Hunter Valley Coal Network Access Undertaking
2022 Annual Compliance Assessment

ATTACHMENT 1: Hunter Valley Network Operating Costs

Submission To

Australian Competition & Consumer Commission

27 March 2024

PUBLIC VERSION

TABLE OF CONTENTS

1. INTRODUCTION

This document contains additional information and analysis relating to ARTC's Network operating costs for the 2022 calendar year. It is intended to supplement the information contained in ARTC's submission to the ACCC for the assessment of compliance with ARTC's Hunter Valley Access Undertaking (HVAU) during the 2022 period.

In alignment with the changes prescribed in HVAU Version 8 ARTC prepared and consulted on the 2022 Maintenance Plan in August 2021. This document outlined the maintenance strategy behind the top 10 maintenance activities by zone, including the various assumptions and inputs that are evaluated during the development of the plan at that time. Throughout 2022, on a quarterly basis, ARTC provided the RCG an update on maintenance outcomes against the 2022 Maintenance Plan. This approach has formalised the level of transparency with the RCG regarding maintenance outcomes and has provided a platform to share insights into the opportunities, successes and challenges ARTC are experiencing. Copies of these documents, along with the 2022 Maintenance Plan have been provided as attachments to this submission.

During 2022, the Hunter Valley Coal network achieved a total coal transportation volume (including domestic) of 149.2 million tonnes (Mt), a 12.4% decrease from total achieved tonnage volumes for 2021 of 167.7Mt. The overall total coal network Gross Tonne Kilometres (GTKM) decreased 9.3% between 2021 and 2022 with the volume profile varying at a zonal level.

Table 1: Hunter Valley Network Actual Coal Thousand Gross Tonne Kilometres (KGTKM)

Pricing Zone	2019 KGTKM	2020 KGTKM	2021 KGTKM	2022 KGTKM	% Variance 2019 - 2020	% Variance 2020 – 2021	% Variance 2021 – 2022
Pricing Zone 1	28,608,590	27,405,381	26,976,698	23,583,949	(4.2%)	(1.6%)	(12.6%)
Pricing Zone 2	[redacted]				(1.1%)	(1.8%)	(12.4%)
Pricing Zone 3	[redacted]				2.6%	(11.8%)	5.3%
Total GTKMs	**46,586,649**	**45,505,895**	**43,847,283**	**39,763,630**	**(2.3%)**	**(3.6%)**	**(9.3%)**

Note: Totals may not add due to rounding

The overall decline in GTKM's on the network can be attributed to a combination of external disruptions primarily:

- Persistent wet weather and flooding interrupting operations; and
- Export market demand and price premiums for high quality low ash coal which saw Customers target these markets leading to increased washing of Run-Of-Mine (ROM) coal and therefore lower yield and railings.

GTKMs in Zones 1 and 2 decreased by 12.6% and 12.4% respectively, whilst Zone 3 GTKM's increased 5.3%. The notable divergence in GTKM trends between Zones can be attributed to the contrasting impacts of extreme wet weather. In 2021, Zone 3 experienced severe localised weather conditions with some Zone 3 mines impacted by flooding for up to a 2-week period, significantly affecting GTKM levels, whilst in contrast in 2022 this impact was lower relative to extreme conditions experienced in Zones 1 and 2.

Figure 1 illustrates the Coal Network's year-on-year actual GTKMs and compares this to Customer contracted volumes per Zone. The historical actual, contracted and customer most likely forecast profiles drive the volume assumptions used in building the forecasted maintenance plan. Actual GTKM's achieved over the last 5 years have, on average, been 15% below customers most likely forecasted scenarios reflecting customers continued positive sentiment which has only been boosted further by the record coal prices seen in 2022.

Figure 1: GTKM's per Zone

The trend of GTKM's over time has an influence on cyclical maintenance requirements. Current customer contracted volumes and most likely GTKM forecasts and contracted volumes show a declining 10-year volume profile. The efficiency and cost focus initiatives that ARTC have been focusing on in recent years are imperative to future maintenance and operating cost outcomes. Notwithstanding, non-maintenance related operating costs (Overheads, Business Unit Management and Network Control costs) largely relate to fixed employee costs therefore the ability to flex these non-maintenance costs in alignment with fluctuations in actual GTKM's is limited. The focus on continuous improvement of asset management practices in line with risk and condition-based principles is ongoing. A significant component of ARTC's maintenance expenditure is fixed in nature due to contract terms agreed with suppliers to achieve cost efficiencies. The categorisation of each type of maintenance activity is determined by the causal factors and cost drivers impacting the fixed yearly costs incurred by Customers.

The graph in Figure 2 shows both Real Operating Expenditure per contracted and actual GTKM's. The trend in Real Operating Expenditure over actual GTKM's shows an increase of 11% from 2018 to 2022. The impact of the persistent, severe wet weather and flooding across the network on declining GTKM's is evident in the upward trend seen from 2020 to 2022. Additionally, 2022 saw a significant increase in incident costs from 2021 primarily driven by weather conditions which is also reflected in the significant increase in operating expenditure from 2021 to 2022, however, when comparing real operating expenditure over contract GTKM's the trend is relatively flat. ARTC is continuously striving to become more efficient with managing both maintenance and non-maintenance expenditure noting that the correlation between real operating costs and GTKM's railed is inherently not a linear relationship.

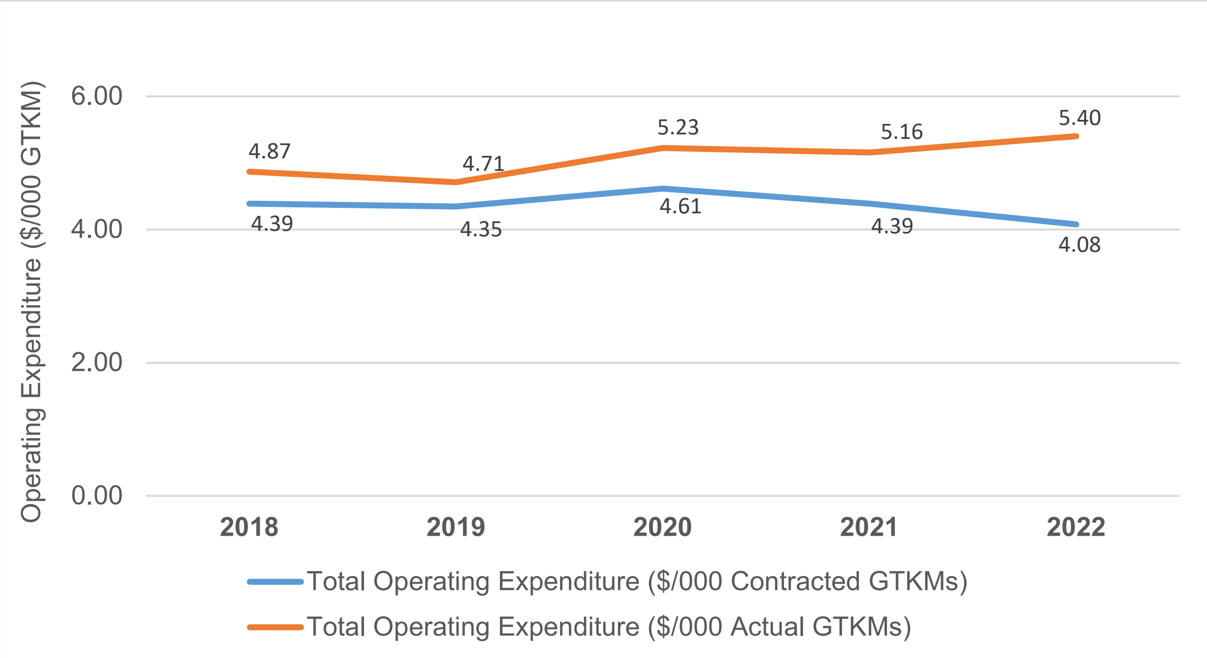

Figure 2: Total Real Operating Expenditure per $'000 Contracted and Actual GTKM (real $2022)

Following the unprecedented weather in 2021, the network continued to endure persistent wet weather and flooding due to the ongoing presence of La Niña conditions. The network wide flooding event in the Maitland region during July 2022 closed the network for eight days. During this period ARTC proactively implemented a staged recovery to assess the integrity of the rail and signalling infrastructure as flood waters receded to accelerate the safe reinstatement of operations.

This event had a substantial impact on the Annual Works Plan (AWP) in terms of both immediate maintenance work requirements in response to the event but also in regard to subsequent condition risks requiring remedy in the live year. Agility in reprioritising plan cognisant of both asset conditions and customer needs was a key focus throughout the year and in consultation with industry the scheduled July 2022 closedown was postponed to September 2022 to enable this required flexibility. ARTC adeptly utilised the Decision Support Platform throughout the year to inform decision making to ensure maintenance efforts were directed towards the highest priority sites, to minimise disruptions and ensure safety to the overall network. This proved particularly valuable in an environment where weather continued to have a dynamic impact on asset condition throughout the year.

Along with weather impacting the volume, cost and mix of maintenance activities executed, the industry also experienced significant cost pressures primarily generated by unprecedented inflation and labour demand. ARTC maintained transparency with customers throughout the year highlighting the primary drivers contributing to changes in plan to actual outcomes through RCG quarterly cost reporting.

Figure 3: Flooding through Maitland[1]

Table 2 sets out a comparison of the total operating costs in 2021 against 2022 for the Hunter Valley Coal Network. An explanation for the movement in costs is the following sections.

Table 2: Hunter Valley Coal Network Operating Expenditure $'000

	2021 (a)	2022 (b)	% Variance (b)/(a)-1
Infrastructure Maintenance	119,012	124,702	4.8%
Loss on Disposals	10,135	9,748	(3.8%)
Expensed Project Costs	4,437	2,200	(50.4%)
Network Control	19,919	21,244	6.6%
Business Unit Management	40,534	38,347	(5.4%)
Corporate Overheads	24,930	26,099	4.7%
Less Non-Coal Allocation	(7,555)	(7,539)	(0.2%)
Total Operating Expenditure	**211,413**	**214,800**	**1.6%**

Note: Totals may not add due to rounding

[1] Aerial Photograph - SKYview Aerial Photography

2. INFRASTRUCTURE MAINTENANCE

Throughout 2022, on a quarterly basis, ARTC has provided the RCG an update on maintenance outcomes against the 2022 Maintenance Plan and provided updated forecasts costs and scope for the remainder of the year. These reports contain detailed information relating to events and conditions that ARTC experienced that resulted in outcomes different to those assumed when developing the plan. Additionally, these reports provide a high-level snapshot of the reliability performance for the quarter, comparing this to established KPIs and historic performance outcomes.

Considering the increased reporting and as maturity develops, ARTC will be looking to consolidate the infrastructure maintenance commentary in future compliance submissions, by linking the narrative between the plan, quarterly reporting and the annual submission to capture the required context surrounding maintenance. Notwithstanding this, for the 2022 compliance submission the approach has remained consistent with that of prior years.

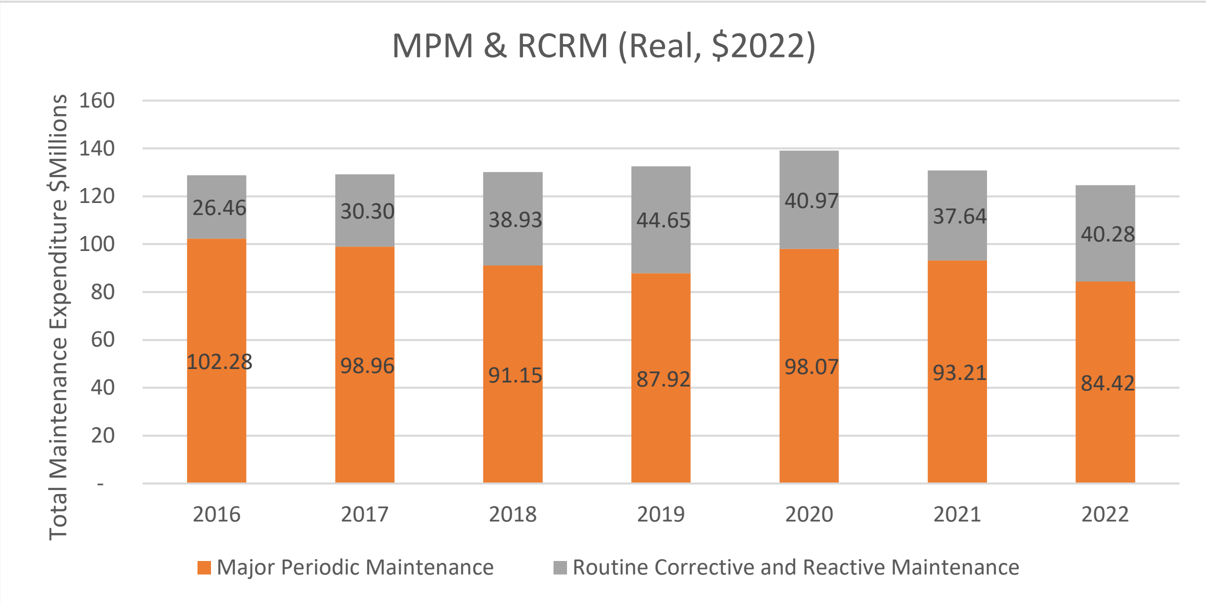

Figure 4: Infrastructure Maintenance Expenditure MPM and RCRM (real $2022)
Figure 4**:** Infrastructure Maintenance Expenditure for the HV Coal Network excluding incident and indirect costs
Source: Australian Bureau of Statistics, ***Consumer Price Index - Table 5 CPI: Groups/ Index Numbers by Capital, Sydney*** **2016 – 2022**

In 2022, Infrastructure Maintenance expenditure in real terms has reduced by 4.7% compared to 2021. This is a continued downward trend since the peak in costs in 2020.The factors that had a major influence on the delivery of the maintenance program included the ongoing scarcity of specialised rail workers, the effects of unprecedented inflation and the impacts associated with the severe weather events, in particular the flooding that occurred in July 2022.

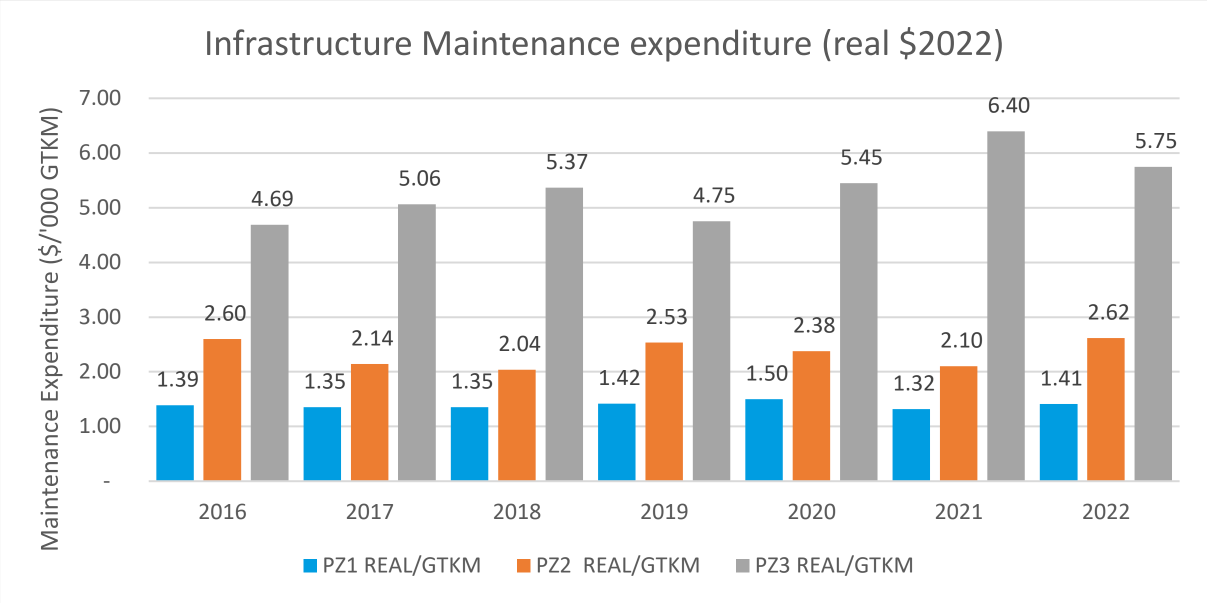

Figure 5: Infrastructure Maintenance Expenditure (real $2022)

Figure 5: Infrastructure Maintenance Expenditure for the HV Coal Network excluding incident costs. HV Coal Network Gross Tonne Kilometres (GTKM) including non-coal traffics.

