing. Includes function testing, signal alignment testing, battery testing, cleaning and security check.
		Power systems and overhead line equipment	Electrical planned periodic inspections and minor servicing. Includes condition testing, oil sampling and isolator testing.
Planned Corrective Maintenance ⁸	Planned rectification of faults found from inspections or remote monitoring. Period to rectify is dependent on the severity of the fault or risk to operations.	Rail, sleepers, turnouts, ballast, formation, culverts and bridges	Rail joint maintenance – rail welding, rail plating and lifting and lining rail joints, squat removal Maintenance Ballast – small section ballast repair / replacement, removal of mud holes Sleeper cluster management – spot insertion of sleepers to repair damaged sleepers, sleeper testing, fastening repairs and sleeper respacing Rail stress adjustment – rail stress testing and adjustment to manage compression and expansion of the rail Top and line resurfacing – hand track tamping and small machinery tamping

⁸ Most of the 'Planned Corrective Maintenance' effort is found in the general track maintenance and corrective signalling maintenance items. The nature of the works typically involves responding to faults identified by track inspection, specific asset inspection and rollingstock operators. Activity can be planned according to the severity and the time period for fault remedy of the identified fault.

Maintenance Approach	Description	Applied to Assets	Maintenance Activity
			Structures repairs – minor concreting works, kerb repair, walkway repair, bridge drain cleaning General earthworks maintenance – embankments and cutting repair, drain cleaning and access road maintenance
		Signals, interlockings, level crossing protection, optic fibre, standby power system, SCADA system, radio system	Control Systems maintenance and component repair.
		Power systems, overhead line equipment	Electrical general maintenance and component repair
Reactive Maintenance	Immediate remedy of faults that have disrupted operation of the rail network	Rail, sleepers, turnouts, ballast, formation, culverts and bridges	Rail repairs – immediate repair of broken rails, failed welds or internal defects Mud hole removal – saturated fouled ballast sections dug out and repaired to maintain track alignment
		Signals, interlockings, level crossing protection, optic fibre, standby power system, SCADA system, radio system	Communication failure response – rectification of a brake in the telecommunication chain across the CQCN. This can be a fibre optic breakage, microwave radio fault or digital radio issue Wayside equipment alarm response – investigation as to the trigger of an alarm such as a dragging equipment detector or bearing acoustic detector Power failure response – rectification of mains power to signalling and wayside equipment. Solar and generator provide immediate power but for limited periods
		Power systems, overhead line equipment	Dewirement repair – infrastructure requiring replacement because of a dewirement Trip investigation – to understand the cause of electrical trips and to remedy fault ahead of re-energisation

13. How we plan asset activity and assess capacity impacts

Aurizon Network understands that asset activities may directly impact the ability for Train Operators and Customers to undertake above rail operations in each Coal System. Effective asset management has the task of managing asset activities and the impact this work has on Committed Capacity. Aurizon Network is acutely aware that engagement and consultation on our access planning processes is important to Customers and will enhance Aurizon Network's ability to align maintenance and renewal activities with their requirements. Such alignment will result in a better Access Plan for all supply chain stakeholders.

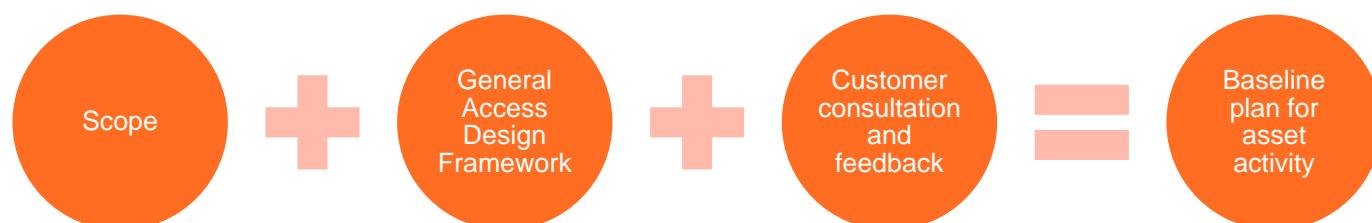
13.1 Access Planning Strategy

The overall strategy for Access Planning has been driven by:

- Maximising access for customer train services to support delivering of committed capacities;
- Coordinating closures with other Supply Chain Stakeholders, including mines, above rail and unload destinations;
- Maximising work conducted during closures as defined by the critical scope duration;
- Maximising the work undertaken during integrated closures;
- Targeting asset reliability and safety requirements of the rail infrastructure; and
- Promoting the prudence and efficiency of costs.

Possession planning is typically undertaken based on the asset management scope requirement and resulting level of customer impact. Through an interactive process, Aurizon Network assesses each element of scope and attempts to deliver it in such a way as to minimise the overall impact to all Network Customers. The high-level process of developing the Access Plan is outlined as:

Figure 93 Overview of Access Plan



13.2 General Access Design Framework

The General Access Design Framework establishes the overarching structure of the possessions plan by identifying strategic requirements and seeks to incorporate requests from other Supply Chain Stakeholders to develop the Access Plan. This is synonymous with a 'basis of design' on engineering projects.

For the FY23 Final Draft Proposal, key assumptions of the design framework are outlined in Table 200 below.

Table 200 Assumptions of the Access Design Framework

Description	Realised benefits
Avoid June & December	Customers require these months to be kept free from major maintenance activities to allow for maximum railings for end of financial year and end of calendar year targets.
6 weekly cycles for Goonyella & Blackwater Systems	By planning integrated closures in 6 weekly cycles: <ul style="list-style-type: none"> Aligns with major ports maintenance closures delivering supply chain coordination Drives an overall reduction in frequency of closures allowing Customers to rail more coal.
Strategic closure sequencing	Adequate timing between corridor integrated closures reduces delivery costs through improved resource utilisation and alignment with the Queensland Rail network (NCL) closures
Alignment of major supply chain interfacing infrastructure outages (Port unloading closures, Train Loadout closures) with high impact Network activity and/or locations	We actively engage with Customers and unloading facilities on their interfacing infrastructure maintenance outage plans to look for opportunities to coordinate our maintenance activities, reducing customer impacts and maximising throughput for the supply chain.
Export terminals with overlapping major unloading/dump station	Early engagement with ports allows Aurizon Network to facilitate collaborative sessions to understand their requirements, align closures and identify opportunities that seek to ensure that Committed Capacity can be delivered.
Spreading works across weeks/months	Spreading works over the period allows the supply chain opportunity to recover in a stable way across the year & assists in delivery of monthly contractual obligations.

13.3 Access Planning Process

The publication of the Critical Asset Activity Calendar (**CAAC**) provides transparency around the detail of the relevant years renewal plan and subsequently informs the Capability Train Plan. This process assists in the development of the FY23 Final Draft Proposal and aligns to the Network Annual Access Strategy for the relevant period.

In the interest of simplifying our access planning processes, Aurizon Network has developed a three-phase process (outlined in Table 201 below), which represents the evolution of Access Planning and maturity of the plan.

Table 201 Key elements of access planning process

Maturity of planning lifecycle	Maturity of Plan	Action to Progress Plan
Aurizon Network share 1st draft of possible closure requirements for consultation		
Phase 1	Project Location (First draft CQCN Integrated Closure Plan)	Output of the SPM shows the type and location of work required. From there, determine the level of impact to Customers including an indication of required time on track.
		Early engagement with QR and the Ports to work through any misalignment issues on integrated closures across the supply chain. Discussions with producers on demand projections over the year to determine high demand/low demand months. Output: Draft CQCN Integrated Closure Plan highlighting critical path scope and locations.
Customers provide feedback as part of consultation process on proposed CQCN Integrated Closure Plan.		

Maturity of planning lifecycle		Maturity of Plan	Action to Progress Plan
Phase 2	Project Scope (Second draft CQC Integrated Closure Plan)	Customer feedback from Phase 1 and what we need to consider as part of Phase 2. A high-level project scope design informed by engineers and site walkouts, providing a clearer picture of the scope requirement and any site-specific issues.	Provided updates to Customers on how their feedback will be considered as part of Phase 2. Output: Draft CQC Integrated Closure Plan highlighting changes from Phase 1 and Integrated Branch line Closures.
Customers provide feedback as part of consultation process on customer specific issues.			
Phase 3	Project Delivery (Maintenance Strategy and Budget, Renewals Strategy and Budget and CQC Asset Activities Report)	A detailed design, delivery method and procurement methodology for some asset activities with maturity continuing to increase closer to execution. The Customers have provided feedback on the access plan, to inform the FY23 Final Draft Proposal.	Output: Draft Maintenance Strategy and Budget, Renewals Strategy and Budget Output: Customers now have access to Power BI CQC Asset Activities Report (representing the CAAC)

13.4 How we plan asset activity to optimise time on track

The Access Planning process relies on collaborative workshops across Aurizon Network planning teams working towards a common goal of maximising availability for our Customers while delivering a safe, reliable network. This approach tests customer impacts using ‘real-life’ experience drawn from multiple parts of the organisation. Planning in this way allows Aurizon Network to develop and refine an access plan that seeks to minimise disruptions to Customers while still completing the necessary scope of maintenance and renewal activity.

