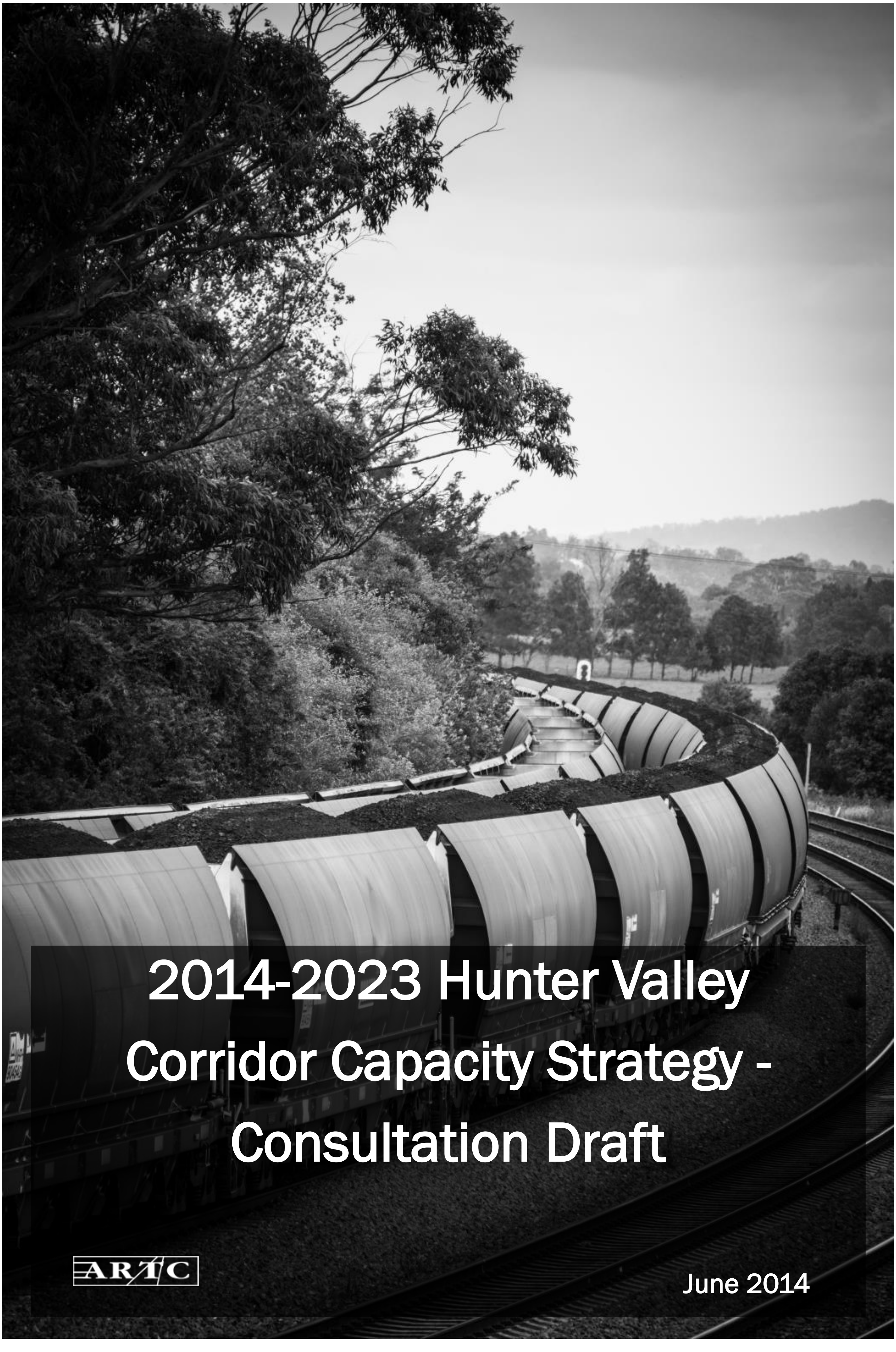
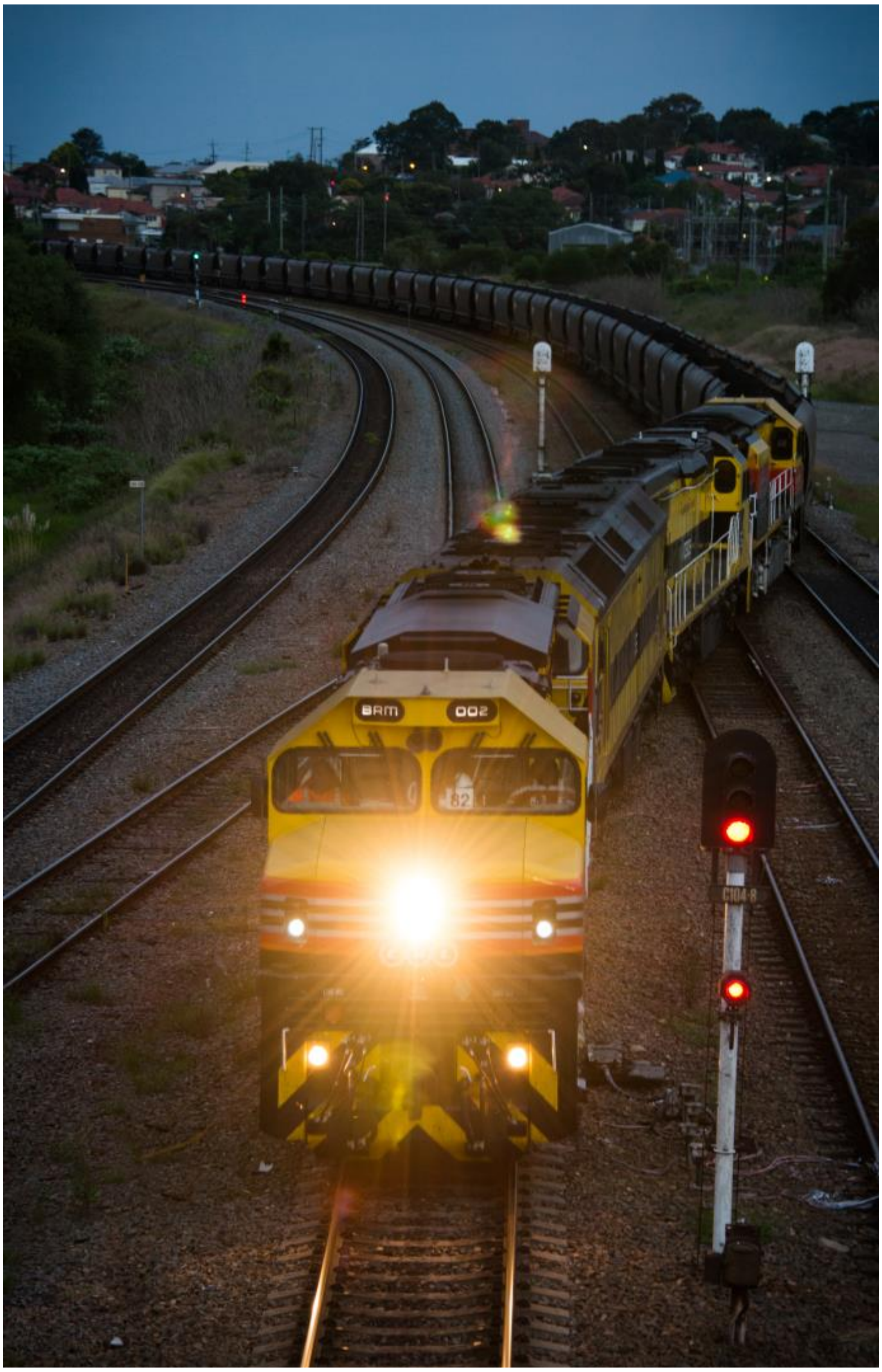