Source: ARTC, confidential financial model 2022; Australian Bureau of Statistics, ***Consumer Price Index - Table 5 CPI: Groups/ Index Numbers by Capital, Sydney* 2016 - 2022**

Real Infrastructure Maintenance expenditure per GTKM has increased slightly compared to 2021, this is primarily the result of reduced rail volumes trafficked in 2022, factors of which influenced this have been discussed in Section 2.3 of the Compliance Assessment.

The 2022 calendar year saw a decline in performance of infrastructure loss outcomes, with the 2022 annual losses reported as 2.16% against a 2021 result of 1.69%. The increases in the reliability losses compared to the prior year were primarily due to Signalling and Points Failures, Rail Breaks and Track Condition.

In 2022, signalling and points related failures resulted in a 0.75% reliability loss, an increase compared to the 0.50% loss in 2021 and equivalent to 35% of all infrastructure losses in 2022. These failures are inclusive of points, track circuits, level crossing, signals, power supplies and axle counters, with the decreased performance partially attributed to the significant wet weather experienced across the network in 2022. The July 2022 Maitland flooding event due to the high concentration of assets in the flood affected area resulted in ARTC inspecting and repairing 21 points machines, 24 track circuit and 15 signals that were water affected.

Figure 6 shows the increase in 2022, relative to 2021, in both the number of failures and the associated delay. These results have fluctuated up and down since 2016, with the 2022 outcome nearing the average outcome across the seven-year period.

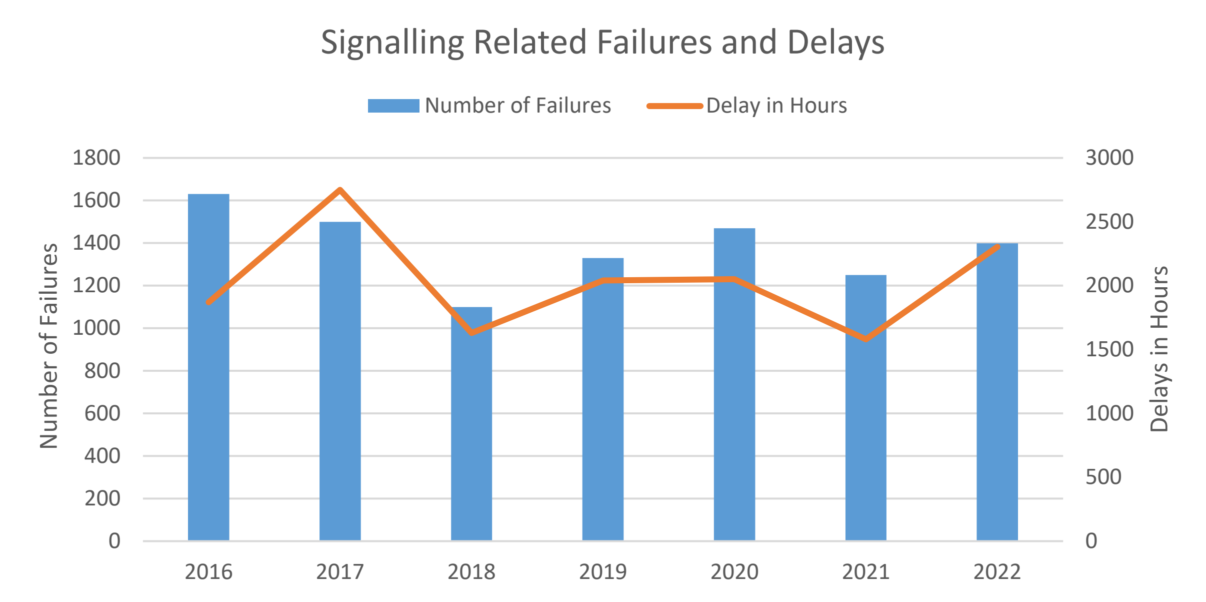

Figure 6: Signalling Related Failures and Delays

Rail breaks in the Hunter Valley remained unchanged from 2021 accounting for 0.65% of infrastructure losses. There were six fewer breaks with 36 breaks in 2022 compared to 42 rail breaks in 2021, however due to the complexity of the nature of the breaks, the impact in terms of train cancellations and infrastructure losses was consistent with 2021.

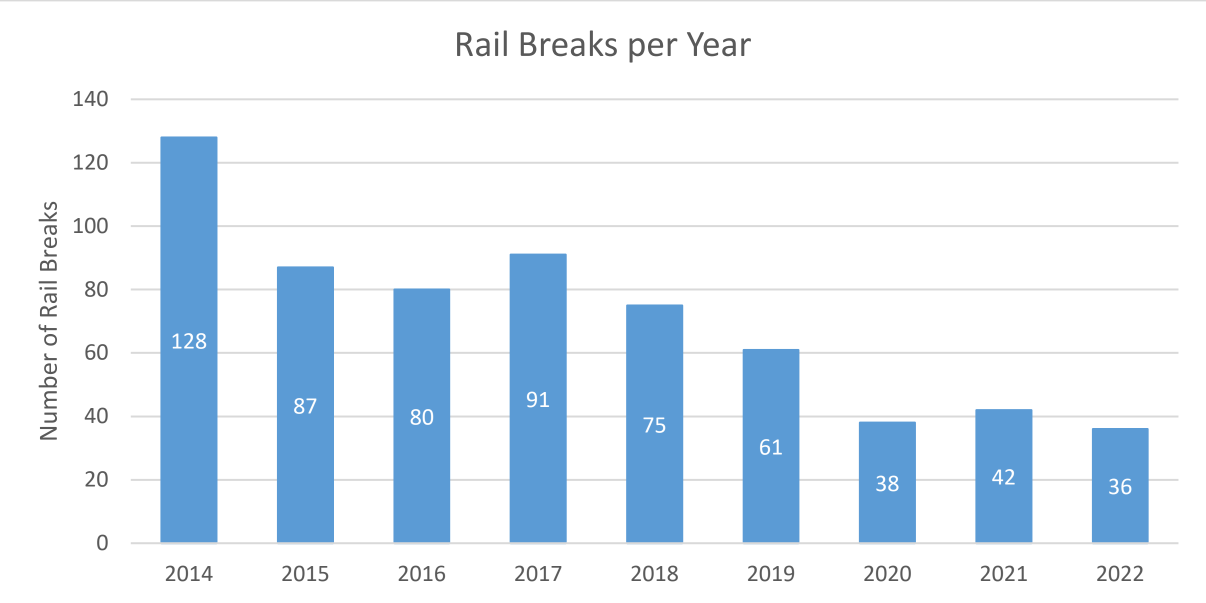

Figure 7: Rail Breaks per Year

Track condition infrastructure losses increased 0.19% in 2022 due to several formation failures, caused by the prolonged rainfall and frequent flooding events on the network, in particular the July 2022 Maitland flooding event. A further embankment slippage at Ardglen, a formation failure at Boggabri and a rail misalignment at Kerrabee on the Ulan line all contributed to the increase in losses for the 2022 compliance period. In September 2022, ARTC reported to the RCG that the impact of the July Maitland flooding event was reflective in the data produced from the AK car which indicated an expected increase of 50% in defects relating to track formation and mudholes over the subsequent six-to-twelve-month period. The three consecutive closedowns performed in the second half of 2022 used a risk and condition-based approach to focus on the identified areas of concern to ensure the most efficient management of the overall reliability of the network.

ARTC has provided details of the top 10 maintenance activities by value in 2022 at a Network level in Table 3A. A zonal break down of these top 10 maintenance activities is provided in Table 3B to Table 3D. The required maintenance activities can vary year to year, particularly where there are discrete projects, and cost variations are to be expected. Commentary has been provided on the key drivers for the movement in costs for the top 10 maintenance activities.

The amounts reflect the underlying maintenance costs for each activity before allocating a share of incremental maintenance to the non-coal traffics.

Also contained in Table 3A to Table 3D is the summary of Other Activities not contained in the top 10 maintenance activities. In 2022 there has been an increase in the overall Other Activities up 12.7% from 2021. Although compared to the 2022 Maintenance Plan, Other Activities was below plan by 1.5%, indicating that these costs were anticipated within the year.

Table 3A: Top 10 Hunter Valley Maintenance Activities $'000 Nominal

		Cost $'000 Nominal					Scope				
Activity (UOM)	**MPM/RCRM**	**2021 Actual** (a)	**2022 Actual** (b)	**% Variance** (b)/(a)-1	**2022 Plan** (c)	**% Variance to Plan** (b)/(c)-1	**2021 Actual** (d)	**2022 Actual** (e)	**% Variance** (e)/(d)-1	**2022 Plan** (f)	**% Variance to Plan** (e)/(f)-1
Ballast Cleaning (m)	MPM	[redacted]		3.1%	16,535	(3.6%)	31,020	31,455	1.4%	30,480	3.2%
Rail Grinding (km)	MPM			2.4%	11,962	4.0%	1,200	972	(19.0%)	1,395	(30.3%)
Maintenance Resurfacing (km)	MPM	8,628	8,943	3.7%	9,989	(10.5%)	533	557	4.6%	719	22.5%
Turnout Steel Component Replacement (n/a)	MPM	8,520	7,851	(7.9%)	6,896	13.8%	-	-	-	-	-
Ballast Undercutting (m)	MPM	3,557	6,892	93.7%	4,844	42.3%	2,209	4,237	91.8%	3,186	33.0%
Track Formation Reconstruction (m)	MPM	10,546	6,455	(38.8%)	5,861	10.1%	2,486	945	(62.0%)	1,226(1)	(22.9%)
Turnout Resurfacing (each)	MPM	4,588	4,943	7.7%	4,560	8.4%	348	274	(21.3%)	321	(14.7%)
Inspection and Minor Repairs of Points (n/a)	RCRM	3,888	3,923	0.9%	3,198	22.7%	-	-	-	-	-
Turnout Grinding (each)	MPM	3,328	3,283	(1.3%)	4,388	(25.2%)	650	652	0.3%	688	(5.2%)
Rail Defect Removal (n/a)	RCRM	3,230	3,169	(1.9%)	4,453	(28.8%)	-	-	-	-	-
Top 10 Total		**73,891**	**73,834**	**(0.1%)**	**72,686**	**1.6%**	-	-	-	-	-
Top 10%		**62.1%**	**59.2%**		**58.5%**						
Other Activities	MPM/RCRM	45,122	50,867	12.7%	51,613	(1.5%)					
Total Maintenance		**119,012**	**124,702**	**4.8%**	**124,299**	**0.3%**					

Infrastructure Maintenance Summary $'000 Nominal

Activity	**2021** (a)	**2022** (b)	**% Variance** (b)/(a)-1
Major Periodic Maintenance	84,780	84,417	(0.4%)
Routine Corrective and Reactive Maintenance	34,233	40,285	17.7%
Total Maintenance	**119,012**	**124,702**	**4.8%**

Note(1): The total Track Formation Reconstruction scope in the 2022 Maintenance Plan was incorrectly reported as 1,403m. This is due to the inclusion of 177m of scope in Zone 1 that forms part of the 2023 program where the costs were planned. This error was identified and addressed in the Quarterly Cost Report Q1 March 2022 Maintenance. The figures in the table above have been updated to reflect the correct values and align with the quarterly reports.
Note: Totals may not add due to rounding

Table 3B: Top 10 Hunter Valley Maintenance Activities Pricing Zone 1 $'000 Nominal

		Cost $'000 Nominal					Scope				
Activity (UOM)	**MPM/RCRM**	**2021 (a)**	**2022 (b)**	**% Variance (b)/(a)-1**	**2022 Plan (c)**	**% Variance to Plan (b)/(c)-1**	**2021 Actual (d)**	**2022 Actual (e)**	**% Variance (e)/(d)-1**	**2022 Plan (f)**	**% Variance to Plan (e)/(f)-1**
Ballast Cleaning (m)	MPM	[redacted]		-	-	-	-	-	-	-	-
Rail Grinding (km)	MPM			11.0%	5,895	14.4%	612	463	(24.3%)	631	(26.5%)
Maintenance Resurfacing (km)	MPM	3,170	2,743	(13.5%)	3,581	(23.4%)	161	170	5.4%	295	(42.5%)
Turnout Steel Component Replacement (n/a)	MPM	5,545	4,612	(16.8%)	5,351	(13.8%)	-	-	-	-	-
Ballast Undercutting (m)	MPM	2,441	4,712	93.1%	2,815	67.4%	1,670	2,679	60.4%	1,851	44.7%
Track Formation Reconstruction (m)	MPM	5,483	1,651	(69.9%)	2,734	(39.6%)	1,254	250	(80.1%)	549(2)	(54.5%)
Turnout Resurfacing (each)	MPM	3,291	3,040	(7.6%)	3,469	(12.4%)	278	207	(25.5%)	250	(17.2%)
Inspection and Minor Repairs of Points (n/a)	RCRM	2,642	2,655	0.5%	2,492	6.5%	-	-	-	-	-
Turnout Grinding (each)	MPM	1,938	2,295	18.4%	3,166	(27.5%)	459	534	16.3%	510	4.7%
Rail Defect Removal (n/a)	RCRM	2,202	1,928	(12.4%)	3,032	(36.4%)	-	-	-	-	-
Top 10 Total		**32,786**	**30,521**	**(6.9%)**	**32,535**	**(6.2%)**	**-**	**-**	**-**	**-**	**-**
Top 10%		**60.7%**	**54.3%**		**54.6%**						
Other Activities	MPM/RCRM	21,247	25,679	20.9%	27,102	(5.3%)					
Total Maintenance		**54,033**	**56,200**	**4.0%**	**59,637**	**(5.8%)**					

Infrastructure Maintenance Summary $'000 Nominal

Activity	**2021 (a)**	**2022** (b)	**% Variance** (b)/(a)-1
Major Periodic Maintenance	34,003	33,976	(0.1%)
Routine Corrective and Reactive Maintenance	20,030	22,224	11.0%
Total Maintenance	**54,033**	**56,200**	**4.0%**

Note(1): $142,000 of Ballast Cleaning costs were captured in the 2022 actuals. These costs are associated with the delivery of ballast to Zone 1 sites in December 2022 in preparation for delivery of scope in 2023.

Note(2): The Zone 1 Track Formation Reconstruction scope in the 2022 Maintenance Plan was incorrectly reported as 726m. This is due to the inclusion of 177m of scope that forms part of the 2023 program where the costs were planned. This error was identified and addressed in the Quarterly Cost Report Q1 March 2022 Maintenance. The figures in the table above have been updated to reflect the correct values and align with the quarterly reports.

Note: Totals may not add due to rounding.