Asset activity is executed using a variety of track possession approaches outlined in Table 202 below which seek to minimise customer impacts and maximise safe access for people and plant.

Table 202 Summary of track possession types

Type	Definition	Key Objectives	Example
Integrated Possessions	When asset activity is required in high impact locations, requiring significant track time or results in significant capacity impacts. Track is typically non-operational to revenue services	To combine asset activities into an integrated closure to enable maximum works to be completed as efficiently as possible. Where possible, this is in line with other supply chain outages (i.e., port closures).	Culvert Replacement, and Ballast Cleaning
Single line possessions	When asset activity can be completed on one track in a duplicated section whilst the other track is kept operational to allow for continuous train services.	To allow execution of scope that can't be completed in Integrated Possessions while allowing some services to continue, minimising network impact.	Track Laying Machine
Shadow possessions	When asset activity can be completed in sections by taking advantage of areas of the network that are unviable for coal trains due to other renewal or maintenance activity occurring and doesn't consume any additional capacity.	To maximise scope being completed without consuming additional capacity.	Rail Stress Management
In-between train services	When smaller asset activity tasks can be undertaken in a safe and controlled manner on track whilst no trains are present or by utilising capacity not	To minimise the impact to capacity by working between trains. However, cost	Points Maintenance

Type	Definition	Key Objectives	Example
	required for coal services (in low demand weeks).	could increase due to inefficiencies (waiting access).	
As a scheduled rail service (moving maintenance or resources)	There are track vehicles or track machines requiring access to perform inspections or maintenance such as, but not limited to, recording cars, high rail inspections, grinding and movement of rail plant.	To complete scope / inspections as efficiently as possible without impacting rail traffic.	Mainline Track Resurfacing
Plan throughs (nil access required)	When asset activity or general maintenance is completed outside the operational areas of the railway having no impact to train services.	To complete scope with no impact to capacity.	Fault Inspection capacity.

13.4.1 Asset activity undertaken during Integrated Closures

Key to minimising the access impact of asset activities is maximising the works planned during integrated closures. This section identifies the location, timing, and duration of these closures over the FY and describes the benefits of completing the works during this type of closure.

In planning an integrated closure, particularly for critical path work packages, consideration is given to the scope planned to be delivered, also in addition to work that could be undertaken prior to the closure. For example:

- Splitting the activity across multiple closures;
- Scheduling the work to commence whilst the system is in ramp up or ramp down, i.e., when consists are stowed;
- Access to the work site;
- Laydown areas or equipment pads;
- Sources of material and their transport;
- Performing activities in parallel;
- Interface management, e.g., isolations, protection etc; and/or
- Access to key plant and labour resources, e.g., resurfacing plant

Critical path activities

Each year, the closure pattern is driven by required renewals scope. For every integrated closure there is typically one significant renewal activity (i.e., the critical path activity) that will determine the length of the closure. Critical path activities are identified and distributed across the year during the access planning process.

Other scope in the impacted locations is subsequently identified and planned for delivery within the same possession to ensure that Aurizon Network can maximise the scope of work to be delivered during the time that the rail infrastructure is closed.

Internal resources, contractor availability and other support facilities (e.g., accommodation) are considered with work capped at around 100-150 independent activities per closure. Some spare capacity is maintained to allow for any corrective maintenance to occur within the possession. These activities are often not known until 84 to 28 days prior to the planned closure.

Other work may be added provided it can be completed safely, does not impact the resources or equipment that are required for the critical activity, and that it will not cause a delay in handing back the track at the expected end of the closure.

13.4.2 Asset activity undertaken outside of Integrated Closures

Not all asset activities can occur within integrated closures due to the limited duration of these possessions, resourcing availability and the nature of delivering these activities.

Mechanised Maintenance and Renewal

Mechanised maintenance and renewal activities that are completed outside of integrated closures are managed in a way that seeks to minimise the impact on Committed Capacity. Table 203 below outlines some of the principles Aurizon Network applies to minimise supply chain impacts when planning activities that take place outside of closures.

Table 203 Mitigating the capacity impact of works that take place outside of Integrated Closures

Task	Planning Principle
Ballast Cleaning	Ballast cleaning scope is delivered predominantly inside integrated closures. Where necessary, single closures are required to deliver identified scope. Supply chain impacts are minimised by planning the highest-impact locations for completion within closures. Where possible, the BCM follows and utilises all systems closures to minimise its requirement for access outside of closures.
Rail Grinding	Rail grinding is an essential preventative maintenance activity that reduces rail defects and extends rail life. Rail grinding is a planned activity with frequency rates defined in track standards. The frequency is dependent on the track alignment, i.e., more grinding on curves than straights. Planning is based on when track sections will reach usage triggers. The activity is planned to minimise capacity impact by considering annual program to ensure capacity and scope requirements are met.
Track Resurfacing	Track resurfacing reinstates the rail alignment and rail geometry by adjusting the position of the sleepers, rail and ballast to required designed characteristics. It is a planned task triggered by usage to rectify identified faults after inspections. Track resurfacing is also undertaken as part of renewal activities where the track has been disturbed This activity is planned between coal trains to minimise impact
Road Runs	On-track inspections as part of the planned inspection strategy mandated by Aurizon SMS. It is a cyclic activity conducted each 96 or 192-hours dependant on location. Road runs are a planned activity however optimised to only consume unutilised or part paths where possible.
Asset Inspections	Track geometry measurements, overhead alignment (Blackwater and Goonyella), fault identification and ultrasonic rail testing. Considered and planned by Aurizon Network but may be adjusted at the start of the ITP process to minimise impacts on Train Orders

Non-mechanised asset activity

Where possible, Aurizon Network plans asset activities to take place in the shadow of other work to minimise potential adverse impacts on train operations or system capacity. This allows multiple activities to occur simultaneously without consuming additional capacity.

An asset activity may also be planned and delivered after the Intermediate Train Plan (ITP) has been laid down (which allows flexible activities to be planned in the spaces between trains) or in-between trains on the day of operations. This is achieved through direct consultation with Train Control. Where asset activities can be conducted efficiently and safely between trains, Aurizon Network's operational teams will opportunistically utilise this time to minimise the impact of required asset activity on supply chain operations.

Asset activities that can be planned in this manner are outlined in Table 204 below.

Table 204 Activities that can be completed within the shadow of other asset activity or in-between trains

Activity		
Inspections and walkouts	Glued Insulated Joints (GIJ) management	Fencing
Preventative maintenance and repair of signalling, overhead and civil components (e.g., rail lubricators)	Fire and vegetation management	Drainage
Top and line spot resurfacing	Monument and signage maintenance	Power systems

13.5 Risk controls to maintain Train Service operability

Aurizon Network may implement operational controls as a means of managing the risk of asset failure in each Coal System. Aurizon Network applies these temporary measures as a means of allowing continued Train Service operability in the period between the fault being identified through to its rectification. The five types of controls are outlined in Table 205 below.

Table 205 Operational risk controls can allow continued train operation

Control	Description
Inspection Frequency	Aurizon Network completes additional targeted maintenance inspections to monitor the rate of degradation of the defect. The intent of this approach is to ensure that the defect does not result in asset failure ahead of the planned date of intervention.
Engineering Inspections	Aurizon Network utilises internal engineering capability to perform inspections, modelling and testing to understand the root cause and rectifications for complex defects.
Temporary Speed Restriction (TSR)	Track defects that are identified via inspections will be assessed as requiring either immediate rectification or the assets can be managed via a TSR until their rectification can be scheduled into and managed within a planned outage. Train speed is lowered during the period from fault identification to planned corrective action. This in turn, will reduce the risk of derailment or incident and the impact of dynamic forces caused by the passage of rollingstock. TSR's are also applied to manage risk of incident resulting from the environmental effects of heat or wet weather.
Temporary Authorised Non-Conformance (TANC)	A TANC is applied if an asset is operating outside its minimum operational standard. An engineering and safety risk assessment is undertaken to determine the appropriate treatment of these assets until the point that they can be rectified. Track speed may also be reduced, and the typical risk treatment is increased inspection to monitor asset performance. A TANC is only raised in exceptional circumstances for defects that cannot be actioned within the required Action Priority timeframe and must be approved by the Asset Manager. Not all TANC's will require a TSR to be imposed; an assessment will be made based on the nature and location of the defect. Where a TANC does require a TSR, the impact is incorporated within Aurizon Network's TSR reporting.
Temporary track closure	If a fault has been identified on a section of track, it may be isolated by temporarily removing that section from service, and operating train services on alternate tracks around the fault. This is achieved by putting a coded block in the train control system to remove the ability to route a train into the affected area.

13.6 Meeting ongoing customer requirements

Aurizon Network's decision making during the access planning process is informed by feedback received from Customers through planned and/or informal engagements. Aurizon Network's focus is on maintaining or improving cost, reliability and performance of the rail infrastructure, taking customer requirements into consideration wherever reasonably possible, particularly in relation to branch lines and cross system impacts.

14. How we set budgets for asset activities

This chapter presents an overview of Aurizon Network's costing methodology for maintenance and renewal activities. It outlines the framework for setting the proposed budgets for each Coal System that are outlined in Part A of this FY23 Final Draft Proposal.