2014-2023 Hunter Valley Corridor Capacity Strategy - Consultation Draft

ARTC

June 2014



2014-2023 Hunter Valley Corridor Capacity Strategy - Consultation Draft

June 2014

Contents

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Pages 1, 2, 11, 18 24 & 37 - Henry Owen | Pages 9 - ARTC | Pages 29 - ARTC | Page 30 & 33 - Michelle Delaney

1

Introduction

On 5 September 2004, the Australian Rail Track Corporation (ARTC) commenced a 60-year lease of the interstate and Hunter Valley rail lines in New South Wales.

ARTC had previously controlled the interstate rail network within the area bounded by Albury on the NSW/ Victoria border, Kalgoorlie in Western Australia and Broken Hill in western NSW. The commencement of the NSW lease consolidated control of most of the interstate rail network under ARTC.

In early 2005, ARTC began to release annual Hunter Valley infrastructure enhancement strategies setting out how ARTC planned to ensure that rail corridor capacity in the Hunter Valley would stay ahead of coal demand.

This 2014—2023 Hunter Valley Corridor Capacity Strategy is the eighth of these annual strategies. It updates the 2013 - 2022 Hunter Valley Corridor Capacity Strategy (2013 Strategy).

In common with the earlier strategies, it identifies the future constraints on the coal network's capacity in the Hunter Valley, the options to resolve these constraints and a proposed course of action to achieve increased coal throughput.

The fundamental approach of ARTC in developing this Strategy has been to provide sufficient capacity to meet contracted volumes based on the principles of the ARTC Hunter Valley Access Undertaking (HVAU), while also having regard to and identifying those projects that would be desirable to accommodate prospective volumes that have not yet been the subject of a contractual commitment. In particular, this Strategy identifies a preliminary scope of work to accommodate prospective volumes of up to 277 mtpa that would require the proposed Terminal 4 (T4) on Kooragang Island or other terminal capacity expansion.

The 2013 Strategy noted the decline in the price of coal and the effect of that on sentiment within the industry. There has been little change from the scope of work required for contractual or prospective volumes compared to the 2013 Strategy.

It is important to note that the whole Hunter Valley coal supply chain is interlinked. The stockpiling and loading capability of the mines affects the trains required, the train numbers affect the rail infrastructure and so on. The capacity and performance of the system is entirely interlinked and the capacity of the rail network needs to be considered in that context.

In determining capacity ARTC makes certain assumptions which are generally covered in this Strategy. The delivery of throughput to align to capacity can be impacted by a range of performance issues across the supply chain. While some of these performance issues are covered in this document, it is not the key purpose of the Strategy.

Volume Forecasts

Currently contracted export coal volumes are 168.7 mtpa in 2014, 184.1 mtpa in 2015 and 191.5 mtpa in 2016 where they approximately stabilize. Forward contract volumes are in part conditional on completion of ARTC projects identified as conditions precedent to those volumes and the Coal Chain Capacity assessment by the HVCCC.

In addition to contracted volumes, ARTC, in consultation with the Hunter Valley Coal Chain Coordinator (HVCCC), has identified new and existing mines that producers have plans to develop in the medium term. These projects have not proceeded to a stage where producers would want to commit to take-or-pay contracts, but to ensure that ARTC is able to plan appropriately for future growth are considered in this Strategy as a prospective volume scenario.

Under the provisions of the Hunter Valley Access Undertaking, it is a matter for the Rail Capacity Group (RCG) to determine the prospective volumes that are to be used for the purposes of this Strategy. The RCG comprises representatives of the coal producers, along with HVCCC and rail operators. At the April meeting the RCG was given an proposal for prospective volumes to consider. This maintained the relatively aggressive rate of growth that the RCG selected as their preferred approach in 2013. Under this scenario prospective volume is estimated at around 3.6 mtpa in 2015, 11.7 mtpa in 2016, 23.1 mtpa in 2017, 40.1 mtpa in 2018, 51.6 mtpa in 2019, 71.2 mtpa in 2020 and stabilizing at 85.2 mtpa in 2021. This rate of growth would require additional terminal capacity to be developed in advance of T4. Options for a modest increase in total terminal throughput capacity are currently being developed.

Traffic Patterns

All but a very small proportion of the export coal shipped through Newcastle is transported by rail for shipping from Carrington (Port Waratah), or one of the two terminals on Kooragang Island.

Most of this coal comes from a series of mines and coal loaders dispersed along the Hunter Valley, conveyed to the terminals on the railway that runs between Muswellbrook and Newcastle. Coal also feeds onto this line from Ulan and the Gunnedah basin, west and northwest of Muswellbrook respectively, and, much closer to the terminal, from Stratford, Pelton and the southern suburbs of Newcastle (Figure 1).

Domestic coal is also transported over the same network. The largest volume is for Macquarie Generation at Antiene, which receives significant volumes of coal originating from mines on the Ulan line.

Export coal also arrives at the terminal from the Newstan and Teralba mines to the south of Newcastle, and in recent times in small volumes from mines in the Lithgow area. This traffic operates on the RailCorp network as far as Broadmeadow. There are no identified capacity issues for this coal on the short section of the ARTC network which it traverses outside the port areas, and accordingly this strategy does not discuss the network between the port terminals and Sydney.

The Hunter Valley coal network consists of a dedicated double track 'coal line' between Port Waratah and Maitland, a shared double track line (with some significant stretches of third track) from Maitland to Muswellbrook,

Figure 1 - The general location of the Hunter Valley network on the east coast of Australia.