Table 3C: Top 10 Hunter Valley Maintenance Activities Pricing Zone 2 $’000 Nominal

		Cost $’000 Nominal					Scope				
Activity (UOM)	**MPM/RCRM**	**2021 (a)**	**2022 (b)**	**% Variance (b)/(a)-1**	**2022 Plan (c)**	**% Variance to Plan (b)/(c)-1**	**2021 Actual (d)**	**2022 Actual (e)**	**% Variance (e)/(d)-1**	**2022 Plan (f)**	**% Variance to Plan (e)/(f)-1**
Ballast Cleaning (m)	MPM	[redacted]	[redacted]	-	-	-	-	-	-	-	-
Rail Grinding (km)	MPM	[redacted]	[redacted]	1.2%	3,534	(1.9%)	325	288	(11.4%)	439	(34.4%)
Maintenance Resurfacing (km)	MPM	1,391	1,730	24.4%	1,577	9.7%	69	127	83.1%	96	31.9%
Turnout Steel Component Replacement (n/a)	MPM	1,254	490	(60.9%)	614	(20.2%)	-	-	-	-	-
Ballast Undercutting (m)	MPM	86	996	1064.2%	619	60.9%	163	655	301.8%	407	60.9%
Track Formation Reconstruction (m)	MPM	2,453	3,191	30.1%	1,751	82.2%	450	535	18.9%	388	37.9%
Turnout Resurfacing (each)	MPM	530	619	16.7%	430	43.9%	31	20	(35.5%)	28	(29.3%)
Inspection and Minor Repairs of Points (n/a)	RCRM	374	399	6.6%	177	125.0%	-	-	-	-	-
Turnout Grinding (each)	MPM	672	299	(55.4%)	385	(22.2%)	76	34	(55.3%)	52	(34.8%)
Rail Defect Removal (n/a)	RCRM	412	582	41.3%	202	188.6%	-	-	-	-	-
Top 10 Total		**10,598**	**11,774**	**11.1%**	**9,289**	**26.8%**	-	-	-	-	-
Top 10%		**60.4%**	**57.5%**		**56.6%**						
Other Activities	MPM/RCRM	6,943	8,712	25.5%	7,111	22.5%					
Total Maintenance		**17,541**	**20,486**	**16.8%**	**16,400**	**24.9%**					

Infrastructure Maintenance Summary $’000 Nominal

Activity	**2021** (a)	**2022** (b)	**% Variance** (b)/(a)-1
Major Periodic Maintenance	13,589	13,812	1.6%
Routine Corrective and Reactive Maintenance	3,952	6,675	68.9%
Total Maintenance	**17,541**	**20,486**	**16.8%**

Note: Totals may not add due to rounding.

Table 3D: Top 10 Hunter Valley Maintenance Activities Pricing Zone 3 $’000 Nominal

		Cost $’000 Nominal					Scope				
Activity (UOM)	**MPM/RCRM**	**2021** (a)	**2022** (b)	**% Variance** (b)/(a)-1	**2022 Plan** (c)	**% Variance to Plan** (b)/(c)-1	**2021 Actual** (d)	**2022 Actual** (e)	**% Variance** (e)/(d)-1	**2022 Plan** (f)	**% Variance to Plan** (e)/(f)-1
Ballast Cleaning (m)	MPM	[redacted]	[redacted]	2.2%	16,535	(4.5%)	31,020	31,455	1.4%	30,480	3.2%
Rail Grinding (km)	MPM	[redacted]	[redacted]	(15.9%)	2,534	(12.1%)	263	220	(16.2%)	325	(32.2%)
Maintenance Resurfacing (km)	MPM	4,067	4,470	9.9%	4,831	(7.5%)	303	260	(13.9%)	328	(20.5%)
Turnout Steel Component Replacement (n/a)	MPM	1,721	2,749	59.7%	931	195.3%	-	-	-	-	-
Ballast Undercutting (m)	MPM	1,031	1,184	14.8%	1,411	(16.1%)	376	903	140.2%	928	(2.7%)
Track Formation Reconstruction (m)	MPM	2,610	1,613	(38.2%)	1,377	17.2%)	782	160	(79.5%)	288	(44.5%)
Turnout Resurfacing (each)	MPM	766	1,284	67.6%	661	94.3%	39	47	20.5%	43	9.0%
Inspection and Minor Repairs of Points (n/a)	RCRM	872	869	(0.3%)	529	64.5%	-	-	-	-	-
Turnout Grinding (each)	MPM	718	689	(4.0%)	837	(17.6%)	115	84	(27.0%)	126	(33.2%)
Rail Defect Removal (n/a)	RCRM	616	659	6.9%	1,219	(46.0%)	-	-	-	-	-
Top 10 Total		**30,507**	**31,539**	**3.4%**	**30,862**	**2.2%**	-	-	-	-	-
Top 10%		**64.3%**	**65.7%**		**63.9%**						
Other Activities	MPM/RCRM	16,932	16,476	(2.7%)	17,400	(5.3%)					
Total Maintenance		**47,439**	**48,016**	**1.2%**	**48,262**	**(0.5%)**					

Infrastructure Maintenance Summary $’000 Nominal

Activity	**2021** (a)	**2022** (b)	**% Variance** (b)/(a)-1
Major Periodic Maintenance	37,188	36,629	(1.5%)
Routine Corrective and Reactive Maintenance	10,251	11,387	11.1%
Total Maintenance	**47,439**	**48,016**	**1.2%**

Note: Totals may not add due to rounding.

The following sections provide an explanation for the key drivers for the movements in maintenance activities across the network.

2.1 Ballast Cleaning

2.1.1 Activity Overview

Ballast cleaning is the mechanical excavation of deteriorated track ballast up to 500mm below the bottom of the sleeper across the entire track cross-section. The activity's purpose is to reinstate the function of the ballast as a free-draining medium, holding the track to its correct geometry under the passage of trains. It is a large component of the recurrent operating costs at an aggregate level, recognising that the activity will move through the zones across a number of years. The ballast cleaning activity is outsourced through the engagement of specialised plant. Unit rates fluctuate year on year dependent on contract rates, ballast reclamation levels, ballast age and maintenance possession scheduling.

The Ballast Cleaning strategy is based on a preventative maintenance intervention cycle, using accumulated line tonnage. The theoretical ballast cleaning cycle for the Hunter Valley has been developed based on industry standards and considers the uniqueness of the Hunter Valley tracks. The frequency for the different tracks on the network can range from 8 years in Zone 1 to 32 years in Zone 3 based on their tonnage profiles. Concurrently to the theoretical cycle, ARTC's strategy is also to ensure all of the coal network has been ballast cleaned at least once. Some large areas on the network, primarily Zone 3, still have not undergone a complete ballast clean since their original construction in late 1800s, with approximately 38 km (15% of Zone 3) remaining to be completed at the end of 2022.

The current ballast cleaning strategy is achieved through the utilisation of a single Ballast Cleaning machine over the six major annual possessions. The program has considered customer feedback regarding their tolerance in relation to total cost of the ballast cleaning program and the outage requirements required to achieve scheduled scope. Considering the assessment of industry standards, track condition, historical cleaning activity and stakeholder feedback, ARTC's current strategy, which was implemented in mid-2017, is to deliver approximately 30km of ballast cleaning scope each year packaged in 5km bundles completed per possession. However, there are certain key contributors that influence the actual scope achieved by the ballast cleaner in any given period which include the condition of the ballast, ballast cleaning machine performance, material handling logistics (e.g. importing fresh ballast to each location) and interaction with fixed infrastructure such as level crossings and turnouts.

In order to assess track condition to refine the scope, ARTCs Decision Support Platform (DSP) utilises condition data which includes the Ballast Fouling Index (as measured by the Ground Penetrating Radar (GPR)). This data reflects the extent of ballast deterioration and the Top Moving Sum serving as an indicator of overall track performance as measured by the AK Car.

In 2018, ARTC commenced a five-year single supplier contract with a two-year extension option, to complete ballast cleaning in the Hunter Valley. The initial procurement of this contract was conducted through an open market international tender specifically seeking a multi-year agreement to ensure the supplier and the associated specialised equipment needed for ballast cleaning was secured for a longer term. The contract is inclusive of the ballast cleaning machine, spoil wagons, resurfacing and regulating activities with the ballast itself acquired directly by ARTC through various quarries, and, depending on the location of the ballast cleaning activity, delivered using both ballast trains and trucks. The schedule of rates of the contract contains both fixed and variable cost components with the fixed rates being related to the general operation of the ballast cleaner in the Hunter Valley. The variable rates are calculated based on the length of the closedown, achieved scope and required supporting resources. Due to the significant nature of this maintenance activity, ARTC is continually assessing the overall strategy and approach to ballast maintenance, including accounting for any changes in network context. A full review of the strategy is scheduled to be conducted prior to expiry of the contract.

2.1.2 Compliance Commentary

The outcomes for scope and costs for ballast cleaning is consistent between 2021 and 2022, with achieved scope increasing by 1% and actual costs increasing by 3% comparatively. For both years, ballast cleaning was delivered in Zone 3 across the six closedowns, where favourable conditions support high production rates. Additionally, across both years, minimal program disruptions occurred that had plagued the ballast cleaning program in years prior, resulting in high volumes of scope delivered, contributing to the consistent outcome between the two years.

Compared to 2022 Maintenance Plan, actual costs were slightly below budget (4%) and achieved scope was slightly higher than plan (3%). As articulated in the 2022 Maintenance Plan, the planned budget is derived from a review of historical costs with assumptions made for escalation and other factors foreseen at the time. During the preparation of the 2022 plan, ARTC had been experiencing increases in ballast supply costs, impacting the variable cost component of ballast cleaning. Based on this, the budget for ballast cleaning was increased by approximately $0.6m to account for escalations in ballast costs as well as a nominal CPI escalation. However, during 2022, ARTC was able to negotiate favourable prices for ballast supply, reducing actual costs below budget.

The planned scope is based on a nominal 30km of ballast cleaning each year, with the aim to achieve 5km in each of the six closedowns. As outlined above, the achievable scope is highly dependent on various site conditions, including the number of fixed assets to work around and the degree of contamination in the ballast. As mentioned previously, the conditions in Zone 3 are favourable for a high production rate for ballast cleaning. Long sections of single line track between fixed assets, reduce the number of cut-out/cut-ins required, as well as the ability to spill spoil directly to the cess, reducing downtime for spoil management. These factors have resulted in achieved scope for the year exceeding the nominal 30km planned for the year.

As the outcomes for scope and costs are consistent between 2021 and 2022, so too is the unit rate, with only a 1% increase between the years. Similarly, due to the costs coming in under budget and scope slightly exceeding, there is a 7% reduction in unit rate between plan and actual.

Unit rates achieved in 2021 and 2022 have been favourable compared to preceding years, this can be attributed to disruptions that occurred during those periods that impacted scope delivery, as outlined in earlier compliance submissions.

[redacted]

2.2 Rail Grinding

2.2.1 Activity Overview

Rail Grinding is the periodic grinding of rail to manage its profile and control stress-related rail defect growth. Grinding improves wheel and rail interface to reduce rail and wheel wear and propagation of rail defects. Rail grinding also provides a safety function by ensuring the rail is able to be ultrasonically tested through the running surface for internal defects and other external defects that can trigger broken rails. When rail defects progress they can create undesirable surface conditions on the rail that have a shielding effect preventing penetration by the probes used during ultrasonic inspection and can prevent the detection of internal defects.

In determining the optimal rail grinding frequency, a detailed analysis of rail performance is undertaken to maximise rail life and minimise the development of rail defects. Rail grinding is a cyclic activity where the required frequency is determined by a combination of factors.

A baseline grinding program is prepared based on frequencies defined in the engineering standards for the following attributes:

- rail steel type;
- track alignment (curvature).
- traffic type; and
- gross tonnage.

To refine the Annual Works Plan for grinding, consideration is given to:

- existing surface condition; and
- maintenance possession timing.

Although generally comparable year on year due to a relatively stable tonnage profile and minimal configuration change to the network, there is still a cyclic dimension of the grinding activity that necessarily results in some fluctuation in the volume of rail grinding becoming due. Additionally, the Hunter Valley rail grinding activity forms part of the ARTC National Grinding Program. This program is primarily delivered by a single high production rail grinding machine as part of a multi-year agreement. The planning of rail grinding scope in the Hunter Valley is reliant on the availability of the machine and alignment with this National Grinding Program. Not all Hunter Valley grinding cycles fit neatly into a calendar year cycle or align perfectly with the National Grind Program availability which can also result in year-on-year fluctuations.

In order to develop a program that addresses the assets grinding requirements, prior to each year commencing a number of rail grinding shifts are allocated to the Hunter Valley Business Unit within the National Grinding Program. The shifts allocated enable a mix of standalone Rail Grinding Possessions, and shifts scheduled within the Hunter Valley Major Closedowns. This ensures that the program is adequate to deliver the scope volume required, that network downtime and customer disruption are minimised and that the grinding resource utilisation is maximised. However, due to the Australia wide grinding program, generally if the program or the wider network experiences a disruption and planned scope is unable to be completed on the allocated and planned shift, this will normally result in a lost opportunity and the scope will not be able to be completed on an alternative occasion with the national high production rail grinding machine, ultimately resulting in a reduction in achieved scope volumes and higher unit rates. Reduced scope and increased unit rate are driven by a range of factors including the fixed cost component of the national grinding contract, the low productivity of alternative grinding resources and the higher grinding effort and lower productivity of subsequent grinding of the missed scope sections of track.

2.2.2 Compliance Commentary

Outcomes for cost in 2022 relative to 2021 are comparable, with the total increasing by 2%. However, the split across zones varied slightly more, with an 11% overspend in Zone 1 largely offset by an underspend in Zone 3. However, despite the similar cost outcomes, scope delivery was substantially below what was achieved in 2021 across all Zones with a 19% reduction across the network.

Likewise, outcomes compared to the 2022 Maintenance Plan followed a similar trend, with actual costs 4% over budget, with a similar outcome across each of the zones with the major variances being an overspend in Zone 1, partially offset by an underspend in Zone 3. Similarly with scope, there was a total under delivery compared to plan of 30%, with consistent reductions across each of the zones.

The variances in cost and scope outlined above in comparison to 2021 and the 2022 Maintenance Plan can largely be explained by two factors:

- The 2022 plan included a high volume of rail grinding scope at a low unit rate. The scope volume was based on high forecast rail volumes. It was anticipated that this scope could be achieved at a favourable unit rate, based on the successful execution of the 2020 and 2021 plans following the introduction of the 120 Stone Grinder, as well as assumptions made around a lower cost per shift, due to the anticipated utilisation of the rail grinder both within the Hunter Valley and nationally. This resulted in a plan that increased in scope with lower unit rates than those achieved in 2021.
- The execution of the 2022 program was severely affected by a number of events, that resulted in significant productivity losses and additional costs. This resulted in significantly less scope being achieved compared to plan and 2021 outcomes, however with costs remaining relatively consistent, resulting in a substantial increase in unit rates.

2.2.2.1 Planning Assumptions

As articulated in Appendix B of the 2022 Maintenance Plan, rail grinding requirements are determined in accordance with ARTCs Engineering Standards, with inputs being the track configuration, axle loads of rail traffic and the line tonnage. Year to year, track configuration and axle loads remain constant, with the only variable component being anticipated rail tonnages. During the preparation of the 2022 Maintenance Plan, customer volume tonnage forecasts for 2022 exceeded forecast volumes for 2021 and actual volumes in 2020 across all zones, refer to Section 4.1.1 of the 2022 Maintenance Plan. Based on these planning inputs, the plan scope requirements exceeded those of 2020 and 2021, see Table 4.

Table 4: Rail Grinding Planned Scope

Pricing Zone	2020	2021	2022
Zone 1	552km	640km	631km
Zone 2	433km	414km	439km
Zone 3	282km	189km	325km
Total	**1,267km**	**1,243km**	**1,395km**

Commensurate with the increase scope volume, during the preparation of the 2022 Maintenance Plan, the initial National Rail Grinding Program had 63 shifts allocated to the Hunter Valley for 2022. The allocation had been based of the forecast scope and the typical production rates achievable with the new 120 Stone Grinder. For the same period, 75 shifts were allocated to the remainder of the business, which was later reduced to 67 subsequent to the refinement of the Interstate business plan. Based on forecast utilisation rates at the time of preparing the 2022 Maintenance Plan and the distribution of contracted fixed costs across shifts, the planned unit rates were low relative to achieved rates in 2020 and 2021.

The anticipated utilisation, as well as the distribution of shifts across the various business units meant that the planned unit rates for the 2022 Maintenance Plan were lower than those achieved in 2021.

2.2.2.2 Program Impacts

In 2022, the rail grinding program experienced some setbacks to the delivery schedule, due to unforeseen events that occurred within the year. These events resulted in both a reduction in scope achieved as well as increased unit costs, particularly in relation to Zones 1 and 2.