Aurizon Network confirms that its methodology for allocating costs between operating expenses and maintenance / renewal activities is consistent with the QCA-approved approach under UT5. Furthermore, it should be noted that Aurizon Network's below rail regulatory financial statements are subject to an annual review by an external, QCA-appointed, auditor. The scope of this review includes any such cost allocations.

14.1 Budget development for maintenance activities

14.1.1 Overview

Aurizon Network's approach to setting the FY23 Final Draft Maintenance Budget varies according to the nature of the asset activity categories that are required to be presented under UT5. While some activities, such as mechanised activities, are predictable and have a clearly defined scope, other activities are corrective (e.g., fix-on-fail) in nature which results in Aurizon Network utilising historical expenditure levels to inform annual budget forecasts.

Aurizon Network ensures clear separation between the costs attributable to asset activities in each Coal System. Any costs associated with asset renewals, asset activities on Third Party Private Infrastructure and Review Events (such as extreme weather events where losses exceed \$1 million) are separately captured which enables Aurizon Network to exclude such costs in their entirety when forecasting the maintenance budgets for each Coal System.

Different methodologies are applied to determine the costs relevant to the various maintenance items. The appropriate method varies according to the individual maintenance activity. Due to the more routine nature of the major mechanised maintenance activities, these activities are budgeted at a more granular level than non-mechanised activities.

Aurizon Network is continuing to pursue opportunities to enhance its OneSAP systems, data and processes to provide greater transparency of cost drivers and improve budgeting and forecasting process for future years.

The primary drivers of Aurizon Network's maintenance costs are discussed below.

Labour & Indirect Costs

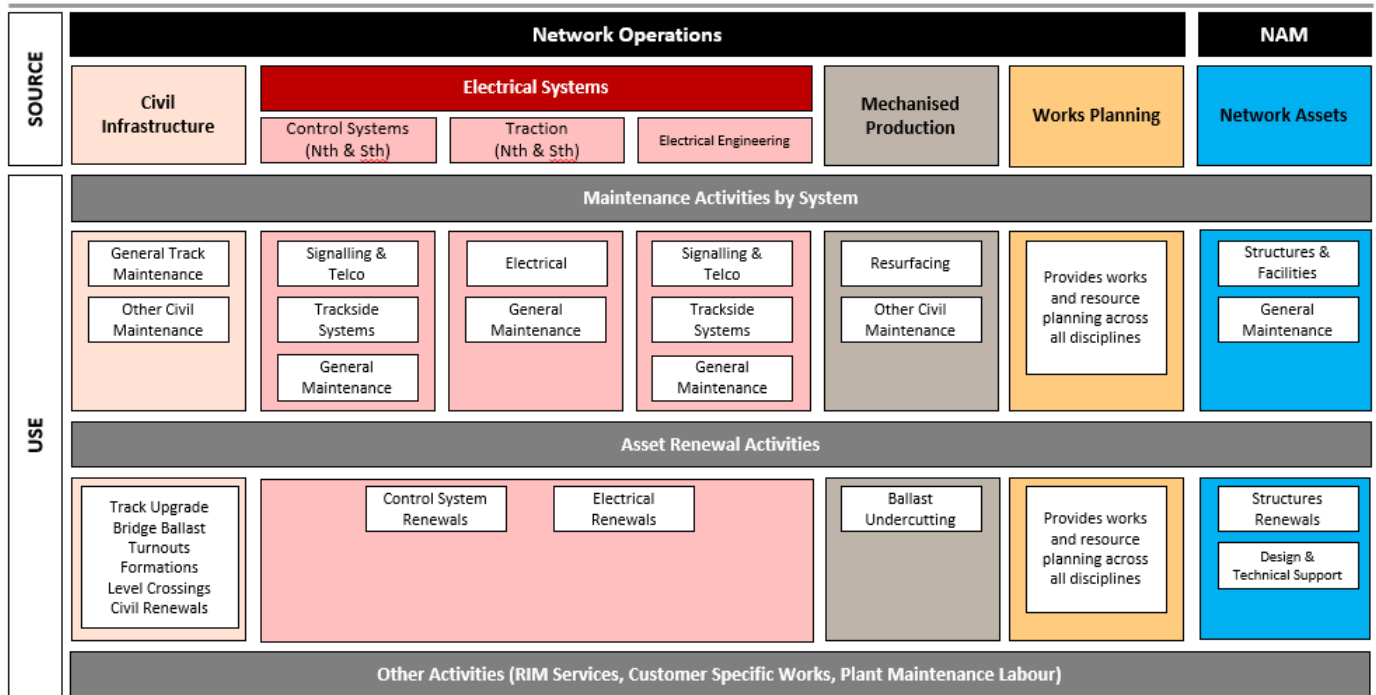
Labour and indirect costs account for more than half of Aurizon Network's maintenance costs.

Aurizon Network's maintenance and asset renewal program is executed primarily by Aurizon's Network Operations and Network Asset Management divisions in conjunction with externally procured resources.

An overview of Aurizon Network's operating structure together with the primary activities performed by each of the teams are summarised in Figure 94 below.

Figure 94 Aurizon Network Operating Structure

Sources & Uses of Gross Labour & Indirect Costs



Aurizon Network’s internal maintenance labour costs are relatively fixed over the short term. The key drivers of Aurizon Network’s labour costs together with an overview of the FY23 budget approach are summarised in Table 206 below.

Table 206 Labour Cost Drivers

Labour Cost Driver	Description	FY23 Budget Assumption
Workforce Size	The number of FTE's employed across Aurizon Network’s operating disciplines (Civil Infrastructure, Electrical Systems, Mechanised Production, Works Planning, Network Asset Management, Structures)	<ul style="list-style-type: none"> Resourcing is assumed to be broadly comparable with average resources employed across FY21 A review of electrical resources is being undertaken to address our aging workforce, the ongoing tight labour market and difficulty in securing qualified trade staff located in regional areas. Qualified Signal Electricians and Systems Maintainers require rail specific training that can take up to 6 years from the commencement of an apprenticeship. These qualifications are currently in demand with the high number of rail infrastructure projects across Australia. As a result, we have included 6 Control Systems trainees (4 – North, 2 – South) to mitigate these labour market restraints and the high number of qualified signal electricians and systems maintainers reaching retirement age in coming years in the south. While the focus has been on attraction and retention of electrical personnel, there is a requirement to address areas of risk in the civil and mechanised production teams as well which will be a focus this coming year. Each of these areas of the business are covered by the Infrastructure

Labour Cost Driver	Description	FY23 Budget Assumption
		Enterprise Agreement which expires on the 27 May 2023.
Gross Labour & Indirect Cost Escalation	Increase in per unit cost of labour to account for Enterprise Agreement rate increases	<ul style="list-style-type: none"> Labour has generally been escalated at 2.75% (Aurizon Enterprise Agreement: 2.25% plus legislated SGC Superannuation Levy: 0.5%) Indirect costs escalated at 2.00% in line with RBA FY23 CPI forecast at end of August 2021
Activity Mix (Maintenance, Capital / Other)	Proportion of time (and therefore cost) allocated to RIG maintenance, non-contract maintenance, asset renewal /other activity. Activity mix varies by team and sub-function.	<ul style="list-style-type: none"> Activity mix by team is assumed to be broadly consistent with mix observed in FY21.
Coal System Mix	Proportion of maintenance hours allocated to each Coal System (Blackwater, Goonyella, Moura, Newlands)	<ul style="list-style-type: none"> Depots (or cost centre) costs generally flow to one or potentially two systems depending on location. Budget assumes that maintenance allocations by depot / team to each of the 4 coal systems are broadly consistent with the mix seen in FY21A
RIG Category Mix	There are 9 RIG maintenance categories. (General Track, Other Civil Maintenance, Structures & Facilities Maintenance, Signalling & Telecommunications, Trackside Systems, Electrical, Track Resurfacing, Rail Grinding).	<ul style="list-style-type: none"> Activity by RIG category within each system is assumed to be broadly consistent with activity levels observed in FY21A.

Non Labour Costs

Non-labour costs comprise externally procured contractor resources, materials & plant usage, consumables and rail grinding. A summary of the key non-labour cost categories as well as an overview of the FY23 budget approach are summarised in Table 207 below.

Table 207 Non-Labour Cost Drivers

Non-Labour Costs	Description	Budget Approach
Externally Procured Resources	Costs associated with external contractors, hire charges and trade services. Aurizon Network supplements its own labour and plant resources with externally procured contractors where specialist skills / equipment is required, or where a large volume of activity is delivered concurrently. Most of the contractor activity is used to support activity in the General Track maintenance and Structures & Facilities RIG maintenance categories.	<ul style="list-style-type: none"> Budgeted cost of known contracts (e.g., Track geometry contract, ultrasonic rail testing contract) Other contractor costs estimated having regard to historic spend and estimated escalation
Materials & Plant Usage	The cost of materials (ballast, rail, sleepers etc) used in project operations either charged directly or consumed from inventories stores and pass-through costs for Aurizon Network owned major plant. All costs associated with major plant (e.g., operational and plant maintenance) are charged to jobs via a unit rate.	<ul style="list-style-type: none"> Machine charges are based on a detailed build-up of plant costs Other materials costs estimated having regard to historic spend and estimated escalation
Consumables	The cost of computer hardware and software, safety equipment, consultant fees, minor tools and plant, travel and accommodation, external freight and waste disposal	<ul style="list-style-type: none"> Budgeted cost of known contracts (e.g., Bulk Freight contract) Other contractor costs estimated having regard to historic spend and estimated escalation

Non-Labour Costs	Description	Budget Approach
Rail Grinding	Costs paid to an external third party for provision of rail grinding services as well as an allowance for the cost associated with the removal and re-installation of signalling equipment from track before and after the rail grinding activity.	<p>The budgeted cost of the rail grinding program in each Coal System is a function of the:</p> <ul style="list-style-type: none"> Forecast mainline and turnout grinding scope expected to be required in each Coal System; and Grinding rates per unit as specified in the Rail Grinding Services Agreement with the Service Provider. <p>Proposed budget also incorporates the costs associated with the removal and re-installation of signalling equipment from track before and after the rail grinding activity.</p>

14.1.2 Non-Mechanised Activities

The budget forecast of delivering non-mechanised maintenance activities have been developed with reference to the actual maintenance costs incurred in FY21 as well as Aurizon Network's FY22 full year rolling maintenance forecast.