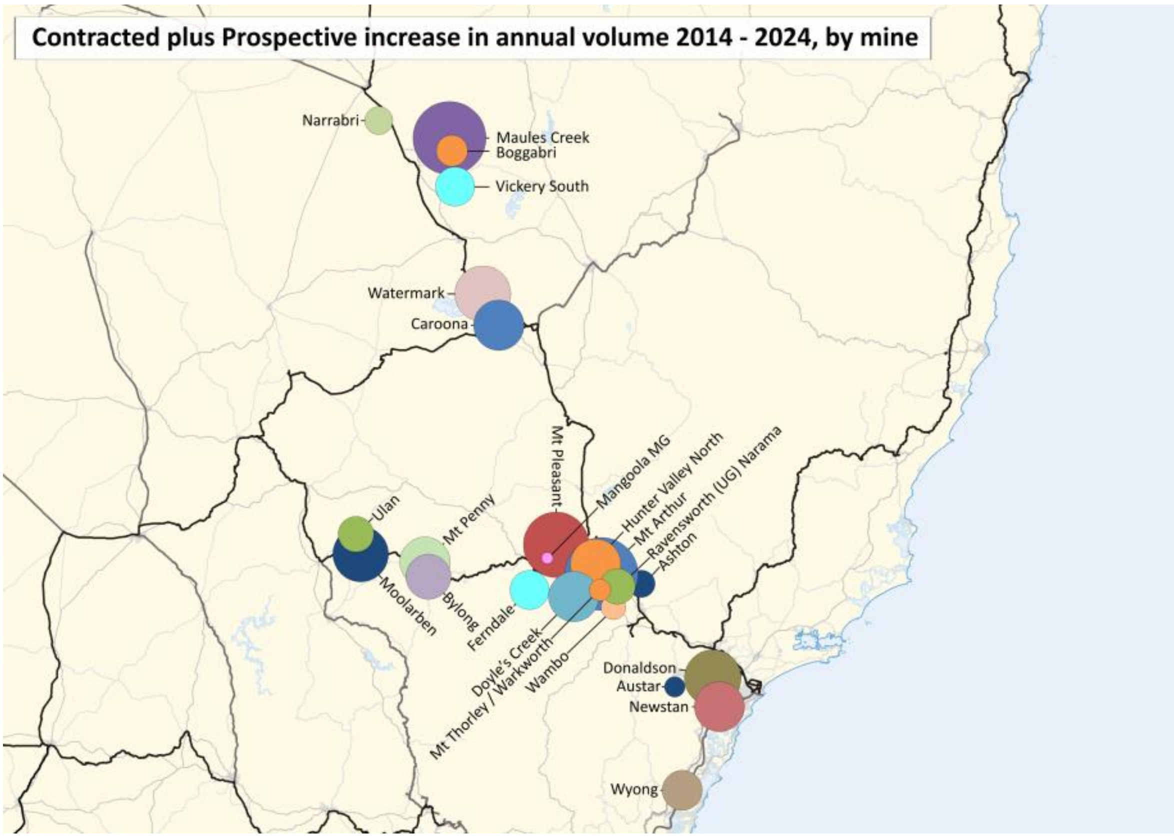


Figure 2 - Volume forecasts by mine, contracted plus prospective. Note that growth is represented by area.

and a shared single track with passing loops from that point north and west.

The heaviest coal volumes are at the lower end of the Hunter Valley. The growth in contracted volumes is now predominantly from the Gunnedah basin, but there is significant prospective growth from across the network (Figure 2 and Figure 3).

Operations

Most of the Hunter Valley coal network is capable of handling rolling stock with 30 tonne axle loadings (i.e. 120 gross tonne wagons), but the corridor from Dartbrook Junction (near Muswellbrook) to the Gunnedah Basin, and the North Coast line to Stratford, are currently only rated for 25 tonne axle loads (100 tonne wagons). The privately owned railway to Austar can only accommodate 19 tonne axle loads (76 tonne wagons). The Gunnedah basin line is currently being upgraded and is forecast to be able to accommodate 30 tonne axle loads from the start of 2015.

Weighted average coal capacity per train averaged 7,691 net tonnes in 2013. This compares to a figure of approximately 7,324 net tonnes in 2012. For the 2014 year to date, average train weight is 7,819 net tonnes, which suggests that contracted volumes appear to be lagging the trend of increasing train size. Further payload growth is expected with Aurizon trialling further increases. Note that the average is calculated on trains arriving at the Port. As the 100 tonne wagons generally travel further, they make fewer cycles and hence have a lower weighting in the calculation of the average than if a straight arithmetic average of train size was calculated.

At the 2014 Hunter Valley system capacity declared by the HVCCC, an average of around 61 loaded trains need to be operated each day, or one train every 23 minutes.

Train lengths vary from around 1,250 metres to 1,543 metres, apart from the approximately 600 metre trains servicing the Austar mine.

Trains made up of ‘120 tonne’ wagons are generally restricted to 60 km/h loaded and 80 km/h empty, while ‘100 tonne wagon’ coal trains are allowed to travel at 80 km/h. Because most of the coal trains are ‘120 tonne wagon’ trains, the coal network tends to be limited to a planned maximum speed of 60 km/h in the loaded direction and 80 km/h in the empty direction.

There are four above-rail operators in the Hunter Valley coal business: Pacific National (PN); Aurizon; Freightliner (as the operator in a joint venture with Glencore) and; Southern Shorthaul Railroad (SSR).

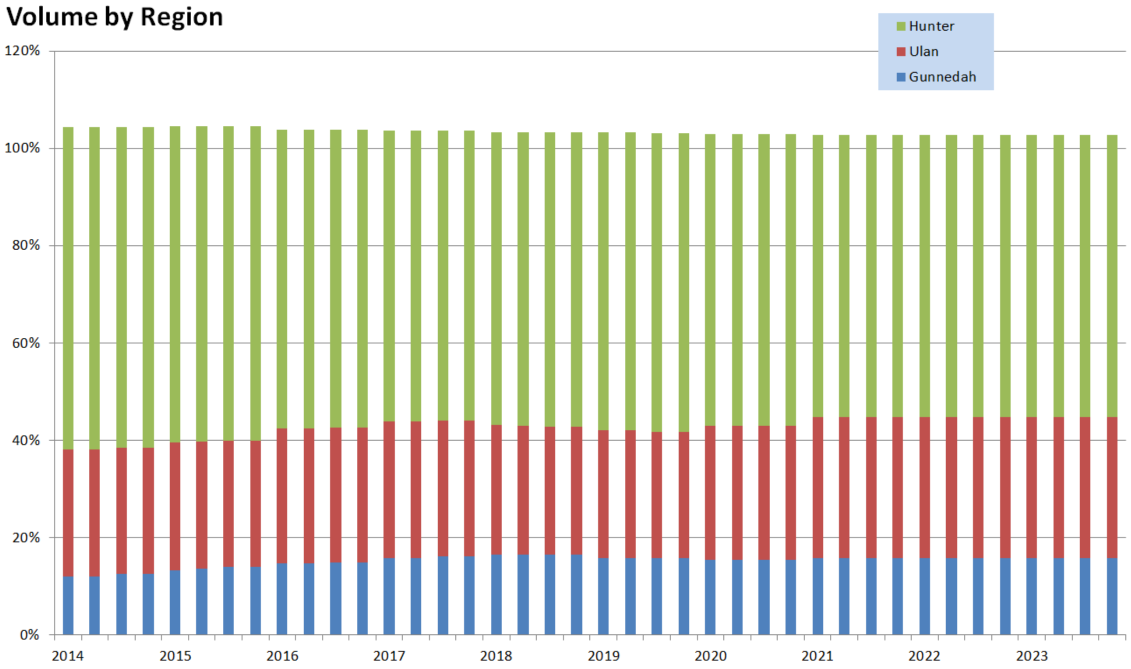


Figure 3 - Percentage of Trains by Sub-Network by Year, including prospective volume (see Note 1)

Note 1: total train numbers in figure 3 are calculated as trains from each of the three zones as a proportion of all trains arriving at the port. The total number of trains exceeds 100% due to domestic coal.