One significant change that impacted Rail Grinding in 2022 was the introduction of additional safety controls to protect workers from rail traffic on adjacent tracks. This was introduced following a significant near miss between a train on an adjacent track and a worker on the ARTC network in March 2022 in Seymour, Victoria. This had the most impact in Zone 1 where there are multiple adjacent tracks that operate during rail grinding possessions. The additional safety measures impacted both cost and scope delivery, due to the need for additional safeworking resources required to implement and manage the controls on the adjacent tracks and the time required to do this, reducing the time available for grinding.

Furthermore, during 2022, ten rail grinding shifts were cancelled at short notice due to a range of other events that occurred throughout the year, including:

- Flooding in South Australia during February prevented the Rail Grinder traveling to NSW to complete planned grinding. This resulted in the cancelation of seven shifts, of which three were allocated to the Hunter Valley.
- Unforeseen issues resulted in the cancellation of six grinding shifts. Issues included a broken rail, a critical repair to a structure, reprioritisation of missed grinding scope elsewhere, failed trains and safeworking resourcing issues. These issues impacted shifts across all three zones.

- One shift was also lost from the National Grinding Plan as a result of a mechanical breakdown of the National Rail Grinder. Although there was an operational cost reduction as a result, there was reduced scope delivered as a result.

For Zone 1, there was limited capacity to recover the scope not achieved from the National Rail Grinder. As a result, additional, lower production grinding resources were sourced for targeted grinding to best manage rail conditions.

For Zone 2, the postponement of work resulted in extended timeframes between grinding as these sections require high frequency grinding to manage wear and track defect progression. Subsequently, to rectify the condition, the work became corrective in nature rather than preventative. This reduced grinding productivity because more grinding was required at each section to restore the rail condition and to manage defects.

For Zone 3, an engineering assessment of the rail condition enabled the reallocation of a shift to Zone 2 to aid in the recovery of sections with a high frequency grinding cycle.

The nature of the National Grinding Contract, other than when the contractor was at fault, meant the fixed costs would be distributed across the remaining shifts that were completed. The outcome of this resulted in a final cost outcome in line with plan, despite the significant under delivery of scope.

In terms of unit rates, lower scope delivery when compared to 2021 and the 2022 Maintenance Plan, with consistent costs outcomes have resulted in an increase in unit rates across all zones. However, despite this, the unit rates achieved are within the normal range of historical trends.

[redacted]

2.3 Track Formation Reconstruction

2.3.1 Activity Overview

The majority of Hunter Valley track formation was constructed between 100-150 years ago using relatively uncompacted locally available materials to suit the axle loads of traffic at that time. This material has consolidated over the years however the original formation would be considered unsuitable for the current operational task. As a result of this aging network, there are sites across the Hunter Valley where the formation is failing and can also no longer be efficiently managed by other maintenance activities, such as tamping and undercutting.

The track reconditioning activity involves the removal and reconstruction of the track formation to effectively manage the risk to rail operations from track geometry deterioration. Track reconditioning includes subgrade treatment, the installation of structural earthworks, a capping layer and new ballast, followed by track and drainage restoration. It should be noted that sites that are 200m or more in length are treated as capital track upgrades and included in the annual Sustaining Capital Program. Key indicators of the requirement for reconditioning include overall deterioration rates, geotechnical risk investigations, temporary speed restriction performance, maintenance effectiveness intervals and formation configuration.

The strategy used to develop the AMP for the Hunter Valley (for both the MPM and Sustaining Capital activities) uses a multi-criteria condition-based analysis to identify scope in the earlier years, with allowances based on historical scope for later years. Due to the dynamic nature of the drivers behind track reconditioning, some sites emerge after the development of scope and are identified by accelerated degradation of track condition. This accelerated deterioration can occur at known or unknown locations and will occasionally result in the inclusion of a site after the plan has been produced. Likewise, there are instances where site performance can stabilise, allowing for planned work to be deferred to later years.

As the track reconditioning scope is heavily dependent on the formation condition and resulting track performance, the amount of scope completed each year may vary significantly. The scope variations seen year-on-year can often be attributed to the susceptibility of the network to wet weather in that period. Inconsistencies between different track reconditioning sites in terms of the excavation depth and transport of material costs (construction and spoil) drive large variances in unit rates which render comparison difficult and ineffective.

2.3.2 Compliance Commentary

Track Formation Reconstruction costs reduced by 39% in 2022 compared to 2021, this shift was driven by a reduction in scope delivered (62% reduction). In 2021, 2,486m of scope was completed over 19 individual Track Formation Reconstruction projects. Whereas in 2022, only 945m of scope was completed over only eight individual projects. These year-to-year variances in the number of projects is typical for this activity, as scope requirements is heavily dependent of formation condition and track performance, as well as the size of sites that are identified during planning and whether they trigger capital treatment.

The 2022 Maintenance Plan included 12 individual Track Formation Reconstruction projects and an allowance for one additional site. As previously discussed, the dynamic nature of formation performance can often result in sites degrading more rapidly and necessitating prioritisation over sites identified in the plan, as well as sites that have been identified can stabilise and can be deferred. During the year, eight sites were prioritised for completion, including three that weren't included in the original plan, for sites that experienced accelerated degradation at Gunnedah, Parkville and Denman. Additionally, one site identified in the 2022 Maintenance Plan at East Maitland was accelerated and completed in 2021. The remaining sites were deferred to later years due to stable performance.

While scope delivered was down in 2022 relative to 2021 and the 2022 Maintenance Plan, unit rates did increase comparatively. This is partially due to the complexity associated with some of the projects completed, as these sites involved level crossings, additional sub-surface and other components not ordinarily part of plain track reconditioning projects. Additionally, work in Zone 1 was performed over the July long weekend, aligning with the Sydney Trains shutdown and closure of the Mains between Newcastle and Maitland. This closedown was necessary to safely perform a range of projects on the coal and main lines without live rail lines directly adjacent to the worksites. However, this arrangement results in increased costs, due to both increased labour rates for work performed on weekends and public holidays, as well as increased demand on industry resources as Sydney Trains are also performing major maintenance activities during the same possession window.

Separately, the cost increases experienced during 2022 are due to sector inflation that had been experienced in general across industry and infrastructure projects. For Track Formation Reconstruction projects, ARTC has observed a distinct increase in the market pricing in response to tenders in 2022 as compared to the 2022 Maintenance Plan and 2021. When comparing like for like work packages from 2021 and 2022, project pricing has trended upwards, ranging from 14% to 19% above estimated budgets reflective of macro-economic inflationary pressures in the construction sector.

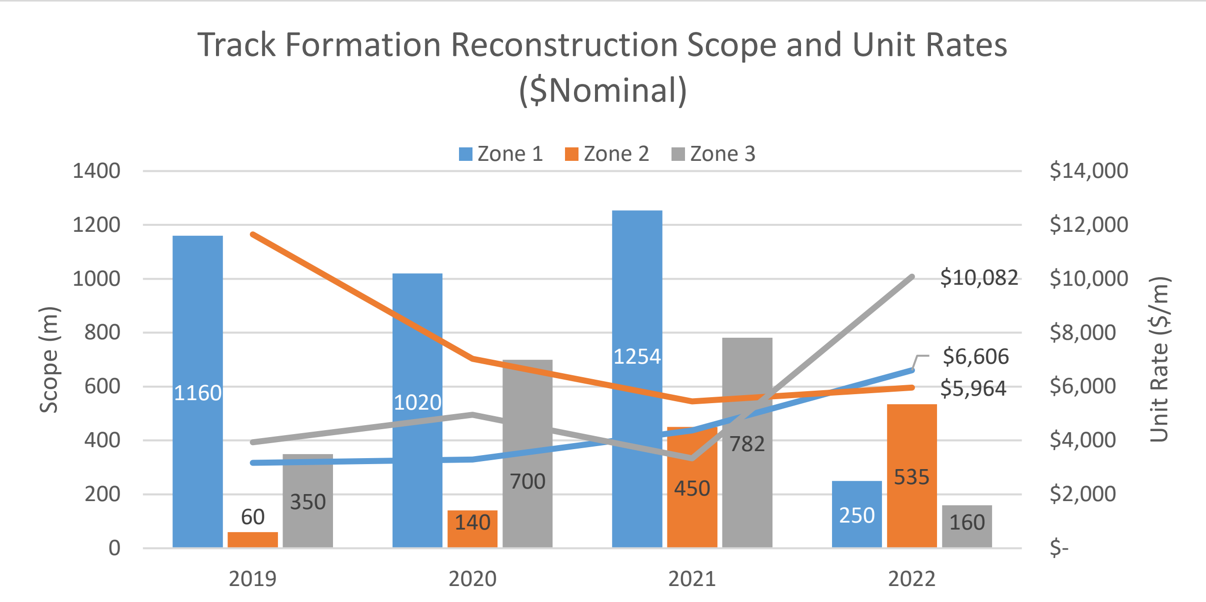

Figure 10: Track Formation Reconstruction Scope and Unit Rate ($Nominal)

2.4 Maintenance Resurfacing

2.4.1 Activity Overview

Track maintenance resurfacing (tamping) restores the track geometry parameters of top, line, superelevation and curvature by mechanised on-track machinery to the “as designed” condition of the track. Resurfacing cycles have been determined for each line segment from historical data and considers factors such as track performance and track configuration. Benchmarking data suggests that tamping is required every 50 to 120 MGT, however the actual requirement is significantly influenced by other factors such as rainfall, track structure, track condition, axle load and speed.

The trigger for maintenance resurfacing is an out-of-tolerance geometric parameter or if the track quality is below, or approaching, the maintenance intervention limit. The key factors that drive the changes in maintenance resurfacing cycles are the configuration, strength and stiffness of the track bed (formation). Traffic during times of high rainfall results in movement of the formation and directly leads to the need for more tamping. It is important to note that in most of the Hunter Valley, particular north of Muswellbrook, track formation remains in its original construction from the late 1800s to early 1900s. While the track bed consists of un-engineered and poorly compacted materials, the rolling stock and track superstructure has been upgraded to suit heavy haul requirements. As expected, the high frequency maintenance resurfacing required on this old formation is reflected in the low MGT resurfacing cycles.

The detailed planning of Maintenance Resurfacing is a complex exercise that goes through multiple iterations in the lead up to each major closedown. The number of machines required for each closedown is largely governed by the number of fixed worksites that require resurfacing, where these sites are located and the number of track blocks (sections of track taken out of service) that exist during the closedown. Machines are first allocated to fixed worksites at the required timeslot so to not affect the projects’ ability to hand back track on time for the end of the possession. Projects typically included track reconditioning and upgrades, undercutting, bridge upgrades, culvert upgrades and turnout renewals. The remaining time available for each track machine is then utilised to complete maintenance resurfacing scope identified using the Decision Support Platform and condition-based inputs from geometry defects, the AK Car and Instrumental Coal Wagons. While the resurfacing costs associated with fixed worksites are captured separately to the Maintenance Resurfacing activity, the scheduling disruption that occurs through supporting these projects often impact the overall production rates. As a result, when machines support a higher volume of fixed worksites, it is typically for is to achieve higher unit rates than it would otherwise.

Maintenance Resurfacing is undertaken using a combination of ARTC and Contractor owned equipment. Maintenance resurfacing contracts were awarded to five contractors during 2019 following an open market tendering process. The total duration of the current contract term is five years and will end in June 2024. The awarded tender focused on a move to improved technology which would involve a change in the mix of machines used to generate higher quality results to increase the effectiveness (or longevity) of the completed tamping. The new strategy and contract focus on condition-based works, and the improved quality of the tamping introduced in 2021 was continued in 2022.

Maintenance Resurfacing is typically performed during major closedowns, as this enables the maximum efficiency of the machine. Additionally, the ability to double shift machines, increase production time relative to the mobilisation and demobilisation activities, resulting in more favourable unit rates. Occasionally, there will be a need to perform Maintenance Resurfacing outside of a major closedown, this is usually performed at short notice to address emerging conditions that are causing disruptions to the network, usually in the form of a TSR or frequent maintenance intervention by the maintenance teams. Maintenance Resurfacing performed outside of major closedowns often attract much higher unit rates due to minimum shift lengths, mobilisation and demobilisation costs, against a short production window.

2.4.2 Compliance Commentary

Maintenance Resurfacing cost and scope increased marginally in 2022 relative to 2021, with a 4% increase in cost and 5% increase in scope. Greater variation occurred at a zonal level, with cost increases in Zones 2 and 3 (24% and 10%), partially offset by a reduction in Zone 1 (13%). From a scope perspective, Zone 1 and 2 increased (5% and 83%), while Zone 3 reduced (14%).

From a unit rate perspective, 2022 outcomes are consistent with 2021, with the overall rate 1% less than what was achieved in 2021. Although there are more substantial fluctuations at a zonal level, with Zones 1 and 2 achieving lower unit rates in 2022 (18% and 32%), while the unit rates in Zone 3 increased (28%). Yearly fluctuations in unit rates across zones are expected, this is due to changing conditions and circumstances that occur each year. Despite this, the outcomes for 2022 are within the normal range of unit rates experienced across each of the zones in recent years, refer to Figure 11.

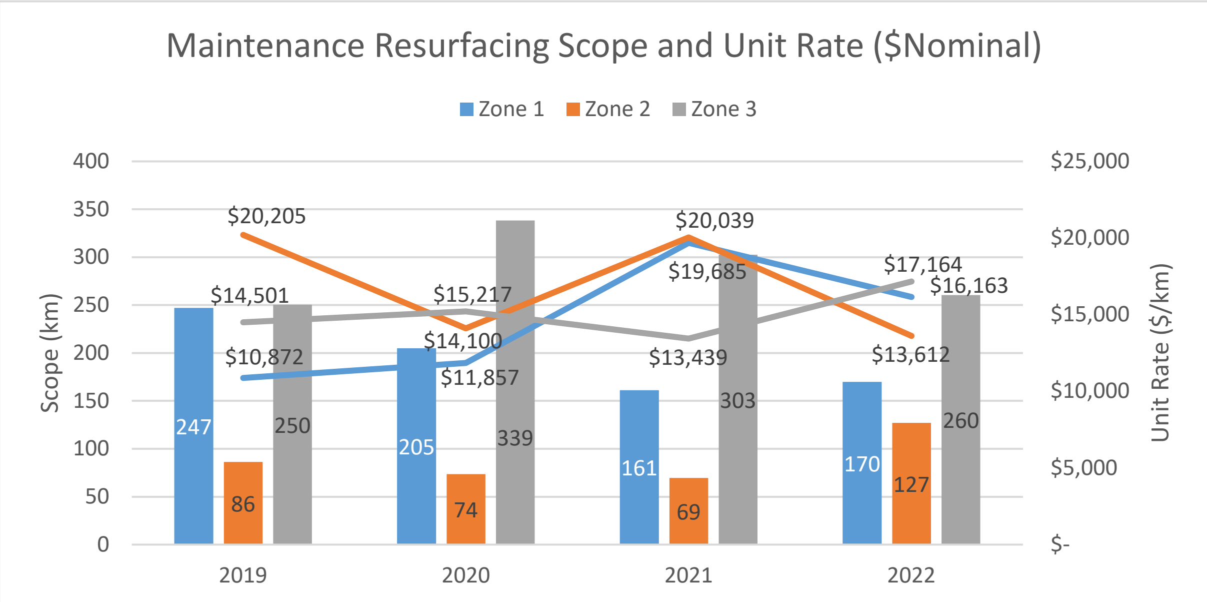

Figure 11: Maintenance Resurfacing Scope and Unit Rate ($Nominal)

Compared to the 2022 Maintenance Plan, costs were below plan by 10%, with reductions in Zones 1 and 3 (23% and 7%), and an increase in Zone 2 (10%). A similar outcome has occurred with scope, with an overall reduction of 22%, made up of reductions in Zones 1 and 3 (42% and 20%), and an increase in Zone 2 (32%). During the preparation of the 2022 Maintenance Plan, future scope programs were maintained at higher levels than the historic actuals, recognising dryer conditions in years prior and the potential for track condition to deteriorate as wetter conditions were being experienced.

During the preparation of the 2022 Maintenance Plan, planned unit rates were aligned to those achieved in 2020, although it was expected that variations between planned and actual would occur, based on the conditions and circumstances that would arise during the year. When comparing unit rates to the 2022 Maintenance Plan, the overall outcome was that the unit rate achieved is 16% higher than planned, with Zones 1 and 3 higher than planned (33% and 16% respectively), and Zone 2 below plan (17%).