Preventative Maintenance Activities

Budget forecasts for controllable or preventative maintenance expenditure categories have been set having regard to actual costs incurred on preventative activities during FY21 (captured for each maintenance activity at a work order level) and forecast costs for FY22 (at the end of September 2021). The budget also incorporates the impact of target efficiencies.

Corrective Maintenance Activities

Corrective maintenance activities tend to vary year-on-year and are reactive in nature. Consequently, it is not practical or possible to develop an absolute scope of work for these activities. Aurizon Network has estimated the costs for corrective maintenance activities with reference to historical corrective activities completed in FY21 and forecast costs for FY22 (at the end of September 2021). The budget also incorporates the benefit of target efficiencies.

14.1.3 Mechanised Activities

The costing methodology for the Aurizon Network's mechanised maintenance activities is summarised in Table 208 below.

Table 208 Summary of costing methodology for mechanised maintenance activities

Maintenance Activity	Costing Methodology
Rail Grinding	Budget for the forecast scope of works required in each Coal System reflect the contractual arrangements with the external Service Provider.
Resurfacing	Forecast costs for total resurfacing program with an allocation of cost between maintenance and capital activities.

Rail Grinding

Rail grinding activities throughout the CQCN are performed by an external service provider (currently Loram). Activities include the re-installation of signalling equipment from track before and after the rail grinding activity.

Resurfacing

Aurizon Network uses a fleet of four high production tampers and regulators and two Unimat tampers and regulators (collectively, the **Resurfacing Plant**) to deliver the resurfacing program of work required in each Coal System.

Aurizon Network's Resurfacing Plant was progressively put into operation between 2013 to 2016, to replace its aging fleet of tampers and regulators. The newer high production Resurfacing Plant are more efficient and can deliver the required scope of work with less track time.

Table 209 below provides a complete list of the Resurfacing Plant that Aurizon Network will use to deliver the resurfacing scope of work outlined in the FY23 Final Draft Proposal.

Table 209 Aurizon Network's Resurfacing Plant

Asset Number	Manufacturer	Model	Machine Description	Year of Production	Expected Life
394308	Plasser	Unimat 08-475/4	MMA 500 – High production switch tamper	Dec 2013	20 years
394309	Plasser	SSP302	MMB 500 – High production ballast regulator	Dec 2013	20 years
394311	Plasser	Unimat 08-475/4	MMA 501 – High production switch tamper	Apr 2014	20 years
394310	Plasser	SSP302	MMB 501 – High production ballast regulator	Dec 2013	20 years
353916	Plasser	09-2X Dynamic	MMA 503 – High production mainline tamper	Jul 2015	20 years
347100	Plasser	SSP302	MMB 503 – High production ballast regulator	May 2015	20 years
345584	Plasser	09-2X Dynamic	MMA 504 – High production mainline tamper	Feb 2016	20 years
347101	Plasser	SSP302	MMB 504 – High production ballast regulator	May 2015	20 years
369487	Plasser	09-2X Dynamic	MMA 506 – High production mainline tamper	May 2016	20 years
369486	Plasser	SSP302	MMB 506 – High production ballast regulator	May 2016	20 years
369489	Plasser	09-2X Dynamic	MMA 507 – High production mainline tamper	June 2016	20 years
369488	Plasser	SSP302	MMB 507 - High production ballast regulator	June 2016	20 years

In addition to the resurfacing plant outlined above, Aurizon Network also has a resurfacing consist (MMA 505 Tamper and MMB 505 Regulator) that primarily supports the ballast cleaning operation. An estimate of the resurfacing costs associated with the operation of two resurfacing machines have been included within the ballast cleaning program costs.

The Resurfacing Plant listed in the Table 209 are not dedicated to any individual Coal System. Each consist (comprised of an MMA and MMB machine) may be used to either:

- Perform maintenance scope (i.e., mainline and turnout resurfacing and civil support⁹); or
- Support asset renewal activities, where resurfacing is required after all track disturbing works to consolidate ballast and restore top and line, therefore forming part of the track renewal program.

This means that resurfacing operations can be planned in a way that ensures the consist closest to the work site can complete the task wherever possible.

The flexibility afforded by this approach not only helps to reduce the supply chain impact of resurfacing activities but also helps to promote operational efficiency. It achieves these objectives by reducing consist travel between work locations, which ultimately:

- Minimises the number of Train Paths consumed by Resurfacing Plant; and
- Helps to maximise production time per labour shift.

It should be noted that the resurfacing cost base is materially fixed year-on-year.

Resurfacing budget forecast

To set a budget for the FY23 resurfacing work program, Aurizon Network has:

- Estimated a forecast budget for operational labour and plant costs having regard to actual costs incurred in FY21 and forecast / budget costs in FY22; and
- Apportioned the labour and plant cost forecast budget between maintenance (mainline resurfacing, turnout resurfacing and civil support) and renewals activities based on estimated activity planned for FY23.

The maintenance budget for mainline and turnout resurfacing in each Coal System is then determined by applying a standard unit rate to the scope (of mainline and turnouts) planned to be completed in each system.

The resurfacing cost of renewal support works are incorporated within the track renewal program and are allocated to Coal Systems based on the location of planned scope for completion.

14.2 Budget development for renewal activities

14.2.1 Overview

Aurizon Network's budgeting approach for high-volume renewal activities, such as Track, Rail and Sleepers, typically relies on standardised rates. The unit rates for each renewal activity are determined at a CQCN level and then applied to the proposed scope locations to determine the budgets for each Coal System.

Budgets for other renewal activities rely on a combination of standard rates and adjustments to reflect common site-specific variables.

⁹ Civil Support costs form part of the 'Other Civil Maintenance' cost category and relate to minor (non-mechanised) ballast cleaning works.

Figure 95 Summary of costing methodology for Renewal activities

Type of Renewal Activity	High Volume Renewal Activity	Other Renewal Activity	Reactive Renewal Activity
Cost Estimation Approach	<p>Example Asset Categories</p> <ul style="list-style-type: none"> Track Renewal Sleeper Renewal Optical Fibre <p>• Cost estimated by applying scope to standard cost estimate</p> <p>• Standard cost estimated having regard to historic costs, escalation and other known cost movements as well as site specific factors</p>	<p>Example Asset Categories</p> <ul style="list-style-type: none"> Formations Structures Turnouts Electrical Control Systems <p>• Each scope item built up based on a standard cost informed by historic and forecast spend levels</p> <p>• Standard cost built up for each major cost component which allows for variability of each site (based on early preliminary inspection / design) to be considered</p>	<p>Example Asset Categories</p> <ul style="list-style-type: none"> Fix on Fail Formations Turnouts Rail <p>• Lump sum budget estimated based on historic average spend</p>

14.2.2 Costing methodology for renewal activities

High Volume Asset Renewal Activity

Renewal activities such as track, rail and sleeper renewals are ongoing, annual programs of work that will generally see Aurizon Network undertaking a large volume of the same activity year-on-year.

These activities typically follow a standardised work methodology which includes:

- Standard designs (that are adapted where necessary to account for site specific conditions); and
- A repeatable construction methodology at each work site.

Drivers of unit cost variability in this asset category include, but are not limited to the following:

- Scope quantity per site;
- Construction methodology – using plant such as the Track Laying Machine (TLM) allows for a greater amount of scope to be completed within a shorter timeframe, however, will incur plant costs;
- Weather impacts; and
- Available closure hours.

While there will be some cost variability between individual work sites, the level of standardisation and consistency within each respective renewal item has allowed Aurizon Network to develop a standard cost for each activity, based on the historic average cost per unit.

Other Renewal Activity

Other renewal activities include Civil Assets (such as formation, structures and turnout renewals), Control Systems Assets and Electrical Assets. These activities generally have lower volumes of scope and require either a detailed, site specific design, or the assembly of standard design elements appropriate for a specific site.

The forecast budget for these asset renewal items is informed by historic spend levels on the relevant cost elements (e.g., design, construction labour, and key materials such as autotransformers or prefabricated concrete culverts) and where possible, takes into consideration factors or variables specific to the work site (e.g., location of the nearest access point, proximity other infrastructure).