How this Strategy has been developed

The development of this 2014—2023 Hunter Valley Corridor Capacity Strategy retains the methodology of the 2013 Strategy.

In compliance with the HVAU, ARTC has undertaken a number of consultation steps to develop this draft Strategy. Specifically:

- The RCG, which is the official approval body representing access holders under the HVAU, has selected the prospective volume assumptions required to be used as the basis for the development of the Strategy.
- Consultation has been undertaken with PWCS and NCIG on the terminal capacity alignment.
- Additional consultation has been undertaken with the HVCCC on system issues.

This document is released as a draft Strategy for consultation and a final version will also be released in early July 2014 having regard to stakeholder feedback.

In common with the previous Strategies, coal capacity is analysed using a set of principles for the practical utilisation of track. Capacity is calculated using headways. On single track the headway is defined as the time the front of a train enters a section between loops until the time that the rear of the train clears the turnout for the loop at the other end of the section. The longest headway between two loops on a section of track defines the capacity limit for that section. This is then adjusted to reflect practical rather than theoretical capacity using an adjustment factor of 65%. On double-track, the headways are calculated on the basis of a ‘double-green’ principle. Under this principle both the next signal and the one after are at green, meaning that the driver will never see a yellow signal. This ensures that drivers should always be able to drive at full line speed.

On single track there is also a transaction time applied to recognise the time incurred by trains executing a cross, specifically signal clearance time, driver reaction time, acceleration and delays to the through train when it approaches the loop before the train taking the loop has fully cleared the mainline. Simultaneous entry loops and passing lanes reduce this transaction time by reducing both the probability and time delay from both trains arriving at the loop at around the same time. This Strategy has adopted a transaction time of 5 minutes for a standard crossing loop, 4 minutes where a simultaneous entry loop is involved and 3 minutes where a passing lane is involved.

After removing capacity lost to background (i.e. non-coal) trains, saleable paths are calculated as a percentage of practical coal paths. This adjustment covers maintenance, cancellations and a buffer.

With the approval of the Hunter Valley Access Undertaking, the buffer has been formalised in the form of the Target Monthly Tolerance Cap (TMTC). The RCG stated preference is for a 10% TMTC which has now been achieved.

The consequent calculation of the adjustment factor, based on cancellation and maintenance loss assumptions as determined by the HVCCC for 2014, is shown in Table 1. Note that the adjustments are cumulative (that is, sequentially multiplied) rather than additive.

To the extent that cancellation or maintenance loss assumptions change in future years it will flow through to the required adjustment factor, which in turn may trigger the addition or deletion of projects.

The adjustment factor of 74.4% used in this 2014 Strategy compares to a value of 67.8% used in the 2013 Strategy. This significant increase has not had any effect on the scope of work required for contracted volume, given the modest forward program. It does have some effect on the program required for prospective volumes, allowing some projects to be deferred from previous 'required by' timings.

Adjustment factor calculation	With TMTC at 10.0%
Cancellations	9.6%
Maintenance	11.4%
TMTC	10.0%
Adjustment Factor	**74.4%**

Table 1 - Adjustment Factor

Terminal Capacity

Critical to the volume forecasts is Terminal capacity.

ARTC's understanding of port capacity is that nameplate capacity is now at 208 mtpa.

Significant growth beyond 208 mtpa is expected to be met by the PWCS development of Terminal 4 (T4). Development of T4 had been triggered by producers entering into contracts for the threshold volumes required to initiate the project and this was reflected in the 2012 Strategy. On 2 May 2013, PWCS announced that through a contractual handback process the requirement for Terminal 4 (T4) had been un-triggered. As a result it does not intend to proceed to construction at this stage, though it is continuing to pursue the environmental approvals for the project.

At this stage there is no certainty around the timing of either the incremental enhancements or the construction of T4. For the purposes of this Strategy it has been assumed that the incremental project would be available to meet 2017 prospective volume and that T4 would start to ramp up in 2019.

The relationship between contractual volumes, prospective volumes as determined by the RCG, and terminal capacity, as assumed for this Strategy is shown in Figure 4.

HVCCC Master Planning

The HVCCC is responsible for the co-ordination of coal chain planning on both a day-to-day and long term basis. It is continuously developing a Hunter Valley Master Plan that deals with the optimisation of capacity enhancements across all elements of the coal chain with a view to providing an integrated planning road map for all elements of the chain.

ARTC is strongly supportive of this master planning process. It sees this Hunter Valley Strategy as both needing to provide the supporting rail infrastructure analysis for the master planning process, and to respond to the investment options identified in the master plan.

System Capacity

For 2014 the HVCCC determined a declared inbound throughput that fell short of contracted volumes. The primary constraint on throughput was the HVCCC assessment of 'track system capacity'. Track system capacity covers loadpoint and terminal discharge capacity and above rail operations including scheduling, as well as the capability of the ARTC network, having regard to the projected daily demand profile, utilisation peaks and terminal allocations. This essentially repeated the events of 2013.

It was determined that a 'gap' between the DIT and contracted volume was in the order of 2% and following consultation producers accepted this contractual position.

HVCCC advice until recently has been that the capacity constraint at KCT will continue to limit track system capacity until such time as the KCT arrival roads project was complete . However, during March 2014, HVCCC updated its model to address an inaccuracy in the models headway assumption and altered it to more accurately reflect the way the network will operate once the Hexham Relief roads and KCT Arrival Roads Signalling Optimisation projects are complete. **With the improved model HVCCC has advised that the KCT arrival roads are not a constraint on system capacity.** This aligns with ARTC's analysis and modelling.

HVCCC advises that this does not mean that track system capacity is unconstrained—other issues such as down congestion may still apply. Whilst KCT Stage 2 is not strictly required for ARTC contracted capacity, the project is well advanced and HVCCC have indicated it provides other benefits to the system.

Operational Initiatives

While this Strategy principally focuses on infrastructure upgrades, ARTC supports industry initiatives to deliver operational efficiencies. ARTC is driving or supportive of the following important initiatives within the Hunter Valley:

- The continued support & involvement in the Live Run Implementation Team establishment as proposed by the Live Run Management Group Steering Committee.
- Continued regular forums with rail operators, to jointly consider improvements to operational performance, in particular crew change practices and train velocity expectations
- Continued consideration jointly with the HVCCC of train park up strategy to provide for efficient management of excess rolling stock at lower demand periods.
- Implementation and assessment of the revised corridor shutdown program.
- Continued assessment of maintenance practices to reduce the need for track based inspections and physical maintenance interventions.
- Complete proposal for industry consultation on incentive mechanisms to minimise coal chain capacity losses.
- Continued development of increased train payload initiatives.
- Development of Dynamic pathing capability.
- Targeted data driven infrastructure reliability improvement initiatives.