While outcomes between 2021 and 2022 were relatively consistent, the variation between plan and actuals were much greater. This was the result of factors that impacted scope execution and costs, ultimately resulting in variations in unit rates. Factors that affected Zones 1 and 3 resulted in reduced scope delivery at higher shift costs, whereas Zone 2 had a more favourable outcome. Factors that impacted Zones 1 and 3 included:

- The July 2022 flood event resulted in a high volume of unexpected and unplanned rectification work was required in the September closedown. Additionally, due to the flooding, the work required in the lower part of the valley for the remainder of the year was mostly smaller targeted sections of scope to address emerging conditions ultimately resulting in lower production rates.
- During 2022, a higher volume of fixed worksites required resurfacing support during the major closedowns; with the average number of fixed worksites amounting to 55 sites per closedown in 2022, compared to 27 sites per closedown in 2021. A high proportion of these sites were located within Zones 1 and 3 throughout the year and had a direct impact on costs, as there is a need to source additional resurfacing resources, resulting in increased mobilisation and demobilisation costs. Additionally, supporting fixed worksites tends to impact the overall productivity of the machine, as there is often lost production time associated with transferring to the fixed worksite and knock on delays as a result of the complexity of the fixed worksites scope. For example, delays incurred due to fixed worksites in Zone 1 during the May and September closedowns resulted in a loss of 2.5 shifts of production time. Similarly, worksite delays during the February and November closedowns in Zone 3 resulted in a further 2.5 shifts of lost production time.
- A large volume of high cost and low production maintenance resurfacing was performed through level crossings during 2022, particularly in Zone 3. This work is generally be performed during night shift to minimise impacts to the community and attracting higher labour rates. Additionally, the work requires addition resources to manage road traffic and remove and reinstate the level crossing and road surface.
- Worksite congestion throughout Kooragang, Sandgate, Maitland, Singleton and Muswellbrook locations reduced overall productivity of resurfacing activities in Zone 1. This had a direct impact on the ability to deliver planned scope. The high number of worksites and track blocks required an increased number of machines which in turn added to the higher than anticipated costs.
- Due to the criticality of the Hexham Holding Roads for stabling of trainsets during the major closedowns, these tracks were resurfaced during planned maintenance possessions in 2022. Additionally, an emerging track condition on the North Fork on arrival to Kooragang Island required resurfacing during a planned maintenance possession during the year. These works attracted higher unit rates than typical maintenance resurfacing performed in major closedowns.

Comparatively Zone 2, due to less worksite congestion across the zone and a lower number of fixed worksites requiring support, conditions were favourable to the allocation of a high production unit enabling high scope volumes to be achieved at a favourable unit rate.

From a maintenance resurfacing cost per thousand gross tonne kilometres (KGTKM), there are minor variations across zones over the recent years. These variations are due to the ever changing conditions and circumstances that have a propensity to impact the maintenance resurfacing program, some of which have been outlined above.

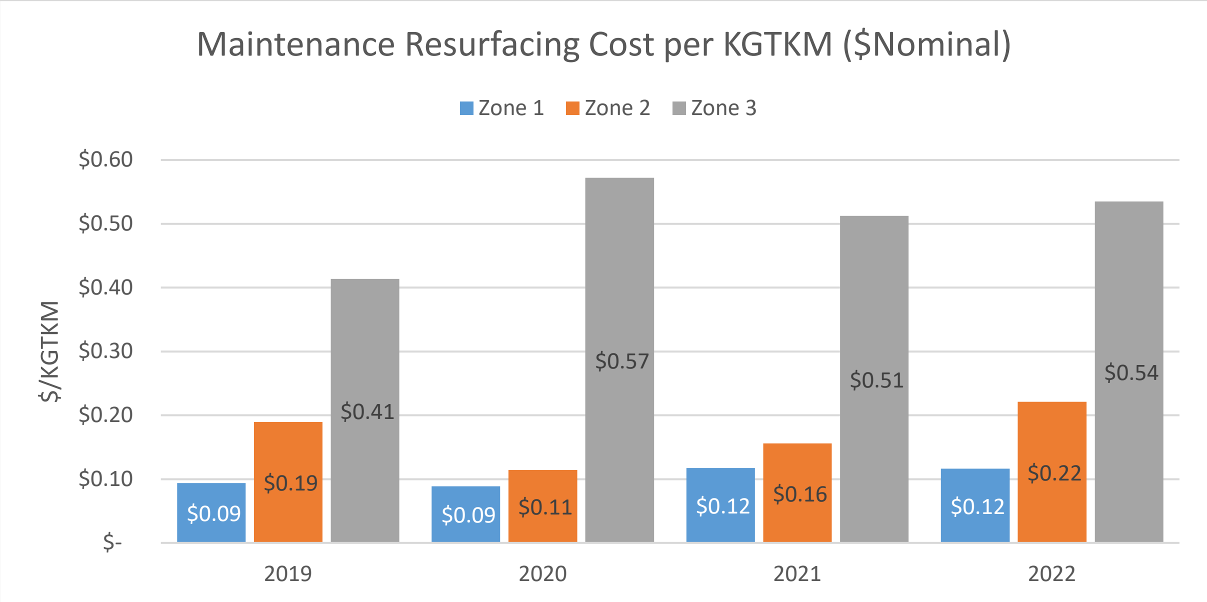

Figure 12: Maintenance Resurfacing Cost per KGTKM ($Nominal)

2.5 Turnout Steel Component Replacement

2.5.1 Activity Overview

Turnout Steel Component Replacement is the in-situ replacement of the turnout steel components through either the installation of a new item or the building-up of existing components through wire feed welding. In general, this relates to replacement or the repair of switch and stock rails, crossings (including fixed and swing nose), insulated joints, check rails and check rail carriers, as these are the major components of a turnout. Turnout steel component replacement intends to return the asset to its original design specification and function.

The replacement of worn and defective turnout steel components reduces the risk of turnout rail component failure and therefore potential derailment. Replacement is required when components are damaged beyond the extent to which defects can be addressed by turnout grinders, hand grinding or wire feed welding (build up) activities.

Scope is identified within the live year via regular inspections performed by maintenance personnel, by the presence of an internal rail condition identified by the rail-bound ultrasonic test car, or through condition datasets within the Decision Support Platform, such as vertical acceleration responses from the Instrumented Coal Wagon (ICW). Although this activity is classified as an MPM activity, it is somewhat reactive in nature due to the rate at which conditions can deteriorate from when they are first identified. This is due to the different types of turnouts in operation in the Hunter Valley, each with their own corresponding lifespans, maintenance regimes, throughput tonnage and usage characteristics. Additionally, steel component performance will also be affected by more general issues with the track formation, ballast, drainage, and the effectiveness of other maintenance activities performed on the turnout, such as tamping and grinding.

The majority of scope delivered under this activity can be classified as one of three categories; build ups, switch and stock rail replacement, or crossing replacement, with the cost of each varying substantially depending on a range of factors. Whilst there are other turnout components that are replaced and captured under this activity, they make up approximately 2% of the total work performed and do not result in significant expenditure, this includes the replacement of insulated joints or the replacement or repair of check rails and check rail carriers. It is important to note that grinding post replacement of a component is also captured are part of the Turnout Steel Component Replacement costs. Post installation grinding is critical to ensuring the maximum component life is achieved by maintaining the correct rail profile for the component as it work-hardens.

A build up is where one or more defects within a turnout are ground down to remove damaged or cracked metal. The ground area is then built back up via a wire fed welding process. The area is then profile ground to restore the original profile of the component. The main variables that impact the unit rate for build ups are the size and number of defects and therefore the effort required to repair. The location relative to other required scope and the delivery (planned or unplanned) of this work can also impact the overall costs. This work is outsourced to a specialist service provider that are typically engaged on a fixed day rate agreement. Therefore, if the scope and location allow multiple jobs to be completed within a shift, the unit rate will be much lower than a location where multiple shifts are required to repair the components. Typically, the unit rate for a build-up will vary between $3,000 and $15,000 depending on these variables.

A switch and stock rail replacement refers to the replacement of either the left or right switch and stock rail assembly. To achieve this, the signalling equipment on the turnout must first be disconnected from the components to be removed, the assembly is then cut and removed from the turnout. The new component is then lifted into place and welded back into position. Following this the signalling equipment is then reinstated and certified back into use. There are many variables that impact the unit rate for this type of scope, these include:

- The cost of the new component which can vary substantially based on the type and size of the turnout.
- The location of the works and the cost delivering the component to site. The size of the component and site access may require a crane to perform the lifting activities versus whether an excavator is sufficient.
- Whether the scope is delivered through internal or external resources.
- Whether there are other works required as part of the scope, such as additional closure rails; or
- The amount of post installation grinding required until a cyclic grinding cycle is sufficient to maintain the correct rail profile.

Typically, the unit rate for a switch and stock rail replacement will vary from about $15,000 for a low cost, easy access component delivered by internal resources, up to about $100,000 for a high value, complex component delivered by external resources.

Crossing replacements are the most significant scope type performed under this activity. They are typically the highest wearing component of a turnout and for the larger turnouts on the ARTC network, are the most expensive component to replace. There are two types of crossings within the Hunter Valley, swing nose crossings and fixed nose crossings. Swing nose crossings are more complex in nature and include signalling equipment to control a switch blade within the crossing. Fixed nose crossings do not have any moving components and therefore have no signalling equipment. The process of replacing a crossing is in line with replacing a switch and stock rail assembly with the variables that affect the unit rate being same as detailed above. Typically, the unit rate for a crossing replacement will vary from around $25,000 for a low cost, easy access component delivered by internal resources (e.g. rail bound manganese insert), up to about $400,000 for the replacement of a large swing nose crossing.

Due to the reactive nature of this Turnout Steel Component Replacement and the resulting variability in work performed year to year, scope units are not compared for this activity. Rather when preparing future year plans, historical zonal spend profiles are analysed, along with a base set of assumptions that are applied to develop future budget allocations. Additionally, due to this, unit rates are not captured or analysed for this activity, as they are not comparable year to year.

In recent years, the delivery model for this activity has changed from the use of contract staff to an in-house team that is supplemented by contractors as required. However, as the internal competencies are still being developed a reliance remains on contractor resources. In the Hunter Valley, one commercial partner has been engaged to support the delivery of scope within closedowns. However, the long-term view is for ARTC to continue to increase development and use of in-house resources for the delivery of this activity to provide better value for money outcomes for customers.

2.5.2 Compliance Commentary

The total Turnout Steel Component Replacement costs reduced in 2022 compared to 2021, with total costs down 8%. However, there is greater variation between zones, with both Zones 1 and 2 costing less than 2021 (17% and 61% respectively), and Zone 3 costing more (60%). This year to year variation across zones is largely driven by the reactive nature of this activity and the conditions that arise within the year.

Likewise, the 2022 outcomes compared to the 2022 Maintenance Plan has a similar outcome, with Zones 1 and 2 below plan (14% and 20% respectively), and Zone 3 above plan (195%), albeit substantially. From a total standpoint, the 2022 outcome was 14% higher than the 2022 Maintenance Plan. When preparing the 2022 Maintenance Plan, ARTC had recently increased focus on post installation grinding of components, evidenced through the increased volume of post installation grinding seen post 2019. It was anticipated that this focus would result in a reduction in turnout steel replacement costs to an equivalent spend experienced in 2019 and prior years, and therefore this was applied as a budget assumption at the time. While total spend in 2022 continued to reduce from 2021 and 2020, the anticipated reduction was not fully achieved, which is driving the increased costs compared to the plan.

The major anomaly when comparing 2022 outcomes to the 2021 and 2022 Maintenance Plan relates to Zone 3 costs. Although, scope volumes completed over the recent years hasn't changed significantly (refer to Figure 13) with the exception being grinding, which contributed approximately $0.3M of the cost increase, as a post hand grind typically costs between $500 and $1200 per grind, depending on location and extent of the works required. The main driver for the increase in costs for Zone 3 relates to the types of components that were replaced during the year and their associated costs. For example, during 2022, three swing nose crossings and two switch and stock rail assembles were replaced at Chillcotts Creek. These turnouts are the largest type of turnout on the Hunter Valley Network, with the cost of replacing these components alone being approximately $0.7M.

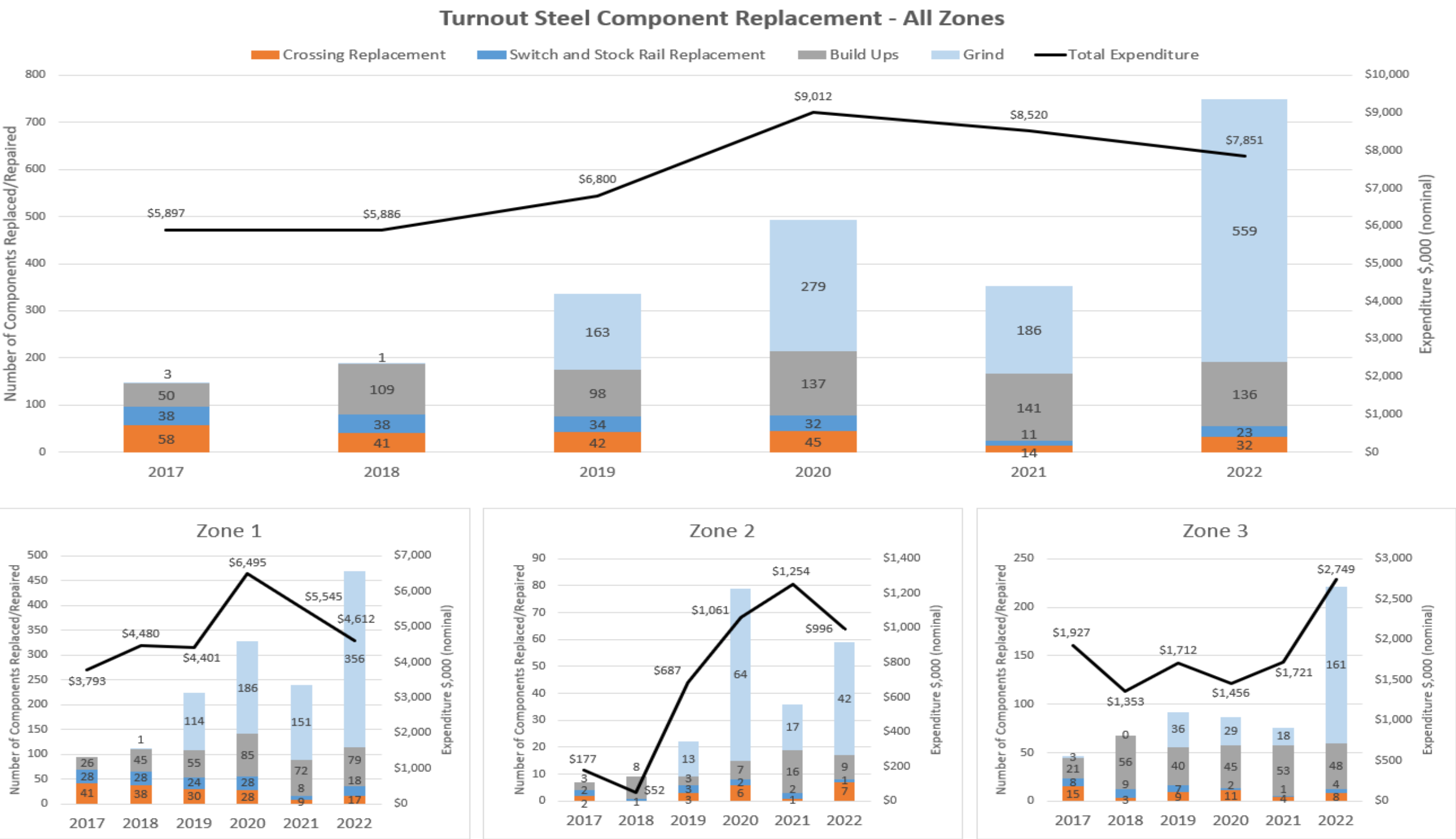

Figure 13: Turnout Steel Component Replacement ($Nominal)

2.6 Turnout Resurfacing

2.6.1 Activity Overview

Turnout resurfacing (tamping) restores the geometric parameters of top, line and superelevation by mechanised on-track machinery. Geometric parameters have a heavy influence on dynamic loading through turnouts which in turn influences the propagation of rail defects and formation loading. Turnout components also interface closely with signalling assets and can impact network reliability through signalling equipment failures if left in poor condition.