Reactive Renewal Activity

Aurizon Network will, from time to time, experience asset failure in some renewal categories such as formations and turnouts. The failure or expected failure of these assets will be identified as part of routine asset inspections and will result in a reactive replacement of the asset. Wet weather is the single biggest driver of reactive renewal work.

Given the difficulties associated with accurately forecasting the occurrence of asset failure, Aurizon Network has made provision for ‘reactive’ works within the forecast budget for formations, turnout, level crossing, electrical overhead and corridor asset renewals. These amounts are broadly based on historical average spend on reactive activities in each individual Coal System.

14.2.3 Ballast Cleaning

Ballast cleaning is made up of three specific items being BCM, excavator undercutting and turnout undercutting.

Mainline ballast cleaning costs have been built up by BCM with total forecast costs allocated to systems based on forecast scope that is planned for completion each financial year. Key assumptions underpinning the cost build up are summarised below.

Budgeted costs for excavator undercutting and turnout undercutting have been determined by applying planned scope by system to unit rates achieved in FY21 adjusted for annual escalation.

A summary of the approach to developing the FY23 budget is outlined in Figure 96.

Figure 96 Approach to forecasting the budget for Ballast Cleaning



Mainline Ballast Cleaning Cost Build Up

Mainline ballast cleaning costs have been built up by BCM. Total forecast cost (excluding Ballast Undercutting plant depreciation) associated with the operation of the BCM have been allocated to each Coal System based on forecast scope that is planned for completion each financial year. Ballast undercutting plant depreciation has been allocated to systems based on the number of days that the BCM is planned for operation in each system. For clarity, key assumptions underpinning the cost build up are summarised in Table 210 below.

Table 210 Ballast Cleaning Cost Assumptions

Assumptions	BCM Only
Scope	FY23: 122.53Km
Machine Operation	FY23: BCM Production rate of 83m / closure hour for the RM 902
Freight	1 dedicated train crew and 5 locomotives Costs largely reflect current contracting arrangements.
FTE	The new BCM entered production in May 2021. The increase in workstations and increased componentry requires additional labour to maintain. At present there is also a requirement for the existing employees to be ticketed and trained in the BCM which is being filled by labour hire. Mechanised Production is reviewing the optimal structure for future operational and plant maintenance staff requirements, and therefore an estimate has been included in the budget for labour hire.
Plant Depreciation	Ballast Undercutting plant depreciation has been allocated to systems based on the number of days that the BCM is planned for operation in each system.
Resurfacing Support	Utilise existing dedicated tamper and regulator.
Ballast	Cost estimates based on estimated screen-ability rates. Wet conditions will materially increase ballast costs.

Set out in Table 211 below is a summary of the estimated costs of mainline ballast cleaning for FY23

Table 211 Ballast Cleaning – BCM Cost Summary

BCM (C01) (\$m)	BCM FY23
Expenses by Type	
Labour	18.8
Plant Maintenance - Components	8.5
Ballast	3.7
Contracted Services	19.8
Signalling & Safeworking	2.0
Other	4.4
Total (excluding ballast undercutting plant depreciation)	57.3
Ballast Undercutting Plant Depreciation	6.1
Total	63.3

In relation to the above, the following comments are made:

- **Labour** – includes labour relating to plant maintenance, plant operation, plant engineers, reliability and planning staff in the Network Operations team.
- **Plant Maintenance** – includes machine components. Noted that maintenance cycle varies each year due to componentry that needs to be changed out.

- **Ballast** – contracted via procurement process. Supplied from various quarries across the CQCN to reduce transport costs.
- **Contracted Services** – includes external work groups conducting pre and post earthworks, rail stressing, stress testing as well as freight costs for ballast trains and undercutter.
- **Signalling & Safe Working** – includes site safety, track protection and pre and post signalling system works.
- **Other** – includes travel, fuel and consumables relating to plant and labour.
- **Ballast Undercutting Plant Depreciation** – the cost of ballast undercutting plant depreciation is recouped via the maintenance cost allowance but is shown in the cost build up for completeness.

Mainline ballast cleaning costs by Coal System are outlined in Table 212 below.

Table 212 Ballast Cleaning Costs by System

BCM (C01) (\$m)	BCM FY23
Ballast Cleaning Costs	
Blackwater	31.3
Goonyella	24.3
Moura	-
Newlands	1.7
Total	57.3
Ballast Undercutting Plant Depreciation	
Blackwater	3.3
Goonyella	2.5
Moura	-
Newlands	0.3
Total Ballast Undercutting Plant Depreciation	6.1
Total Ballast Cleaning	
Blackwater	34.5
Goonyella	26.7
Moura	-
Newlands	2.0
Total	63.3

NB: Figures may not add due to rounding.

15. How we deliver asset activity

This chapter outlines Aurizon Network’s considerations to delivering and executing the asset activity required in each Coal System along with the supporting procurement. The way in which asset activity is delivered is a key factor in ensuring Aurizon Network can meet Committed Capacity.

15.1 Access planning considerations

During the development of the Access Plan, high level works planning considerations have been incorporated to provide an indication of delivery planning, preparation, mobilisation, works duration, demobilisation and delivery risk. In preparation for the delivery of the project (either in a possession or outside of one), an execution strategy is developed which aims to create an optimal plan taking into consideration the competing interests of scope delivery, access and cost.

15.1.1 Works Planning governing principles

Aurizon Network considers key drivers across the asset works program as a whole and then as part of each major renewal activity. The governing principles that shape the execution strategy include:

Table 213 Works planning considerations

Matter for consideration	Description
Can work be packaged together (integrated)?	For example, ballast cleaning, rerail and overhead work all occurring within the same vicinity would be undertaken as one block of work utilising the same possession, track protection and electrical isolation.
Can the work be undertaken during an integrated possession?	Generally, work activities are planned during integrated possessions to the limit of available resources (people, machines and equipment and/or available contractors) and reducing the impact to Customers by minimising the footprints where possible.
Can the work be undertaken on a single line allowing trains to run on the adjacent track?	If the worksite is on duplicated track, a single line closure can be taken which would allow trains services to continue to operate on the adjacent track.
Does the work need to be undertaken during daylight or under specific weather conditions?	For example, welding is influenced by track temperatures so is planned to occur early morning or early evening, particularly in the warmer months. Other activities are also limited to daylight hours for either safety or visibility reasons.
Does the activity require specialised skills not within the Aurizon Network workforce?	External contractors may be engaged to supplement the Aurizon Network workforce where there are capacity constraints, equipment constraints or specific skills required. For example, the bridge bearing replacement program will be delivered by specialist bridge contractors that have the specific skills and equipment required to undertake the tasks.
Is the activity urgent?	Regular inspections (of track or electrical assets) may identify faults that require urgent attention. These will often require emergency track possessions and potentially a diversion of resources from planned activities to undertake the repair. Where there is a diversion of resources, deferred work is replanned in a manner that minimises impacts on access and cost.
Does the activity require long lead-time items?	Some inventory has a 3 to 6-month lead time for delivery. Activities that have inventory risk are typically scheduled into the second half of the year.
Is the work activity fixed, flexible or can be undertaken between trains in the day of operations?	All work activities are categorised into one of the three categories with appropriate planning horizons applied. Fixed: work activities that require large teams, involve major plant and equipment or require pre-delivered materials. This work is deemed fixed and is planned up to 12 months in advance. Flexible: work activities that are flexible and could occur on different days of the week (with some notice). These activities are moved to minimise impact to train services.

Matter for consideration	Description
	Between trains: work activities that are short in duration (e.g., inspections), don't involve breaking the track and could occur between trains in the day of operations.

15.2 Procurement

15.2.1 Contractor resources

Aurizon Network seeks to apply the most efficient resources to deliver the scope derived by the maintenance and renewal strategies. It maximises the use of its internal Aurizon Network delivery teams and augments internal resource requirements with suitably qualified contractor staff and plant.

If the scope requires a specific skill set or plant not held within Aurizon Network, or if resources are deployed on alternative more critical work activities, pre-qualified contractors are engaged to perform work either under supervision or if approved, as principal contractors for short periods of time. Aurizon Network has established a series of engineering and technical service contractor panels (managed through the Aurizon's enterprise-wide procurement function) where competitive rates are pre-agreed with vendors. These include asset specific service panels, skilled labour hire, plant hire and plant transportation services.

Contractors are either engaged through these panel arrangements or one-off engagements for specific work packages. For one-off engagements, tenders are called through Tenderlink or equivalent with tenders evaluated against set criteria including cost, capability, safety, construction methodology/program and contract departures. An evaluation panel determines a preferred vendor and following negotiation, contracts are awarded.

Depending on the activity, work is packaged to attract multiple vendors and competitive pricing. Packaging could include multiple sites over a specified duration or greater scope within the one site.

All internal and external contract workers are required to be accredited Rail Industry Workers and hold the appropriate qualifications for the activity they are undertaking. Aurizon Network has an internal assurance program for external contractors to ensure they have the required business and safety processes and policies that align with Aurizon Network's requirements.

In developing the FY23 program, the availability of contractor resources has been considered. Where possible, larger packages of works planned for integrated possessions, have been planned for periods where there is minimal conflict with known Queensland Rail work activities.