Network Control Optimisation

During 2008 ARTC completed the implementation of new train control systems and automated signalling systems during the Train Control Consolidation Project (TCC). Under the project all 28 of the 19th century manually operated signal boxes within NSW were fully automated to Phoenix train control system technology and consolidated to ARTC's two Train Control Centres, Network Control Centre North (NCCN) at Broadmeadow and Network Control Centre South (NCCS) at Junee. This project realised significant operational gains, both in improved train transit times through the use of technology in addition to reduced budget expenditure. More recently ARTC has completed the 'Proof of Concept" Advanced Train Management System (ATMS) safety case and is in the process of implementing a field trial between Port Augusta and Whyalla.

The industry is acutely aware of the challenges associated with an integrated system such as the Hunter Valley Coal Chain. ARTC is working on initiatives to enhance our decision making capability. This is exemplified by the introduction of the Hunter Valley Live Run Integration Team which consists of above and below rail service providers to overcome some of these issues.

The existing complexity of the system and the expected increase in volumes requires tools which enable informed decisions to be made in a live run environment that are based on accurate and timely information. In December 2013, the RCG approved Phase 1 of a project known as the ARTC Network Control Optimisation (ANCO) project to investigate and to attempt to resolve the current and potential future issues caused by these inefficiencies within the Coal Chain. This project phase was approved

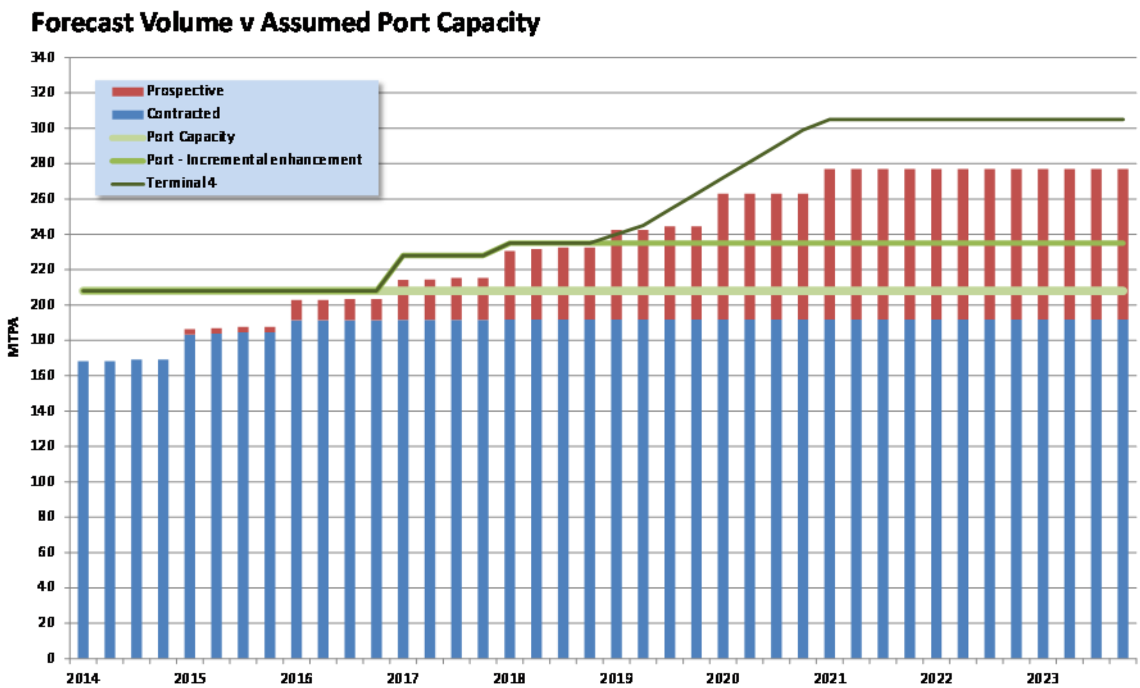


Figure 4 - Forecast volume at Newcastle Port compared to assumed port capacity (mtpa)

with an initial budget estimate of approximately $30 Million, over a 5 year project timeframe.

With a budget of $630,000, Phase 1 of this project is planned for practical completion in September 2014, with approvals phases to be complete in November 2014. Phase 1 of the project involves defining the functions required of the overall system; identifying the preferred options to overcome the issues; identifying an appropriate implementation path in order to resolve issues to effectively manage the growth profile in the Hunter Valley; market capability analysis; identifying KPI's for overall system; and to refining the project budget and program for the entire scope of the project.

It is the intent of this project to identify process improvements which can be made, in conjunction with potential technological solutions which could be implemented that would enhance decision making and reduce variability within the chain. Primarily these systems will allow real time data feeds across organisations inclusive of train forecast times which are deduced using live information, and provide the capacity to manage disruption through optimised scenario modelling.

In addition to reducing the future requirement for further investment in additional Network Control workstations and associated personnel costs these systems would also allow for detailed analysis of network performance to enhance the coal chain's capacity to identify areas in which operational improvement can be made and offset potential infrastructure investment.

ARTC intends to move forward with investigation of options for the delivery of such a system and will involve HVCCC and other service providers in the project as appropriate. Key Inclusions planned for the system at this stage of the project are:

- Train Monitoring & Planning
- Live Run Disruption Management & Scenario Modelling
- Reporting
- Trackwork Possession Management

Types of systems/system enhancements being considered to provide these functions include:

- Electronic graph
- Long range optimization/planning tools
- Automatic route setting
- Live run (short range) optimization tools

Advanced Train Management System (ATMS)

ARTC's ATMS project has completed the proof of concept stage, and is now moving into a field trial phase to demonstrate the functionality of the system in a live environment.

ARTC has previously identified that a commercial case existed for roll-out of the ATMS system in the Hunter Valley, where the capabilities of the system may both allow some projects to be deferred, and the construction cost of others to be reduced.

Previously much of the identified benefit of ATMS was associated with the ability to defer projects or to reduce their cost. With the slowdown in the rate of growth, these benefits are unlikely to be as significant. However, ATMS is still likely to be a highly desirable initiative due to the system performance and productivity benefits that ATMS will offer.

ATMS has now moved to a level of development where ARTC is making further assessment of the benefits to the Hunter Valley and observing the success of the Port Augusta to Whyalla implementation as referenced earlier. The main effect of ATMS is to eliminate the need for a number of projects between the Port and Muswellbrook, as discussed in Chapter 5.

Accordingly, this Strategy now focuses on the scope of work required for both contracted and prospective volumes under a 'with ATMS' scenario.