Turnouts are generally tamped on a time-based cycle which are derived from tonnage and turnout performance, with factors such as drainage effectiveness and turnout geometric design also having an impact. Some turnouts have a high tamping requirement, for example three times a year for high traffic areas around Hexham, while other turnouts may only require resurfacing every two years.

Turnout resurfacing work is carried out under the same contracts as the maintenance resurfacing activity. Following an open market tendering process, a multi-year contract (five-year term) was awarded to five contractors. The contract is based on a schedule of rates where all shift rates are fixed, however includes variable components for extra hours or shifts, mobilisation and demobilisation, or additional resourcing requirements as requested by ARTC.

2.6.2 Compliance Commentary

The Turnout Resurfacing costs increased slightly in 2022 compared to 2021, with an 8% increase across the program. Zonal outcomes varied slightly, with increases in Zones 2 and 3 partially offset by a reduction in Zone 1. From a scope outcome, 2022 reduced 21% when compared to 2021, with reductions in Zones 1 and 2, and a slight increase in Zone 3. This has resulted in a substantial increase in the unit rate when comparing 2021 and 2022; the average unit rate increased 37%, with increase across each of the zones ranging between 24% and 81%.

Similarly, when compared to the 2022 Maintenance Plan, costs were above plan by 8%, with increases in Zones 2 and 3 partially offset by a reduction in Zone 1. Likewise, scope reduced overall by 15%, with a reduction in Zones 1 and 2, and a slight increase in Zone 3. This resulted in a similar outcome when comparing actual and planned unit rates, with the average unit rate 27% higher than plan, and each zone above plan. Although, the outcome for Zone 1 was much closer, at only 6% over plan, Zones 2 and 3 were much higher, at 104% and 78% respectively.

There are various factors that impacted the outcome for 2022, these factors either resulted in reduced production rates, impacting the volume of scope completed, or had an impact on cost. These factors have been summarised below:

- During 2022, there was an increase in turnout related project works that required resurfacing support relative to previous years, projects include undercutting, reconditioning and turnout upgrades. While costs associated with the project works are captured under their corresponding activity, this had a negative impact on the productivity of the turnout tamping machine. This is due to the inability to schedule work in a geographical manner to maximise production, as would ordinarily be the case if the machines were dedicated turnout tamping units. This shift in general has resulted in a less efficient delivery plan for turnout resurfacing.
- The July 2022 flooding event at Maitland had a significant impact on one resurfacing contractor that regularly performs this work. The flood resulted in significant damage to two resurfacing machines that are contracted to perform both turnout and plain track resurfacing. These machines were damage beyond short-term repair and were unable to perform work for the remainder of 2022.
- Following the July 2022 flooding, ARTC determined that it was in ARTCs and the Customers best interests to defer the July closedown until September, this was due to multiple reasons, including the impact to safety following the saturation and weather conditions in July, enabling the Customers to maximise their railing for the remainder of July following the downtime due to flooding, as well as ensuring the closedown remained aligned with the Sydney Trains possession that was also deferred. As a result of the rescheduling of the closedown, another three contract turnout resurfacing machines became unavailable for the September period, as they had prior contracted commitments.
- The multi-year tender delivered favourable shift rates for the units mentioned above, additionally, these units were preferred due to their production capability. As a result of the unavailability of these units, ARTC, where possible, sourced alternate machines from contractors. However, these were sourced at less favourable rates, ultimately driving up costs.
- During the second half of 2022, due to the machine shortage and the inability to perform all work required by the cyclic program. To ensure that the right work was prioritised, a turnout condition assessment was performed to supplement the cyclic scope and develop a revised plan with reduced scope volumes. This led to a further reduction in production rates, as prioritised turnouts weren’t often located near one another, resulting in increased travel time. This is in direct contrast to a cyclic program that enables high machine utilisation as turnouts

within the same area are typically scheduled to be tamped at the same time, resulting in much less travel between worksites.

- The loss of efficiencies was most noticeable in Zones 2 and 3 where the volume of scope delivered was substantially lower than in Zone 1. Additionally, the work in these zones attract higher machine mobilisation and demobilisation, as these costs are spread across less scope and are generally higher due to the remoteness and accessibility.

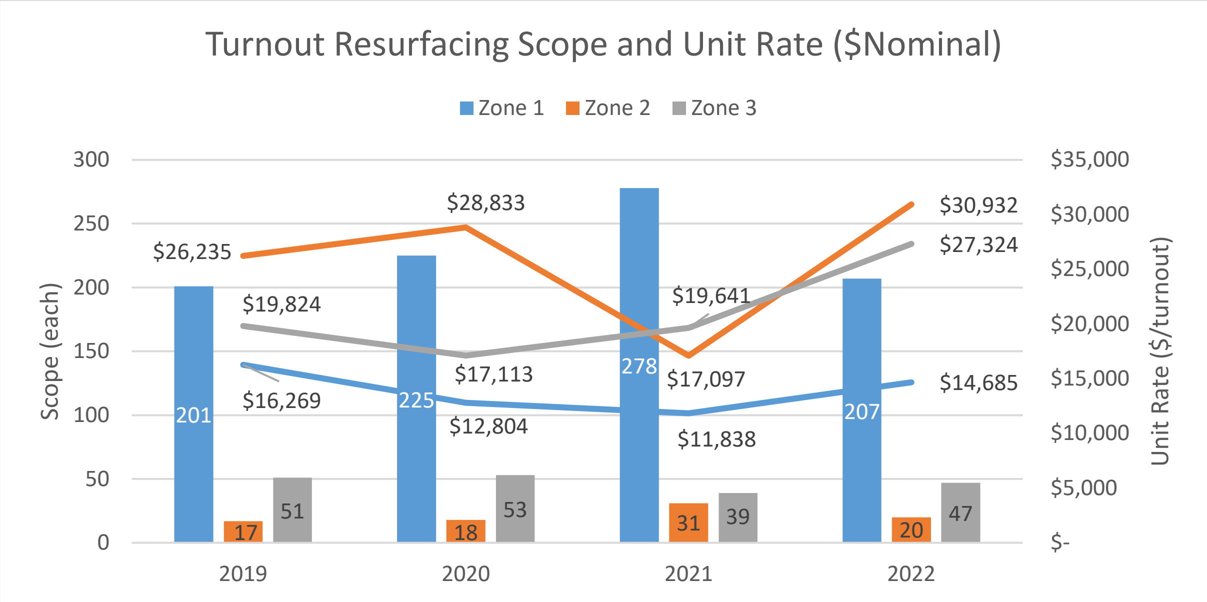

Figure 14: Turnout Resurfacing Scope and Unit Rate ($Nominal)

2.7 Inspection and Minor Repairs of Points

2.7.1 Activity Overview

This activity relates to the minor, routine maintenance of the point machines and their moving parts. The performance of the point machines can be impacted by the vibrations of moving trains and environmental factors. Environmental factors include wet weather, the large differential in temperature between night and day, as well as sand, dust and coal debris generated from trains operating in the rail corridor. To keep the point machines in working order, they need to be regularly inspected for maintenance which can include cleaning, lubrication, adjustment, repair and/or replacement of life expired components.

The points assembly must also be tested to ensure it is operating as designed and is safe to be in service. There are different types of inspections and testing performed at different intervals on the point machines. As this is an RCRM activity, a portion of work captured under this activity is routine and occurs at intervals specified within Engineering Standard and form part of the statutory obligations under ARTCs Safety Management System. Additionally, a portion is either corrective or reactive and is triggered as conditions arise or failures occur during the year.

2.7.2 Compliance Commentary

The costs for this activity remained consistent between 2022 and 2021, with only 1% variation between the two years and close to no variation across the zones. The costs continue to reflect the reliance on signalling contractors engaged to backfill permanent positions while accreditation of internal resources continued. The competitive labour market for skilled signalling workers has continually resulted in the need for a high use and cost of signalling contractors. The scarcity of this resource still remains in 2022 and later years. ARTC remains committed to upskilling and retaining signalling staff and have implemented a number for strategic tactics to aid that process, including school-based traineeships, insourcing the signal electrician apprenticeship program, improving development programs for leadership and technical training, and remuneration adjustments to reduce the gap between the ARTC and the contractor market.

The 2022 outcomes are higher compared to the 2022 Maintenance Plan, at a total of 23% above plan, reflected as an increase across each of the zones. This increase above plan is the result of the plan being quite ambitious in its assumptions around the reduced reliance in high-cost signalling contractors, particularly in Zones 2 & 3. This is evidenced by the 2022 and outer year forecasts provided in the Appendix L of the 2022 Maintenance Plan closely resembling actuals from 2018 and earlier when retention of signalling resources were less of an issue. However, as stated above, ARTC has continued to experience issues in this space in 2022 and subsequent years, and therefore has experienced costs higher than planned.

2.8 Ballast Undercutting

2.8.1 Activity Overview

Ballast undercutting addresses localised ballast defects on track sections typically less than 100m in length, it involves the use of specialist plant to remove a mud-hole and/or area of highly fouled ballast which impedes the drainage. Often these sites deteriorate to a condition where temporary speed restrictions (TSRs) are required to ensure operational safety is maintained until the condition is repaired. Additionally, while in a degraded state, rail break risk is significantly increased due to additional stresses exerted on the rail under dynamic loading conditions, emphasising the need for prompt intervention.

Although this activity is classified as an MPM activity, it is somewhat reactive in nature. Allowances are made in the AMP based on historical scope requirements and the current asset condition. The actual scope locations are determined within the live year, usually during the closedown planning cycles. These locations are primarily detected through maintenance inspections and identified as deteriorating areas that require maintenance intervention to reduce the need for temporary speed restrictions and lowers the risk of rail breaks on the network.

Varying types of scope are performed under this activity, that have differing production rates and associated costs, this often results in differing unit rates between projects. Varying types of scope include the undercutting of plain track, turnouts and level crossing, as well as some instances where the rails and sleepers are removed to excavate the fouled ballast, which is referred to as a skim reconditioning.

While ballast cleaning is considered very effective in addressing fouled ballast over large sections of track, it is not financially or practically feasible for smaller sections due to the mobilisation and movement of the large on-track machinery. Ballast undercutting is therefore utilised as a more efficient method for addressing localised ballast fouling in smaller track sections. It is often a short-term solution deployed before full track reconditioning is required to improve the track condition.

Ballast undercutting is delivered by both internal and external resources. The contract for the ballast undercutting activity is based on a schedule of rates and was awarded through a competitive open tendering process in 2021.

2.8.2 Compliance Commentary

The overall scope outcome for 2022 has increase by 92% relative to the 2021. This has resulted in a proportional increase in costs between the two years of 94%. Although, there is much greater variability in the shifts in scope and costs at a zonal level, this is predominantly caused by the unit rate outcomes in 2021, where the rate varied substantially between the zones, as a result of the varying types of scope performed within that year; whereas outcomes for unit rates in 2022 were much more stable.

Similarly, the costs and scope outcomes for 2022 compared to the 2022 Maintenance Plan follow a similar trend, with actuals higher than plan for both, at 42% and 33% respectively. Increases in scope compared to plan have only occurred in Zones 1 & 2 for reasons discussed below.

There are many variables that impacted the scope increase for this activity, including:

- All zones experienced significant weather events in 2022, saturating the formation, increasing sediment and ultimately increasing the number of mudholes on the network.
- Works were performed within the year to alleviate the impact of longstanding TSRs, this included works to mitigate flooding at Sandgate (large scale undercutting) and skim reconditioning at Baerami and Muswellbrook.
- A strategic approach was adopted to reduce the volume of point failures at key locations by completing full ballast replacement in turnouts. As turnouts age, the ballast voids become fouled and result in track instability and contribute to reliability issues with the points.

In Zone 1, the scope increase was predominately driven by inclement weather, with over 1km of undercutting completed in the September and October Closedowns following the flooding at Maitland and Sandate that occurred July 2022. In addition, turnout reliability issues experienced within the year resulted in the need to undercut 15 turnouts. Turnout undercutting increases the unit rate as the production rate is typically slower when compared to plain track undercutting, as well as requiring specialised signalling resources and turnout resurfacing machinery which increases the cost of the works.

In Zone 2, the scope completed increased tenfold compared to 2021, however, in 2021 minimal undercutting was performed with only one site completed throughout the year. Whereas in 2022, 22 sites were completed ranging in length from 6 to 200m. The zones topography and number of cuttings with restricted drainage increase the impact of wet weather in the area, which in turn significantly increases the required scope during the year to maintain track performance and reliability.

Inclement weather had a lower impact in Zone 3. Over the last six years large scale drainage and ballast replacement projects have been completed which reduces the effect of heavy rain on track performance and reliability. When compared to 2021, the complexity of sites in Zone 3 in 2022 were lower and resulted in a reduction in the unit rate of 52%. Worksites in Zone 3 continue to focus on critical areas skipped during ballast cleaning, including turnouts and level crossings.

From a unit rates perspective, the unit rate outcomes for 2022 have some minor variability across the zones, however, are fairly stable compared to prior years. Noting that, when preparing the 2022 Maintenance Plan, a flat unit rate has been applied across each of the zones given the inability to predict the types of scope that will be required in each zone within the year; there is an expectation that actual outcomes will have some variance to this.

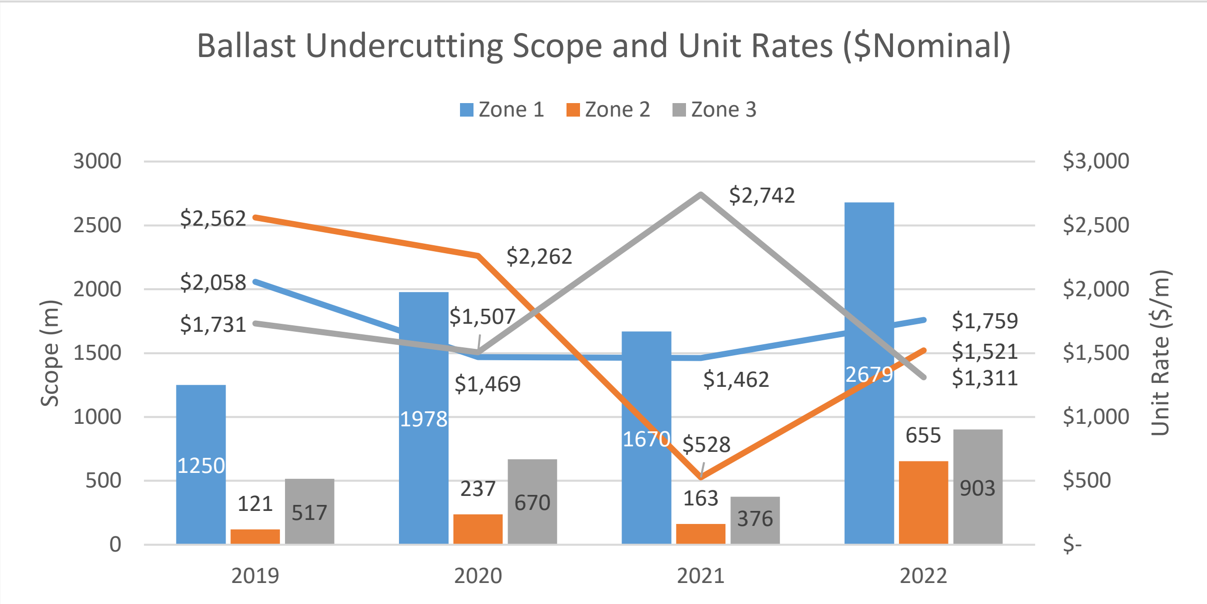

Figure 15: Ballast Undercutting Scope and Unit Rate ($Nominal)

2.9 Turnout Grinding

2.9.1 Activity Overview

Turnout grinding is the periodic grinding of turnouts to manage rail profile and stress generated rail defect growth. Grinding improves the interface between the wheel and the rail reducing wear on both surfaces and slows the propagation of rail defects, in turn, minimising premature steel component replacement and improving whole of life costs.