15.2.2 Materials Procurement

Aurizon Network utilises the Aurizon enterprise centralised procurement function to source the major materials required for the maintenance and renewal of the Rail Infrastructure.

Enterprise procurement has a performance-focused governance framework that ensures the right goods and services are procured to support Aurizon Network, at the right price, and quality ensuring delivery at the right place and time. The major materials utilised by Aurizon Network and their procurement approach are:

- Ballast – various quarries across Central Queensland are contracted to provide ballast and other rock and soil materials to defined Aurizon Network standards. Location is a critical consideration to reduce transit time and delivery cost;
- Sleepers – Open tender contracted supplier producing and storing Aurizon Network specified sleepers in Central Queensland; and
- Rail – currently two international suppliers provide world leading rail. Rail is delivered to the port of Brisbane, welded into 110m lengths at the Aurizon Rail Weld Facility in Brisbane and then transported via dedicated rail delivery rollingstock to trackside locations as per renewal scope.

Procurement of key inputs

Rail

Aurizon mainly purchase premium deep head hardened 60 kg rail. The hardness of the rail has a direct impact on its usable life, while the weight of the rail is associated with the axle load of the train consists being run on the network.

Annual demand is roughly split between the following suppliers:

- Voestalpine Railway Systems - manufactured in Austria and supplying Aurizon since 2013.
- JFE Shoji Trade Corporation - manufactured in Japan and supplying Aurizon since 2016.

Aurizon's rail contracts with both suppliers were awarded through a competitive tender process and are both evergreen contracts. Aurizon employs a dual supply strategy, to promote continuity of supply and price competitiveness throughout the contract life and optimal technical collaboration from both suppliers.

Ballast

Aurizon Network currently has 21 suppliers of ballast who are spread throughout the Goonyella, Newlands and Blackwater/Moura Systems. The panel of ballast providers was re-negotiated in FY20. The procurement review included full market scan to re-engage with existing suppliers and identify potential new suppliers; negotiation of the competitive ballast prices and improve the quality of contracts in place. Suppliers were selected based on:

- Geographic proximity to the network to support improved network coverage of supply points, and preferably having multiple quarries/supply points to assist with disaster recovery plans and supply continuity;
- Compliance to the ballast quality and testing standards as set out in Aurizon Network's specifications;
- Competitive pricing against existing average rates of all suppliers and specifically regional competitors; and
- Understanding and compliance with chain of responsibility and general safety standards.

The range of suppliers ensures adequate and reliable supply to meet Aurizon Network's demand for ballast. Each system has a rail siding and a contracted supplier providing loading, unloading and stockpile management services.

Aurizon Network ensures cost competitiveness of ballast through the multi-supplier arrangement and consolidated internal supply planning arrangements.

Fuel

Fuel expenditure within the Aurizon Group is significant. Aurizon's existing contractual arrangement for fuel was awarded to BP Australia following a competitive tender process.

Aurizon Network's maintenance and renewal activities comprise a relatively low proportion of the Aurizon Group's total fuel consumption, with the majority being consumed by the above rail business, and the maintenance and renewal program benefits from the ability to leverage the larger purchasing power of the Aurizon Group as a whole.

15.2.3 Inventory

For asset renewal activities, inventory strategies are focused on limiting the number of variations of the same asset type being installed, e.g., rationalising turnout types and sizes in a system to reduce the supporting component types required in inventory. Asset Managers set and monitor emergency spares and component renewal inventory levels to ensure that a minimum amount of inventory is held with an ability to respond to emergencies and maintain continuity of service operations.

Control Systems inventory levels are managed to achieve system availability requirements and the renewals deployment schedule as well as maintaining critical spares for assets near obsolescence such as Relay Based Interlockings.

Specialist replacement inventory is typically held at depot sites to support emergency response and expediting the return the Rail Infrastructure to service following an incident. Three centralised stores at Gracemere, Rockhampton and Paget are maintained for high volume consumables, and replacement stock for depot stores.

For maintenance activities, the quantity of maintenance replacement inventory is typically set by procurement lead time requirements and usage frequency. Additional inventory is held for equipment items that are becoming obsolete in the marketplace, to defer renewal based on obsolescence. Recovered obsolete components are retained in inventory to extend renewal intervals of components that are obsolete and beyond their economic life.

16. Asset Strategies Applied within Asset Activities

16.1 Guiding Principles in Action

Aurizon Network seeks to apply the outlined guiding principles toward implementation of asset maintenance and renewal activities. This chapter provides details of these principles and examples of how targeted Asset Strategies deliver better outcomes through the management of asset life cycles, smoothed planning, integration of works and long term renewal strategies.

16.1.1 Minimise the impact of asset activity

The first guiding principle is to minimise the impact of activity through; minimising supply chain impact of major renewal; monitoring preventative maintenance renewal profiles; engaging with other supply chain participants and using critical path scope to plan closures.

A significant strategy to minimise the impact of activity is to identify major asset renewal activities that can be integrated. This integration often needs to be identified early in planning process to enable design phases to be completed. An example of this in FY23 is the coordinated installation of active control (boom gates) at two level crossings in the Blackwater system (Tryphinia and Mourindilla Road) with the upgrade of the Blackwater Signalling System to axle counters. Planning these works to be installed together will enable high impact works to be completed in the location at the same time, minimising impact to services.

Managing long term asset renewal investment profiles through preventative maintenance activities and extended renewal profiles is another way to reduce impacts of activity. This is beneficial where there are many aging assets and renewal expenditure can be smoothed and planned. Examples of smoothing future Asset Renewal activities to manage large spikes in renewal requirements is evidenced in Chapter 11, section 11.1.8.

Smoothing of Asset Renewal profiles and options analysis will be key features of Aurizon Network's Substation renewal program, currently in the early stages of planning. This long term program presents an opportunity for Aurizon Network and its customers to discuss the reliability requirements of individual rail corridors, and a possible trade-off between network resilience, renewal CAPEX and ongoing maintenance costs within the parameters of essential requirements for safety of people and compliance to legislation and industry standards.

22 of Aurizon Network's 45 traction substations will reach the end of their 40-year design life in the next 5 years with these substations constructed in the mid-1980s. The Asset Strategy will focus on short-term life extension as well as a decade long renewal strategy to maintain reliability, safety and compliance with modern standards. Aurizon Network's 2020 Electrical Traction Asset Management Plan flagged the need for this renewal, and concept work has commenced as part of the FY22 renewals program. This renewal will maintain the Electric Traction network's existing 'N-1' redundancy which provides electrical network resilience to a wide range of outage and equipment failure, maintenance and partial track isolation scenarios. As this concept work matures, Aurizon Network will seek to engage with customer regarding options identified to be progressed for further development.

To allow more time for smoothing strategies, optioneering and integrated planning, Aurizon Network is extending program planning for major renewals to move to a multi-year development process. Turnouts are a multi-discipline asset requiring a high level of design coordination, integration and planning to deliver. Aurizon Network have identified that a longer term planning horizon is needed to provide increased design and planning maturity, and to enable more customer engagement in the process. For this reason, in FY23 Turnout construction has been deferred where possible to allow more time to implement a multi-year timeline for design development and construction planning prior to construction year. As part of managing assets within this policy, the team redesign turnout assets which are no longer fit for purpose to current traffic tasks.

The timely delivery of turnout renewals will enable:

1. Alternative asset renewal options
2. Better integration with other significant asset renewal scopes in the CQCN

3. Better integration opportunity with Interlocking upgrade (e.g., no double handling signalling design)
4. Sufficient timeline allowed to meet the community, cultural heritage, and property engagement requirements
5. Confirm cross-discipline staged construction requirements to accommodate the project complexity

16.1.2 Promote below rail asset reliability

The second guiding principle is to minimise unplanned failures of Aurizon Network assets through fit for purpose, condition-based renewal and preventative maintenance to identify, plan and rectify asset failures before they occur.

The Goonyella Ports, (DBCT and Hay Point) and its mainline connecting infrastructure is the most critical part of the Goonyella rail network. Asset failures in this region result in significant supply chain impacts. For example, the dewirement at DBCT on Departure Road 2 on 6/11/2018 resulted in 18 cancellations and 11,976 minutes of delays. This incident highlighted the need for a coordinated maintenance and renewal strategy for this area to minimise both unplanned failures, and the need to access to maintain, this critical infrastructure. The program's key objective is to "reset" the Goonyella Ports overhead line so that it can continue to deliver reliable service with minimal maintenance for the next 15-20 years.

Specific scope areas include:

- Simplifying the electrical sectioning (flexibility to re-configure the electrified network);
- Rebuilding portions of the overhead line in a "tramway" configuration to eliminate the failure-prone 7-strand catenary wire;
- Changing selected wire runs to reduce the impact of future dewirements;
- Making design changes to enable easier single line maintenance; and
- Address corrosion issues.

Preventative maintenance inspections provide essential condition data to inform asset specific strategies.

The bridge bearing replacement program uses this condition data to prioritise higher risk bridges first and monitor lower risk bridges preventing a large spike of renewals in a particular year. In FY23 one bridge is being completed under this strategy in the Goonyella System. Nebo Creek bridge has been identified as having a significant issue with bridge bearing pads tearing and moving out from between girders and headstocks. Early intervention into bridge bearing pad replacement once in a condition like Nebo Ck eliminates the risk of damage to girders and headstocks, which if damaged from fallen out bearing pads, will be significantly higher cost and require longer track closures to renew.