Continuous Review

ARTC is continuously analysing and reviewing the available options to ensure that the value for money of projects is optimised. This process continues right up to the commencement of construction.

As such, this strategy represents a snapshot in time. Although the formal written strategy is only produced annually, in practice it is continuously reviewed internally to reflect the best available information and analysis.

Project Costs

This document is a strategy document and the indicative project costs are generally orders of magnitude only unless a project is in or close to construction. Costs are not ARTC's anticipated outturn costs as there are too many unknowns at the strategy phase to attach any reliability to the estimates. Scope and construction conditions are progressively better defined until a project cost is established for approval by the industry in accordance with the HVAU.

Other Assumptions and Qualifications

The following additional qualifications apply to the analysis and proposals in this Strategy:

- Estimates of the numbers of trains required to carry the forecast coal tonnages are generally based on train consists nominated by producers under the contracting process. Assumed average train capacity by section by year is shown in Table 2. It should be noted that for the Gunnedah basin 30 tonne axle loads will apply from Q1 2015. There remains some uncertainty about the actual train configuration that will operate and this issue will need to be monitored.

- Trains are, on average, loaded to 98% of their theoretical capacity.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Narrabri - Boggabri	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Boggabri - Gunnedah	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Gunnedah - Watermark Jct	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Watermark Jct - Caroona Jct	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Caroona Jct - Werris Creek	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Werris Creek - Scone	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Scone - Dartbrook	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Dartbrook - Muswellbrook	5,932	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634	7,634
Cobbora - Ulan	-	-	-	-	-	-	-	-	-	-
Ulan - Moolarben	8,330	8,330	8,330	8,330	8,330	8,330	8,330	8,330	8,330	8,330
Moolarben - Wilpingjong	8,149	8,116	8,116	8,116	8,116	8,116	8,116	8,116	8,116	8,116
Wilpingjong - Bylong	8,138	8,119	8,119	8,119	8,119	8,119	8,119	8,119	8,119	8,119
Bylong - Ferndale	8,138	8,119	8,119	8,119	8,119	8,119	8,119	8,119	8,119	8,119
Spur Hill - Mangoola	8,138	8,119	8,119	8,119	8,119	8,119	8,119	8,119	8,119	8,119
Mangoola - Mt Pleasant	8,185	8,171	8,168	8,168	8,168	8,168	8,168	8,168	8,168	8,168
Mt Pleasant - Bengalla	8,185	8,171	8,184	8,184	8,185	8,185	8,185	8,185	8,185	8,185
Bengalla - Muswellbrook	8,204	8,191	8,200	8,200	8,200	8,200	8,200	8,200	8,200	8,200
Muswellbrook - Antiene	7,488	8,006	8,019	8,019	8,020	8,020	8,020	8,020	8,020	8,020
Antiene - Drayton	7,488	8,006	8,019	8,019	8,020	8,020	8,020	8,020	8,020	8,020
Drayton - Newdell	7,721	8,140	8,142	8,142	8,143	8,143	8,143	8,143	8,143	8,143
Newdell - Mt Owen	7,742	8,056	8,063	8,063	8,063	8,063	8,063	8,063	8,063	8,063
Mt Owen - Camberwell	7,826	8,115	8,118	8,118	8,118	8,118	8,118	8,118	8,118	8,118
Camberwell - Whittingham	7,847	8,123	8,126	8,126	8,126	8,126	8,126	8,126	8,126	8,126
Whittingham - Maitland	7,942	8,165	8,166	8,165	8,166	8,166	8,166	8,166	8,166	8,166
Maitland - Bloomfield	7,638	7,935	7,946	7,945	7,946	7,946	7,946	7,946	7,946	7,946
Bloomfield - Hexham	7,641	7,941	7,951	7,951	7,951	7,951	7,951	7,951	7,951	7,951
Hexham - Kooragang	7,296	7,576	7,599	7,600	7,600	7,600	7,600	7,600	7,600	7,600
Hexham - Carrington	7,296	7,576	7,599	7,600	7,600	7,600	7,600	7,600	7,600	7,600

Table 2 - Average Train Capacity under Contracted Volumes (tonnes)

- Various ARTC initiatives including changes to the possession regime has enable the HVCCC to reflect a lower maintenance loss rate for the 2014 capacity declaration.

- The project related capacity gains referred to in this Strategy take no account of the capabilities of loading and unloading interfaces, including the capabilities of private rail sidings and loops. In other words, at the conclusion of each project the identified rail capacity will be available, but this does not necessarily mean the coal supply chain will be able to make use of this capacity at that stage. This broader capacity analysis is undertaken by the HVCCC.

- Infrastructure is treated as being available for a quarter if it is projected to be available by the end of the first month of the quarter. If it is not expected to be available until later than the first month of the quarter it is treated as being available in the following quarter. For example, if a project is projected to be completed by 30 April, it is treated as being available for the second quarter. If it will not be competed until 1 May it would be treated as being available for the third quarter.

- It is assumed that a flyover for access to the NCIG facility will be constructed as part of Stage 2F of the development in accordance with its planning approvals.

ARTC

2

What has changed between the last strategy and this one

This section summarises the key methodology, assumption and outcome changes between the 2013 Strategy and this 2014 Strategy to allow ready comparison between the two.

Volume forecasts

Volume forecasts have been updated based on contracted volumes. This Strategy maintains the distinction between those volumes that are subject to a binding contract and those that are associated with projects that are moving forward but not yet at a stage where producers wish to commit to a contract. The latter category is referred to as prospective volumes.

Figures 5 to 8 compare the forecast volumes from the 2013 Strategy with the forecasts used for this Strategy. A comparison is made at the terminal, at Muswellbrook, for the Bylong – Mangoola section (which is the majority of the Ulan line), and Werris Creek – Muswellbrook (which is representative of most of the Gunnedah basin line).

Capacity Calculation Inputs

As outlined in Chapter 1, the capacity calculation methodology uses the industry nominated cancellation losses and non-aligned maintenance losses as determined by the HVCCC as inputs into the capacity calculation, together with the target monthly tolerance cap (TMTC) as nominated by the RCG. While the TMTC is now a constant, the forecast cancellation and maintenance rates will vary from year to year.

Ideally the HV Capacity Strategy would be based on forward estimates of cancellations and maintenance losses on a year by year basis. However, at this time the HVCCC only finalises these losses for the year ahead and only does so when determining the Declared Inbound Throughput (DIT). Accordingly this HV Strategy is based on the HVCCC estimates of cancellations and maintenance losses for 2014.

For 2013 the estimated cancellations rate was 16.4% and the maintenance losses were 15.2%. For this 2014 Strategy these have been updated to 9.6% and 11.4%

The 9.6% cancellation rate equates to the 8.8% loss rate as per the 2014 DIT assumptions released by the HVCCC, but is expressed as 9.6% as it is applied as an escalation rather than a reduction.