Hand grinding is also undertaken to maintain the integrity and shape of fine or intricate steel components, such as switch blades or crossing noses, that cannot be ground by turnout grinding track machines. In determining the optimal grinding frequency of all the turnouts across the Hunter Valley Network detailed assessments and reviews of turnout performance are undertaken annually. Turnout grinding cycles are determined based on the requirements of the asset and the logistical considerations in terms of delivering the program. These cycles vary from six times per year through to once every four years.

ARTC has consistently engaged with a small number of contracting partners at each stage of the turnout grinding process to provide a cost-efficient delivery of its scope. A key risk to the program is that there is a very limited pool of suppliers available to deliver this type of work due to the specialised nature of the work and the equipment. During 2021, following an open market tendering process, a multi-year contract (4.5-year term) was awarded to two contractors. These contracts secured all available resources on offer; despite this there was still a resource shortfall identified. Notwithstanding this resource limitation, competitive shift rates and mobilisation/demobilisation were successfully negotiated and locked in for the full contract term.

2.9.2 Compliance Commentary

The overall outcome for cost in 2022 was consistent with 2021, with 1% variation between the two years. Although there was some variation between zonal outcomes, with an increase in costs experienced in Zone 1, offset by reductions in Zones 2 and 3. This trend is also reflected in scope outcomes, with a total variation of 0%, with an increase in scope in Zone 1, offset by a reduction in Zones 2 and 3.

Compared to the 2022 Maintenance Plan, costs were less than plan by 25%, with underspends across all three zones ranging between 18% and 28%. However, the scope outcome is slightly different, with Zone 1 slightly above than plan by 5%, resulting in a favourable unit rate for the zone. Whereas Zones 2 and 3 had less scope than planned, resulting a unit rate higher than planned.

The unit rate achieved in 2022 was relatively consistent with that of 2021, with a slight reduction of 2%. Whereas the 2022 unit rate is much more favourable compared to the 2022 Maintenance Plan, with the outcome 21% below plan. This result has been primarily driven by favourable results in Zone 1, where over 80% of the scope was performed within the year. Whereas Zones 2 and 3 achieved unit rates double that of Zone 1, however had less of an impact on the overall outcome due to the lower amount of scope performed in these areas of the network.

Various factors influenced the delivery of turnout grinding in 2022 and had an impact on both cost and scope outcomes, therefore result in variances in unit rate achieved across zones and between years; these are summarised below:

- Due to the multi-track nature of Zone 1, asset density is much higher, resulting in a larger number of turnouts that are also geographically located closer together. This typically results in less travel required between grinds and higher production rates achieved.
- Traffic volumes experienced in Zone 1 are much higher compared to the other zones, this requires more frequent grinding as a result to manage condition, hence why planned scope is much higher in Zone 1 compared to the other zones.
- The market tender process in 2021 presented the availability of four turnout grinders all of which were contracted; of these two are high production machines and two are low production machines. Decision on where these machines are deployed can greatly impacts cost and unit rate outcomes.
- During 2022, the majority of work performed in Zone 1 was completed by the high production machines. This maximised the benefit of their high production capability and delivered favourable unit rates. Whereas the low production machines were allocated to Zones 2 and 3 where unit rates would be less impacted by the machines capability, rather than the mobilisation/demobilisation and the travel between turnout locations.
- During 2022, the contractor organisations experienced resourcing issues limiting the ability to crew the low production machines for double shifts (day and night shifts back-to-back). This limited scope delivery in Zones 2 and 3 and necessitated supplementary grinding performed by trolley grinders to maintain grinding cycles. However, as a result, not all planned scope in Zones 2 and 3 was able to be achieved within the year.

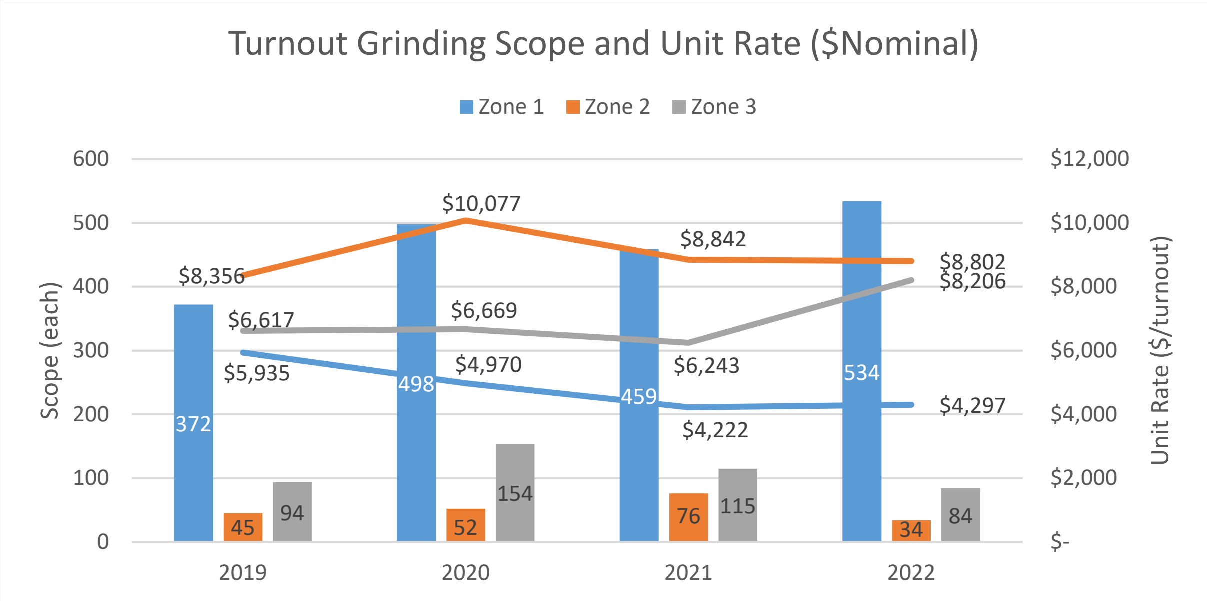

Figure 16: Turnout Grinding Scope and Unit Rate ($Nominal)

2.10 Rail Defect Removal

2.10.1 Activity Overview

Rail defect removal is the removal of surface or internal defects through replacing and welding in of a new length of rail, generally 6-8 metres in length. The activity is undertaken to eliminate the risks associated with a range of rail defects as well as ensuring the rail is of sufficient strength and integrity to carry the axle load reliably and safely at the design track speed.

Rail defect removal is a condition-based corrective maintenance activity where defects are identified through visual or ultrasonic inspections. The planning of the scope also considers various factors relating to rail performance, including the history of broken rails or internal defects, surface condition, untestable rail, poor weld condition and corrosion; additionally, for certain defect types, ARTCs Engineering Standards require the rail to be replaced before it reaches its safety limits. Response timeframes to internal rail defects are published in Engineering Standards and form part of the statutory obligations under ARTCs Safety Management System.

This activity is generally undertaken using internal resources, with the scope mostly delivered by the Provisioning Centres and supplemented with external resources (welding, testing, etc.) on an as-required basis. Within the context of this activity, ARTC also works with commercial partners for the delivery of specialised rail head repairs, with quotations sought in each instance and compared against the cost of replacement.

ARTC's rail defect removal strategy is aimed at improving network reliability and reducing network losses associated with rail breaks or the development of emergency internal defects that require extensive, unplanned intervention.

The scope for RCRM activities is not measured, nor is it used for maintenance planning purposes. The unit rates reported below are inferred using defects closed within the Ellipse.

2.10.2 Compliance Commentary

The costs for this activity remained consistent between 2022 and 2021, with only 2% variation between the two years and only a slight variation across the zones.

The 2022 outcomes are lower compared to the 2022 Maintenance Plan, at a total of 29% below plan, reflected as a reduction in Zones 1 and 3, and an increase in Zones 2. The reduction compared to the plan is driven by budget assumptions at the time of preparing the 2022 Maintenance Plan, as costs were anticipated to remain high, off the back the costs in experienced in 2020.

Rail defect removal, along with other maintenance activities, over the recent years have contributed to the successful reduction in rail break events. The total number of rail breaks in 2022 across the coal network amounted to 36, this is the lowest number of breaks achieved in any one year and a continuation of the improvement trend experienced over the decade prior, with 2022 having less than one-third of the breaks that were experienced in 2014, refer detail contained in Figure 7.

Figure 17 shows the number of rail related defects removed and rail defect removal expenditure by year and Pricing Zone. In 2022, a total of 621 defects were removed, this number reduced 31% from 2021 where a total of 905 were removed. Although the number of defects removed reduced across the period, the ratio of defects removed across the zones has remained consistent, with the majority of defects removed in Zone 1, where tonnage volumes are much greater. Despite the reduction in defects removed, rail break performance has continued to improve, indicating the success of the accelerated program in 2020, discussed in previous compliance submissions to lower the infrastructure losses associated with rail breaks and rail defects.

Note: Figure 17 shows the rail related defects that have been closed in each calendar year in Ellipse. It is important to note that this dataset is relative given that some rail defects are not exclusively removed through the Rail Defect Removal activity. Whilst relatively a smaller proportion of the overall, some rail defects will have been removed as part of larger Rerailing and Rail Grinding programs and these numbers will vary year to year.

Additionally, there are a number of other factors that affect the cost of removing a rail defect, such as the mix of internal and external resources, outage type which effects productivity rates, the type of defect and the methodology to repair, this can result in differing expenditure by zone.

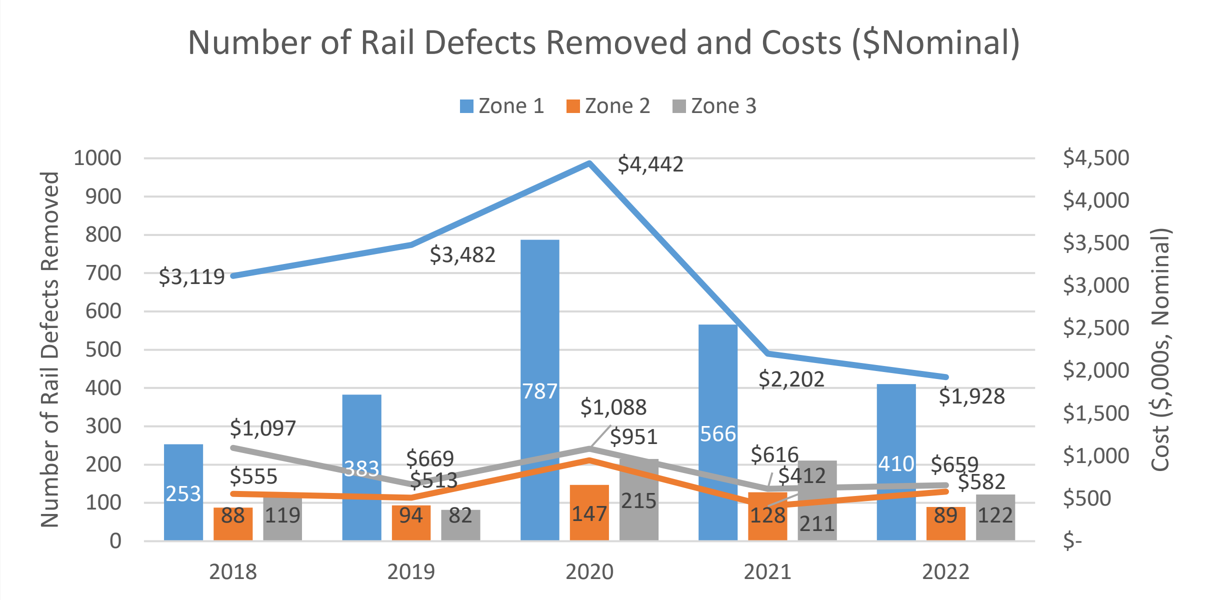

Figure 17: Number of Rail Defects Removed and Costs ($Nominal)

Figure 18 shows the average unit rate for rail defect removal over the last five years. ARTC notes that unit rates for rail defect removal is not an entirely sound method to analyse costs, due to variability in scope type and due to not all rail defects closed in Ellipse having been addressed through the Rail Defect Removal activity. The graph shows that the cost per defect increased 43% in 2022 relative to 2021. However, costs in 2021 were the lowest unit rate achieved in the five-year period, with 2022 being the second lowest.

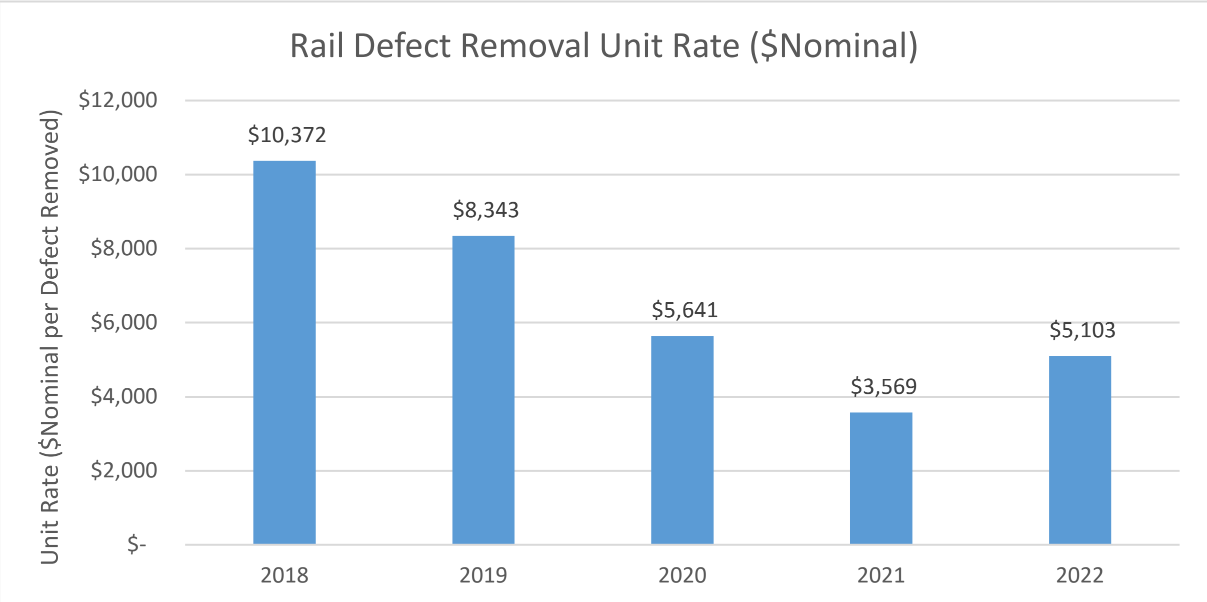

Figure 18: Rail Defect Removal Unit Rate

One of the major contributing factors to unit rate fluctuations is the mix of work performed by internal and external resources throughout the year. Figure 19 shows the proportion of costs associated with contract resources, in terms of both a percentage of the total program and total costs. The graph shows that contractor costs peaked in 2018 in terms of percentage, and in 2020 in terms of total cost. It also shows that in 2021, the lowest cost and percentage was achieved. These results correlate with the unit rates achieved for those years, with 2018 and 2020 higher than 2021. Comparing these results to 2022 outcomes, the second lowest percentage and total costs associated with contractors was achieved, and as a result the second lowest unit rate outcome was achieved.

There are many drivers that can influence the mix of internal and external resource utilisation for this activity. This includes the available skillsets of internal resources as this work is performed by specialised welding resources, cost trade-offs between having internal resources perform this work as opposed to other maintenance activities, and the volume of scope against the finite internal resources available to perform it.