Increasingly technology assets play a key role in minimising unplanned asset failures, these smaller technology assets also need lifecycle management to manage continuity of operations. For example, there are over 800 devices facilitating data communications, including firewalls, routers and switches, creating a large and varied asset to manage. Aurizon Network have developed common configurations and centralised tools for configuration management. This is appropriate for maintaining the equipment and managing response times for data communications failures. The strategy also is investigating partnering with an external managed service provider for the Central portion of the Data Communications Network. The policy is to maintain knowledge from top to bottom but blend internal resources with external capability. The strategic control of the data communications network is maintained but seeks to optimise FTE where value for the Supply Chain is the key consideration. The partnering is a new initiative being explored in a very conservative way. This is to ensure minimum risk exposure for the data communications technology which is at the very heart of the systems that operate trains.

Due to changing business environments and the interconnectivity of technology advances there is also a need to ensure appropriate protection against potential threats. Aurizon Network have identified a need to implement a Cyber Security Design for all OT Systems that support operation of the CQCN Supply Chain and align to international standards and an applied Security Business Framework (SABSA). We have partnered with an external Industrial Cyber Security Specialist with international and Australian experience implementing Industrial Systems Security designs. The design will be developed over an 18 months period and risks reviewed monthly to encompass newly published vulnerabilities.

16.1.3 Cost Effective

Asset strategies seek to maintain or improve cost, reliability and performance ensuring procurement is market based and competitive. Some assets are highly specialised and can only be sourced from a few speciality providers. In these examples, asset strategies seek to build strong relationships with multiple suppliers to ensure available assets over long range programs of asset renewal. For example, there are 202 interlocking equipment housings presently in the CQC. Interlockings are essential signalling assets which provide for the safe separation of trains in Remote Controlled Signalling Territories. Interlocking housings are a specialist product with few suppliers and essential equipment in the network. The cost of the Interlocking design is the driver of renewal cost rather than the hardware. Aurizon Network is continuing to look at the required renewal of Interlocking housings which in the future, beyond FY27 will need a balance to minimise risk for an unsupported product. Aurizon Network seeks to maintain two interlocking technology suppliers for competitive reasons.

Appendices



Description of practices used to carry out asset activity

This section provides a description of the key maintenance activities, maintenance practices and renewal activities that are used to carry out asset activity. It also provides a general overview of:

- the benefit of completing the works;
- the risks mitigated; and
- the relevant trigger for intervention.

Maintenance Activities

Table 214 Summary of CQC Maintenance Activities

Activity	Description	Benefits and risks managed	Trigger for intervention	Access Management
Resurfacing	Restores geometry of the track and turnouts by lifting and lining to the appropriate level and alignment and compacting the ballast underneath the sleeper. This fleet is also utilised to complete tasks within the renewal program and ballast cleaning program.	Mitigates the need for temporary speed restrictions applied as a risk control prior to component renewal or full asset renewal.	Triggered by tonnage over a rail section. Track resurfacing: 50 million gross tonnes (MGT) Turnout resurfacing: 80 MGT Resurfacing to remedy geometry faults identified often required ahead of these limits.	Resurfacing tasks are typically managed between trains and planned after the ITP has been agreed. This minimises the impact to capacity and allows the work to be fluid and targeted for priority locations.
Rail Grinding	Grinding rail in track and turnouts to remove micro cracks and small surface faults from the rail, restoring a profile that spreads the contact band, and positions it for better wheel set tracking around the curves.	Reduces risk of severe defects (rail failure or breakage) and prolongs the life of the rail.	Triggered by tonnage over a rail section or curve. Straights: 40 MGT Curves 1001m to 2500m radius: 40 MGT Curves less than 1000m radius: 20 MGT Turnouts: 40 MGT	Annual programs are developed and negotiated to avoid conflicts with other regulated inspection vehicles.
General Track Maintenance	Encompasses the planned corrective maintenance effort, responding to faults identified by drivers, track inspection, specific asset inspection, and Track Recording and Rail Flaw Detection	Identification of faults through inspection – notification and prioritisation managed via the OneSAP to minimise impact on capacity	Time based inspection regimes for track geometry recording, ultrasonic testing and track inspections.	Tasks are planned in accordance to Network Maintenance Block rules. Predominately on nominated maintenance days or in shadow of existing renewal works.

Activity	Description	Benefits and risks managed	Trigger for intervention	Access Management
	<p>inspections. Activity can be planned according to the severity and the time for fault/fault remedy of the identified fault.</p> <p>Fault severity ranges from:</p> <ul style="list-style-type: none"> - Immediate - Track closed until repair completed; to - 'Y1' – repair required within 1 year of identification 	<p>Faults managed to mitigate against infrastructure failure leading to unplanned outages</p> <p>Localised depots responding to infrastructure faults to reinstate operability of the network in a controlled manner</p>	Planned corrective dependent on fault severity	
Other Civil Maintenance	<p>Minor activities on track and turnouts. Includes minor ballast cleaning, a corrective maintenance activity to replace the fouled ballast and mud holes from beneath the sleepers for a length of track up to approximately equal or less than 40 sleeper bays (as a guide).</p>	<p>Identification of faults not visible via person inspections allows for fault rectification in a controlled manner prior to the fault resulting in a failure</p> <p>Undercutting Minor Activities Spot repair mudholes and small areas of ballast fouling which cause track defects and increase the risk of derailment and remove TSRs.</p>	Dependant on defect severity and time to remedy	Tasks planned in accordance to Network Maintenance Block rules, predominately on nominated maintenance days or in shadow of renewal works.
Structures and Facilities Maintenance	<p>Periodic inspection of bridge and culvert structures to monitor asset condition and performance</p>	<p>Trend of condition allows for component or renewal works to be forward programmed given the wear rate of the assets</p> <p>Faults managed to mitigate against infrastructure failure leading to unplanned outages</p>	<p>Ground based bridge decks – every 2 years</p> <p>Scaffolded inspection – every 10 years</p> <p>Underground pile exam – every 10 years</p> <p>Underwater Inspection – every 4 years</p>	These tasks are planned in closures or in accordance to Network Maintenance Block rules, predominately on nominated maintenance days or in shadow of renewal works.
Signalling and Telecommunication Maintenance	<p>Inspection and maintenance that is regularly performed on the signalling asset to lessen the likelihood of it failing. Performed whilst the asset is in place and working so that it does not break down unexpectedly.</p>	<p>Faults managed to mitigate against infrastructure failure leading to unplanned outages</p>	<p>Time based – planned periodic inspection and repair activities</p> <p>Planned rectification works on identified faults to return equipment to working condition</p>	These tasks are planned in closures or in accordance to Network Maintenance Block rules. Predominately on nominated maintenance days or in shadow of existing renewal works.
Trackside Systems Maintenance	<p>Inspection and maintenance that is regularly performed on the wayside equipment assets to lessen the likelihood of it failing. Performed</p>	<p>Faults managed to mitigate against infrastructure failure leading to unplanned outages</p>	<p>Time based – planned periodic inspection, servicing and repair activities</p>	Where these tasks have an impact to train running, these tasks are planned in closures or in accordance to Network

Activity	Description	Benefits and risks managed	Trigger for intervention	Access Management
	whist the asset is in place and working so that it does not break down unexpectedly.		Planned rectification works on identified faults to return equipment to working condition	Maintenance Block rules. Predominately on nominated maintenance days or in shadow of existing renewal works.
Electrical Overhead Maintenance	Inspection and maintenance that is regularly performed on the electrical substation and overhead line assets to lessen the likelihood of failure. Performed whist the asset is in place and working so that it does not fail unexpectedly.	Defects managed to mitigate against infrastructure failure leading to unplanned outages	Time based – planned periodic inspection and repair activities Planned rectification works on identified defects to return equipment to working condition	Tasks planned in accordance to Network Maintenance Block rules, predominately on nominated maintenance days or in shadow of renewal works.
Other General Maintenance	Asset Management and Inventory Management	Inventory is held and managed at specific location across the network so as materials required for recitation works are available	Critical spares determined by lead time to obtain parts, level of supplier support and availability of materials / component	Tasks planned in accordance to Network Maintenance Block rules, predominately on nominated maintenance days or in shadow of renewal works.