Concept Assessments

Following the identification in the 2012 Strategy of a large program of works likely to be required in conjunction with T4, ARTC undertook an extensive program of concept assessments to firm up the likely scope and cost of the identified projects. The analysis in this Strategy draws on those concept assessments.

KCT Issues

In the 2013 Strategy ARTC foreshadowed an intention to examine whether re-signalling of the arrival roads could increase train speed and the effect that this may have. This analysis was undertaken during the year and led to the Arrival Roads Signal Optimisation project. The initiation of this project together with revised HVCCC modelling has led to a reduction of the required scope of works on the KCT arrival roads.

Completed Projects

The only project completed during the 2013/14 financial year was the KCT departure road No 3 reconfiguration and utilisation of the recently constructed banking sidings at Chillcots Creek. However it should be noted that five major capacity projects will be commissioned in Q3 and Q4 of 2014.

Recommended projects and timing

A summary of the recommended projects comparing previous and new proposed delivery timeframes is shown in Tables 7 & 8 in Chapter 7, for both contracted and prospective volumes.

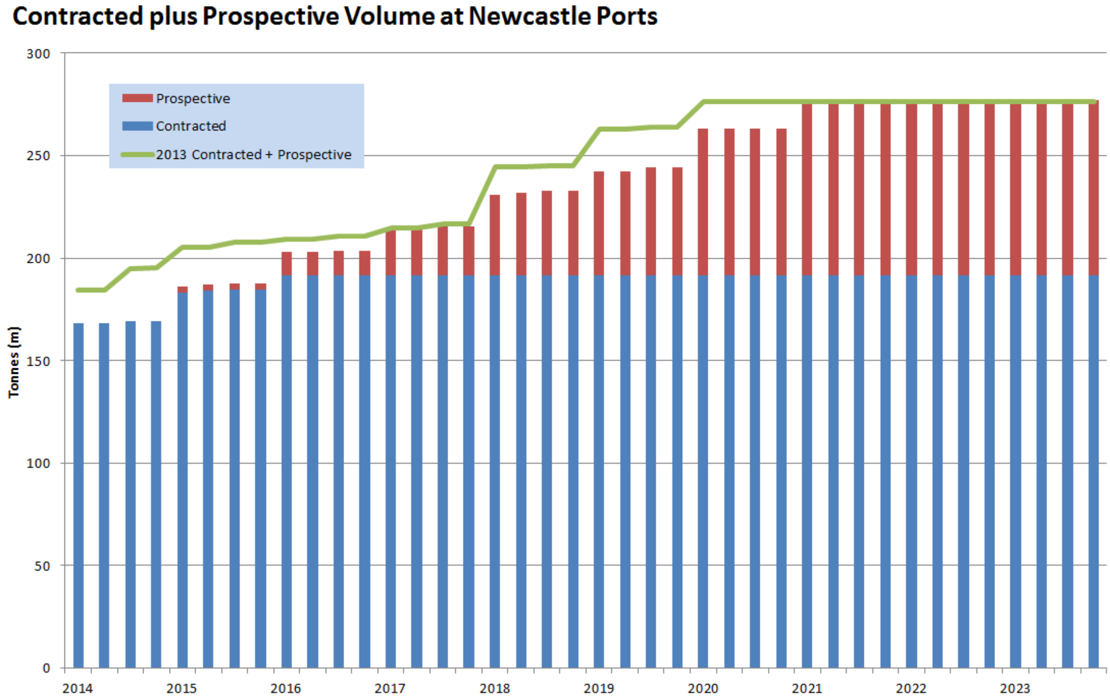


Figure 5 - Current Volume Forecasts vs. 2014-24 Volume Forecast, Newcastle Terminals (mtpa)

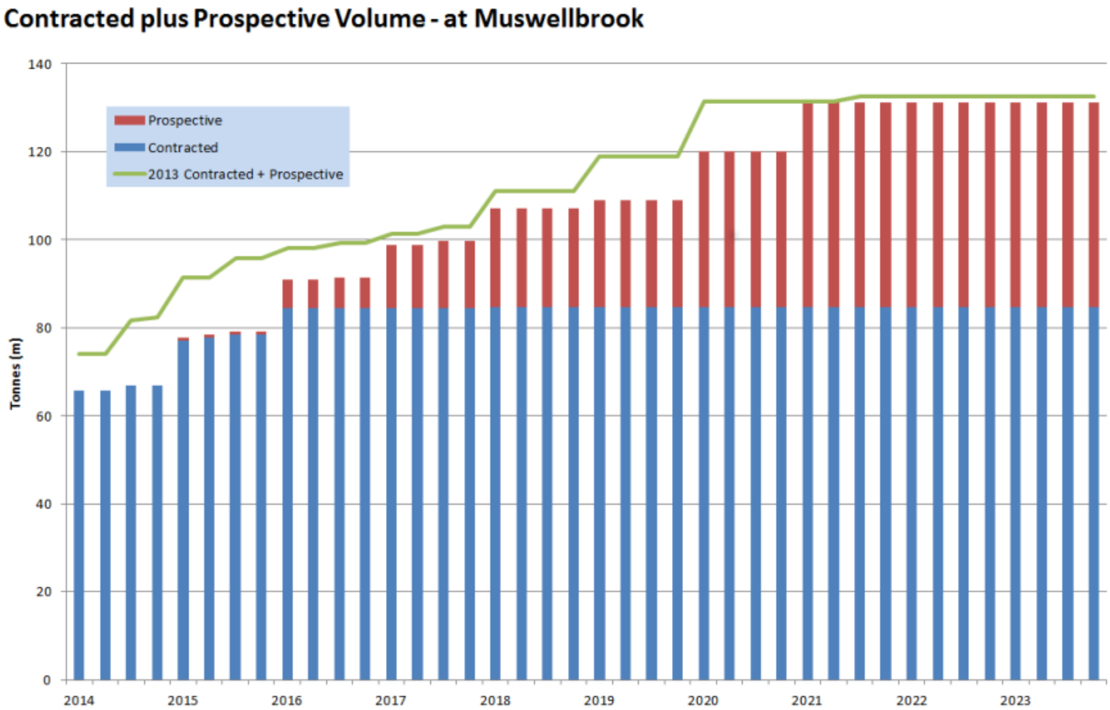


Figure 6 - Current Volume Forecasts vs. 2014-24 Volume Forecast, Muswellbrook (mtpa)