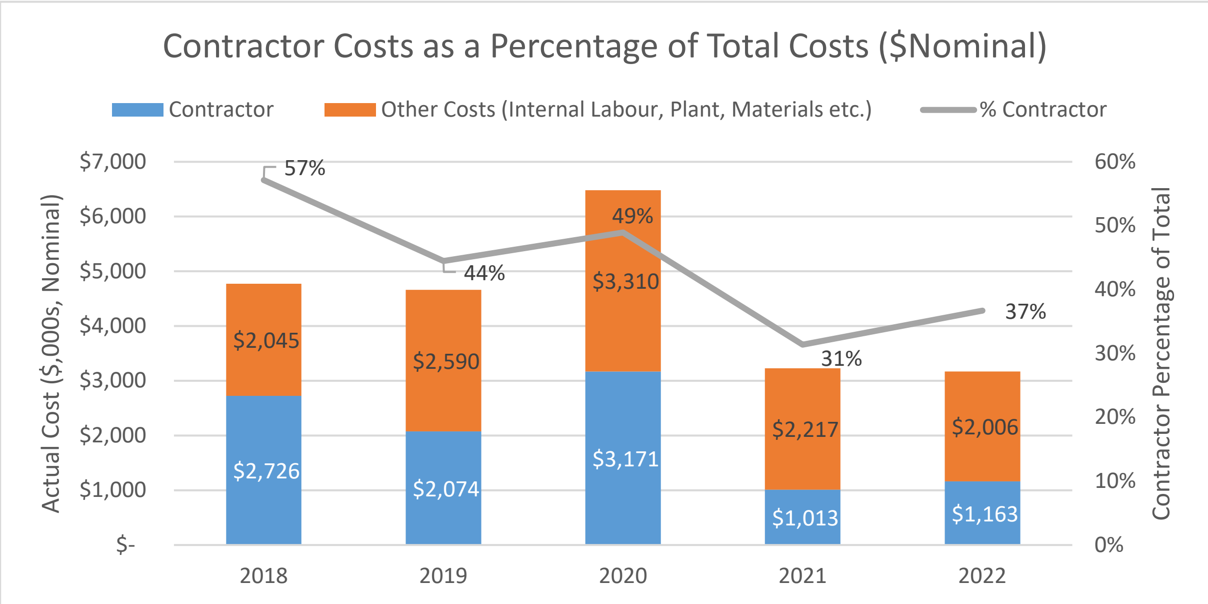

Figure 19: Contractor Costs as a Percentage of Total Costs

3. LOSS ON DISPOSALS

Section 6 of the 2022 Compliance Submissions set out the process for determining the loss on disposal for assets being removed from the regulated asset base (RAB). Table 5 summarises the loss on disposal amounts by zone relating to Expansion Capital Project works and Sustaining Capital projects.

Table 5: 2022 Disposals $

Expansion Capital Projects	Written Down RAB Value	Net Disposal Proceeds	Net Loss on Disposal
Pricing Zone 1	-	-	-
Pricing Zone 2	-	-	-
Pricing Zone 3	-	-	-
Total	**-**	**-**	**-**

Sustaining Capital	Written Down RAB Value	Net Disposal Proceeds	Net Loss on Disposal
Pricing Zone 1	6,334,141	804,608	5,529,533
Pricing Zone 2	3,391,964	489,467	2,902,497
Pricing Zone 3	1,316,074	-	1,316,074
Total	**11,042,180**	**1,294,075**	**9,748,104**

All Disposals	Written Down RAB Value	Net Disposal Proceeds	Net Loss on Disposal
Pricing Zone 1	6,334,141	804,608	5,529,533
Pricing Zone 2	3,391,964	489,467	2,902,497
Pricing Zone 3	1,316,074	-	1,316,074
Total	**11,042,180**	**1,294,075**	**9,748,104**

Note: Totals may not add due to rounding

Loss on disposals decreased $0.4m during the year from $10.1m in 2021 to $9.7m in 2022. The major contributor of this reduction relates to loss on disposal for rerailing which reduced $2.4m (32%) from 2021. This is in line with the significant reduction in the overall scope in the capital commissioned for this activity for the same period reducing by 41% across the network. Additionally, there was a $1.0m decrease in loss on disposal for signalling related activities due to the replacement of the aging and unreliable signalling infrastructure at Waratah to Sandgate in 2021.

The above reductions in loss of disposals were offset against an increase in the loss on disposal on across turnout renewal and track strengthening projects. The upgrade of the fixed nose crossings to swing nose crossings at the critical location of Maitland 402A/B Points and 403A Points to provide more reliable performance and reduce ongoing maintenance intervention resulted in a $2.1m loss on disposal for turnout renewal projects 2022. Further, a net loss on disposal of $1.9m can be attributed to track strengthening activities which aligns to the significant increase in capital projects commissioned in 2022 compared to 2021. This increased scope of works required to be completed in 2022 was a consequence of several track strengthening projects being deferred in August 2021 due to COVID-19 and again in November 2021 due to severe wet weather impacting the network, as outlined in Attachment 2 Capital Consultation.

Disposal proceeds and asset recovery rates vary across years and Pricing Zones due to several factors including:

- The location and nature of the RAB asset being disposed and the RAB written down value attached to the applicable Segment;
- The nature of the capital projects/activities and scope being undertaken in each year;
- The nature of the asset or material being disposed of (e.g. rerailing and turnout projects have scrap rail, whilst concrete culverts have unsaleable and non-reusable scrap materials); and
- The market value for the scrap material.

For the 2022 calendar year, the overall asset recovery rate slightly increased by 1% on the prior year. This was largely due to the change in the nature of the capital projects and activities undertaken during 2022, coupled with the continued increase in the recovery price of steel. Global average scrap prices increased from $415 in 2021 to $459 in 2022. This continued upward trend in steel prices is consistent with 2021 outcomes. The quantity of scrap steel disposed decreased from approximately 3,293 tonnes in 2021 to 2,803 tonnes in 2022 in line with reduce rerailing scope.

4. EXPENSED PROJECT COSTS

Expensed projects reflect the development cost of capital projects (as endorsed by the RCG) that have since been determined will no longer be required. The amount expensed represents the value of work in progress up to the point at which the project was suspended. For the 2022 compliance period, there were four expense projects totalling $2.2m as represented in Table 6.

Table 6: 2022 Expensed Projects

Location	**Expensed Projects**
Aberdeen Loop Extension	$149,821
Blandford Loop Phase 1	$152,378
Bells Gate South	$206,292
Ardglen to Kankool Duplication	$1,691,769
Total Expensed Projects	**$2,200,260**

These projects were initially proposed in consultation with the RCG to address expected contract and prospective volumes linked to the proposed development of Terminal 4 at Port Waratah Coal Services. These projects were proposed as expansionary capital projects with the objective to provide rail capacity across the Hunter Valley Network in line with forecasted industry demand. Over time, subsequent forecasts have predicted lower volumes in line with existing rail capacity thus prompting a reassessment of the need for these projects. After re-evaluation and review of the Hunter Valley Corridor Capacity Strategy ARTC has concluded that these projects are no longer required to meet capacity demands and therefore should be expensed. ARTC consulted with Zone 3 Customers on this treatment at the time 2022 tariffs were set.

5. NON-MAINTENANCE OPERATING ACTIVITIES

Non-maintenance operating activities are categorised as Network Control, Business Unit Management or Corporate Overheads.

In 2022 the basis for the allocation of Non-Segment Specific costs was Schedule I.

Table 7 sets out a year-on-year comparison of the costs for each of the non-maintenance operating cost categories.

The movements in non-maintenance operating costs between 2021 to 2022 are driven by a combination of:

- The change in the relative values for each allocator between Hunter Valley and Interstate; and
- Increases or decreases in the underlying costs associated with Network Control, Business Unit Management or Corporate Overhead activities.

Table 7: Non-Maintenance Operating Cost $'000

	2021 (a)	**2022 (b)**	**Variance % (b)/(a)-1**
Network Control	19,919	21,244	6.6%
Business Unit Management	40,534	38,347	(5.4%)
Corporate Overheads	24,930	26,099	4.7%
Total	**85,384**	**85,690**	**0.4%**

Note: Totals may not add due to rounding

The drivers for the cost movements are considered further in the following sections.

6. NETWORK CONTROL

Network Control includes costs associated with ARTC's Network Control Centre North (located at Broadmeadow). The control centre controls the train movements for the entire Hunter Valley business unit including the coal network and non-coal segments that adjoin the coal network. The network is controlled by a series of 'Network Control Boards' (NC Boards) which manage defined areas. Twelve of the thirteen NC Boards (11 directly related to coal) are required to be operationally staffed 24 hours per day, 365 days a year.

Network control expenses include labour and materials associated with the delivery of the following functions:

- train control and signalling both on the main line and within the coal terminals;
- train planning and programming;
- operations and operational customer interface;
- incident management; and
- communication costs.

With the ANCO technology suite embedded, project team activities were focussed on continuing to tailor and improve the user interface and internal engagement to refresh focus and execution in the day of operations.

Table 8: Network Control Cost $millions

	2021	2022	Variance $ 2021 - 2022
Network Control Cost	19.9	21.2	1.3

Table 9: Network Control Movement of Cost Drivers $millions

	2022
Labour Costs	0.3
Utilities - Electricity Accrual	0.9
Other Cost Movement	0.1
Total Cost Movement from Prior Year	**1.3**
Allocator Movement	(0.0)
Total	**1.3**

Note: Totals may not add due to rounding

Network Control costs increased by $1.3m compared to 2021. The major drivers of the cost movement in the 2022 period compared to 2021 included:

- $0.3m increase in labour costs as a result of Enterprise Bargaining Agreement annual award increases.
- $0.9m increase in utilities expenditure is linked to the cost reduction observed in the 2021 period, while the 2022 costs align with longer-term trends. The reduction in 2021 stemmed from addressing a significant over-accrual of electricity costs at the Network Control Centre North (NCCN) from prior periods. The correction in 2022 was facilitated by the receipt of revised utility contracted terms.

7. BUSINESS UNIT MANAGEMENT

Business unit management costs comprise Hunter Valley direct costs and encompasses four functions:

- Hunter Valley Customer Service and Operations;
- Hunter Valley Asset Delivery, including the Provisioning Centres;
- Hunter Valley Asset Development; and
- Hunter Valley Management and Support.

Table 10: Business Unit Management Cost $millions

	2021	2022	Variance $ 2021 - 2022
Business Unit Management	40.5	38.3	(2.2)

Table 11: Business Unit Management Movement of Costs Drivers $millions

	2022
Engineering Software Platforms	(4.5)
Labour Impact	0.3
Property	0.3
Contactor Costs – HV Project Delivery	0.4
AMIP Mobile Functionality for Field Workers	0.2
Other Costs	0.8
Total Cost Movement from Prior Year	**(2.5)**
Allocator Movement	0.3
Total	**(2.2)**

Note: Totals may not add due to rounding

In 2022 Business Unit Management costs decreased $2.2m compared to 2021.

The major drivers of the cost movements are:

- $4.5m decrease in engineering software support platforms in 2022 due to additional costs incurred in the 2021 period relating to the internal review of the accounting treatment for various cloud-based software related projects such as the Decision Support Platform (DSP), Weighbridge Data Capture Project (WDC) and the Ellipse Update.
- $0.3m increase in labour costs as a result of Enterprise Bargaining Agreement annual award increases.
- $0.3m increase in Property costs to provide increased resourcing to support adhoc licencing and occupancy of third-party land to facilitate access to the rail corridor by the Hunter Valley maintenance teams and contractors.
- $0.4 million increase in contractor costs to temporarily backfill critical track reconditioning and signalling engineering roles within the Hunter Valley project delivery team.

- $0.2m increase in costs related to AMIP mobile functionality for field workers. As highlighted in the 2021 compliance submission, as a component of the AMIP project, ARTC successfully deployed field mobility services across the network. This implementation enabled staff to promptly evaluate assets for defects and instantly record the asset's condition whilst in the field, facilitating timely and informed decisions on whether monitoring or repair was necessary to ensure the safe and reliable operation of trains. The new system replaced all traditional paper forms utilised across the network, resulting in a substantial enhancement in the reliability and timeliness of data input into the ellipse asset management system. The field worker devices were fully procured as part of AMIP in 2020, with the initial software costs integrated into the overall expenditure. Commencing from 2022, however, the agreement encompassing the continuous licensing of this software, initially included in the purchase, lapsed. Consequently, increased costs were incurred due to the necessity of a new software licensing agreement essential for running the system.

- $0.3m increase in the allocator movement due to the impact of lower DSIB costs on the non-coal sections of the Hunter Valley corridor resulting in a reduction in the share of costs being allocated to the non-coal network.

The balance of the other cost movements is attributed to minor cost movements across various business unit activities.

8. CORPORATE OVERHEADS

Corporate overheads include costs associated with the following ARTC wide functions:

- Executive;
- Finance;
- People;
- Corporate Services and Safety; and
- Strategy.

Table 12: Corporate Overheads Cost $millions

	2021	2022	Variance $ 2021 - 2022
Corporate Overheads	24.9	26.1	1.2

Table 13: Corporate Overhead Movement of Cost Drivers $millions

	2022
Insurance	0.7
Plant	(0.2)
Other Cost Movements	(0.2)
Total Cost Movement from Prior Year	**0.3**
Allocator Movement	0.9
Total	**1.2**

Note: Totals may not add due to rounding

Corporate Overhead costs increased by $1.2m compared to 2021.

The major drivers of the cost movement for the 2022 period compared to 2021 included:

- $0.7m increase relates to the continued rise in insurance costs. In 2022, Insurance costs rose substantially, continuing the trend of the last few years. The severe weather impacts of 2019-2021 continued into 2022 leading to a further rise in ongoing flood losses and escalating costs for existing claims. This combined, with the La Nina weather pattern and the continuing reduction in predictability of the severity, location and timing of weather events, has resulted in a further hardening of the insurance market cycle and the consequent continued increases in insurance premiums and deductibles.

  ARTC remains committed to mitigating risks through the provision of detailed information to insurers, adopting a commercial approach to incident cost recovery, and proficiently managing significant liability and asset claims. The high quality of ARTC's underwriting information has effectively kept premium increases at a minimum; however, the continuing hardening of the market and the premium rates ratio has continued to drive an unavoidable increase in insurance costs over the period.

- $0.2 million decrease in Plant Charges due to the timing difference between financial and calendar year

- $0.9m increase due to the allocator movement, this is caused by lower Hunter Valley non-coal DSIB costs compared to 2021, reducing the share of Corporate Overhead costs allocated to the Hunter Valley non-coal network.

The balance of the other cost movements is attributed to minor cost movements and annual salary increases across various business unit activities.

9. VARIABLE COSTS

Table 14 sets out the variable charges attracted by various groups of traffic within the Hunter Valley network.

Table 14: 2022 Variable Costs $'000

	Maintenance and Loss on Disposal	Capital Charges	Total
Constrained Group of Mines	33,839	68,437	102,276
Pricing Zone 3 Traffics	30,560	13,679	44,239
Other Unconstrained Coal	825	-	825
Non-Coal Traffics	7,539	-	7,539
Total	**72,763**	**82,116**	**154,879**

Note: Totals may not add due to rounding

9.1 Pricing Zone 3 Incremental Costs in Pricing Zone 1

In the interests of transparency, sets out the Pricing Zone 3 incremental costs in Pricing Zones 1 and 3. Note that under the ACCC approved methodology, incremental capital charges are not applied in Pricing Zones 2 or 3.

Table 15: 2022 Pricing Zone 3 Incremental Costs $' 000

	Maintenance and Loss on Disposal	Capital Charges	Total
Pricing Zone 1	4,987	13,679	18,666
Pricing Zone 3	25,573	-	25,573
Total	**30,560**	**13,679**	**44,239**

Note: Totals may not add due to rounding

10. NON-COAL ALLOCATION

Under the HVAU, all traffic including non-coal traffics are required to contribute revenue sufficient to meet the Floor Limit. The Floor Limit as applies to non-coal traffics is the variable maintenance cost attributable to them based on GTKM or Train Km, as applicable to each maintenance activity.

The non-coal variable maintenance cost attributed to non-coal traffics in 2022 was $7.5m which is consistent with 2021 and reflective of similar non-coal volumes in the two periods.

These amounts are deducted from the costs that are allocated between coal traffics in the Hunter Valley Network, as shown in Table 2.