Renewal Activities

Table 215 Description of CQCN Renewal Activities

Activity	Description	Benefits and risks managed	Trigger for intervention
Ballast	<p>Over time ballast becomes fouled through, coal dust general degradation, and sub soil contamination.</p> <p>Ballast cleaning removes these contaminants from the ballast to restore drainage and load distribution requirements.</p> <p>Ballast fouling is managed via the following approaches dependant on the location of the fouling:</p> <p>BCM - excavating the fouled ballast from beneath the sleepers by a dedicated ballast cleaning consist,</p> <p>Ballast replacement as part of a formation repair or track upgrade – ballast is replaced as part of the formation repair activity and only where required as part of a track upgrade activity.</p> <p>Ballast undercutting turnouts - excavating the fouled ballast and mud holes from beneath a turnout by minor mechanised equipment such as an excavator</p> <p>Bridge ballast roll out – due to the width, height and environmental constraints on bridges fouled ballast on bridges is completely removed and new ballast added.</p>	<p>Restores the drainage and load management properties of the ballast moving water away from the formation and spreading loads across the track structure to reduce the risk of track geometry defects and formation failures.</p>	<p>Ground Penetrating Radar (GPR) provides a measure of ballast fouling severity comparative to prior GPR runs. This provides a non-destructive level of fouling.</p> <p>Scope is determined based on the number and frequency of resurfacing activities (a lag indicator of deteriorating track geometry), track geometry and GPR which is then reviewed and validated by Track Inspectors and Supervisors. The most fouled locations or those showing the greatest degradation are matched to the production of the Undercutting fleet and track access constraints.</p>
Rail Renewal	<p>Replacement of rail in a section of track due to rail fatigue (increased defect rates) and/or wear approaching SMS limits. Rail renewal includes rail stressing to restore continuously welded rails to a design stress state, reducing risk of rail misalignment (buckles) and rail breaks</p>	<p>Renewing rail in a planned way reduces rail breaks and rail faults that would otherwise lead to unplanned delays</p> <p>Reduces derailment risk related to rail break or rail misalignments</p>	<p>The timing of renewal is dependent on the weight of the rail, its location in track (loaded / unloaded, on straights or curves) and rail compassion (head hardened, standard carbon on through hardened)</p> <p>Network utilises a rail condition analyser model to identify future years renewal requirements based on rail wear against standard to determine the required renewal intervention</p> <p>The Rail renewal strategy includes scope focused on smoothing the anticipated bow wave of tangent rail renewals through renewing tangent rails that have fatigue related issues, such as</p>

Activity	Description	Benefits and risks managed	Trigger for intervention
			squats and shelling. Where appropriate, rail which has been subjected to significant cyclic loading is renewed with sleepers to gain efficiencies in renewal.
Turnouts and Component Renewal	Turnouts (sometimes called Switches) allow trains to move between tracks in duplicated sections, as well to allow entry and exit from passing loops and to move from the main line into spurs and balloon loops. A turnout is a combination of civil assets being the steel rail and sleepers and Control Systems Assets being the points motors, rodding and electronics	Component renewal extends the life of the turnout Full renewal and maintain operability of turnout providing operational flexibility	Renewal - Condition and location of assets and degradation rate Component – items within the turnout that require renewals based on asset component condition
Sleeper Renewal	Sleepers (or ties), along with sleeper clips, hold the rails to gauge and alignment. There is a variety of sleeper types across the CQCN with most being 28 tal concrete for 60kg/m rail. Other sleepers are older styles with different rail fastening (clips). In sidings and older track sections there are both timber and steel sleepers.	Reduction in track alignment issues relating to gauge and rail twist leading to temporary speed restrictions or unplanned delays. Reduces derailment risk cause by loss of gauge or rail twist	Sleepers are condition rated based on weight, material and condition. The sleeper renewal program is renewing aged underweight sleepers with the 28 tal concrete standard.
Structures Renewal	Structures are bridges and culverts that allow for the flow of water through the rail formation or for access under the track Bridges are located at large hydrological water flows (rivers, creeks etc) Culverts are located at low points allowing overland flows through the track infrastructure.	Renewal of assets prior to failure to reduce unplanned delays or safety risks associated with structure failures Strategy to review hydrology in renewal locations to reduce number of culverts.	Structures are inspected and assigned a condition rating and allotted a location criticality. Structures are then ranked based on condition and operational criticality rating
Control Systems Renewals	Control Systems assets are the physical and digital assets that provide, train control, telecommunications and wayside monitoring systems. These assets provide the capacity multiplier for the track assets, that is they allow for the safe movement of more train services over the track structure. The main classes within the Control Systems grouping are: Train control Systems: signalling system, level crossing active protection, interlockings and point motors Telecommunications: the data network required to connect assets to train control, includes the optic fibre network, digital radio and microwave radio systems Wayside Systems: assets in the rail corridor that provide a level of monitoring and alarming to protect track and overhead assets	Train control: <ul style="list-style-type: none">• Ensure the continuity of the train control systems and provides incremental improvement to the operability of the system Telecommunications: <ul style="list-style-type: none">• Reduce telecommunication outages due to fibre faults and data flow interruptions• Ensure the integrity of the safe working systems• Ensure the track side equipment faults are being reported for cation Wayside systems:	Unlike civil assets, the trigger for the renewal of Control Systems assets is predominantly driven by the age of the asset along its life cycle. These assets do not necessarily wear with tonnage, and often don't show degradation until the point of failure. Obsolescence of data systems or components is also a key trigger for asset renewal.

Activity	Description	Benefits and risks managed	Trigger for intervention
Electrical Renewals	<p>Blackwater and Goonyella Systems are electrified, enabling the operation of electric rollingstock. The traction system comprises two main asset groups,</p> <ul style="list-style-type: none"> - Overhead Line Equipment (OHLE) - infrastructure distributes traction power to trains on the system - Traction Substations - stations provide a means of connecting to the high voltage transmission network (Powerlink or Ergon) and converting the transmission voltage (132kV or 275kV) down to 50kV for the traction system <p>All the traction substations which were built as part of the main line electrification in the 1980s are nearing the end of their service life. Aurizon Network is employing best-practice asset management techniques to maintain the performance of this infrastructure. In parallel with this Aurizon Network is in the Concept phase of a project to renew these ageing substations. As the Concept phase develops Aurizon will liaise with the RIG to agree on appropriate options for these renewals.</p>	<p>OHLE</p> <ul style="list-style-type: none"> • Allows for real time monitoring across the 2600Km network to identify out of tolerance or non-controlled rollingstock interface issues and stop or reduce the impacts • Renewal of components cross the 2000Km of OHLE to reduce the instances of faults causing disruptions and cancelations. <p>Traction substations</p> <ul style="list-style-type: none"> • Managing the risks associated with the control of high voltage electricity 	<p>Some Traction Power Systems assets are like Control Systems assets in that the renewal is primarily driven by the age of the assets against their lifecycle. The renewal of other Traction assets including the Overhead Line and transformers, is driven by age, environmental factors and tonnage.</p>

Glossary

Term	Definition
2017 Access Undertaking or UT5	Aurizon Network's 2017 Access Undertaking, as approved by the QCA on 191 December 2019, together with any subsequent changes approved by the QCA from time to time
Access Holder	A person or organisation that holds access rights to the Central Queensland Coal Network
AM	Asset Maintenance
AMRP	Asset Maintenance and Renewal Policy
APS	Advanced Planning and Scheduling
ATIS	Automated Track Inspection System
Aurizon Network	Aurizon Network Pty Ltd, the provider of access services in accordance with the 2017 Access Undertaking
AZJ	Aurizon Holdings Limited
Ballast	Ballast is the material that is laid on the rail bed under the sleepers, providing stability and drainage to the track structure
Capex	Capital Expenditure
CETS	Civil Engineering Track and Standards
CPI	Consumer Price Index
CQCN	Central Queensland Coal Network
DBCT	Dalrymple Bay Coal Terminal
DTS	Dynamic Track Stabilisers
egtk	Electric gross tonne kilometres
Electrical Safety Act	Electrical Safety Act 2002 (Qld)
FD	Final Decision
FTE	Full Time Equivalents
FY	Financial year
GAPE	Goonyella to Abbot Point Expansion
GPR	Ground Penetrating Radar – A non-destructive subsurface inspection technology that is used to measure the condition of Aurizon Network's Assets, in particular ballast.
gtk	Gross tonne kilometres
HPCT	Hay Point Services Coal Terminal
ICAR	Initial Capacity Assessment Report as defined the 2017 Access Undertaking
ITP	Intermediate Train Plan
Mt	Million tonnes
MGT	Million gross tonnes
MNT	Million net tonnes
Mtpa	Million tonnes per annum
NAMS	Network Asset Management System
NCL	North Coast Line
NSAP	Network Strategic Asset Plan

Term	Definition
nt	Net tonnes
ntk	Net tonne kilometres
OHLE	Overhead Line Equipment
Opex	Operational Expenditure
OTCI	Overall Track Condition Index – a measure of quality of the geometry of the track calculated from track geometry recording vehicle outputs
QCA	Queensland Competition Authority
PVC	Percent Void Contamination – calculated by dividing the volume of contaminates by the volume of voids within the ballast profile. PVC is determined in a compacted state to simulate actual track conditions
QCA Act	Queensland Competition Authority Act (Qld) 1997
QR	Queensland Rail Limited
QRC	Queensland Resources Council
RAB	Regulated Asset Base
RGTCT	RG Tanna Coal Terminal
RIM	Rail Infrastructure Manager
BCM	High Production Mainline Ballast Undercutter Machine
Single line possessions	When asset activity can be completed on one track in a duplicated section whilst the other track is kept operational to allow for continuous train services.
SMS	Safety Management System
TRSA	Transport (Rail Safety) Act 2010
Turnout	A section of railway track-work that allows trains to pass from one track on to a diverging path
UTC	Universal Train Control
UT5	Aurizon Network's 2017 Access Undertaking, as approved by the QCA on 19 December 2019 and subsequently amended from time to time.
WICET	Wiggins Island Coal Export Terminal
WIRP	Wiggins Island Rail Project