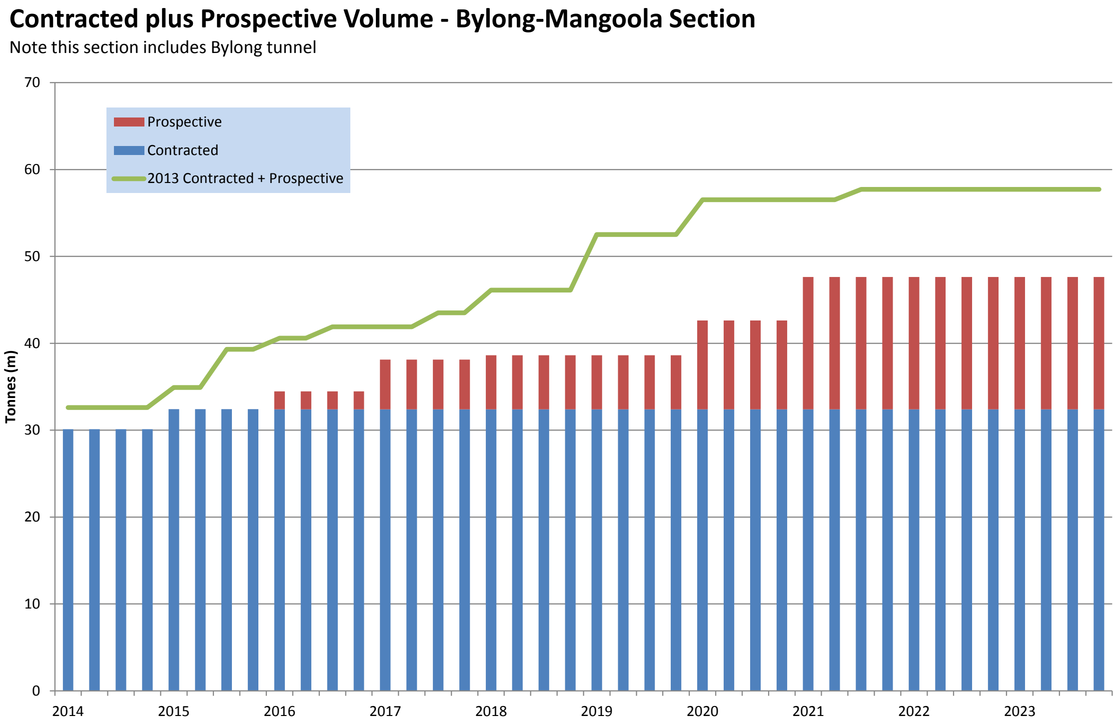


Figure 7 - Current Volume Forecasts vs. 2014-24 Volume Forecast, Bylong—Mangoola (mtpa)

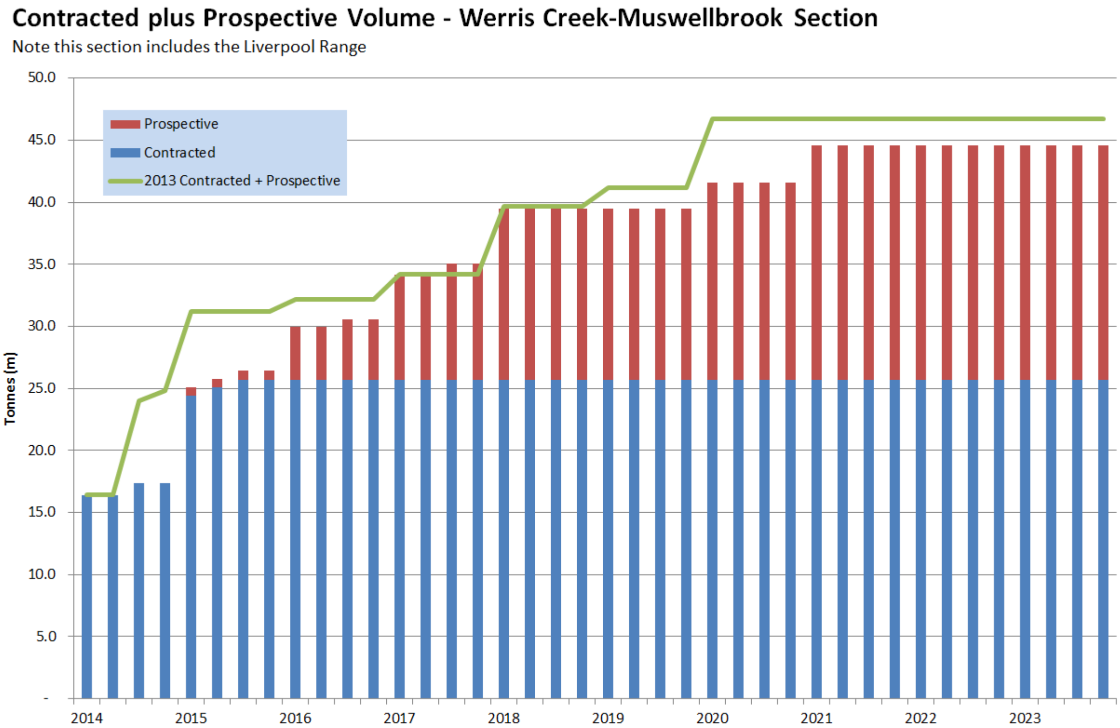


Figure 8 - Current Volume Forecast vs. 2014-24 Volume Forecast, Werris Creek—Muswellbrook (mtpa)

ARTC

3

Increasing Capacity between Narrabri and Muswellbrook

Context

The Gunnedah Basin line extends from the junction for the Narrabri mine to Muswellbrook.

This single-track line is highly complex. In addition to its coal traffic, it carries passenger trains (CityRail services to and from Scone and CountryLink services to and from Moree / Armidale) and a proportionately high level of grain, cotton and flour train activity. This 'background' traffic is up to seven trains each way between Narrabri and Scone, and 10 trains each way per day south of Scone.

There are four coal train origins / destinations along the route, at Turrawan, Boggabri , Gunnedah and Werris Creek. Four major new mines are proposed for the Gunnedah basin: Maules Creek, Vickery South, Caroona and Watermark.

Maules Creek is now under construction and will load from a balloon loop on a new branch connecting close to the existing Boggabri balloon loop. The Boggabri mine will also in future load from a balloon loop off this new branch. Vickery South is assumed to load in the vicinity of Gunnedah. It is understood that Watermark and Caroona will load from new load points either side of Breeza, at approximately the 443.5 km and 424 km points respectively.

The Ardglen bank, crossing the Liverpool Range, is a particular impediment on this corridor. The severe grades on the short section between Chilcotts Creek and Murrurundi dictate limits for train operations on the whole Werris Creek to Newcastle route. The need to use 'banker' locomotives for loaded coal and grain trains on this section means it carries greater train volumes than the rest of the line, because the return of the 'banker' locomotives adds a northbound train path for each southbound coal or grain train, though this is mitigated to some extent by the ability of bank engines to use the short loop at Kankool and the ability to bank from Chilcotts Creek following the opening of the new loop with purpose built bank engine sidings.

Passing loops on the Muswellbrook–Narrabri route had highly variable lengths when ARTC first started investing in capacity enhancement on this corridor. The majority of loops are now 1330 m – 1450 m with only a small number of short loops remaining. Of these short loops, Gunnedah, Quirindi, Kankool and Scone have specific challenges that make extension impractical.

The track north of Dartbrook is only currently rated for 25 tonne axle loads (i.e. '100 tonne' wagons), compared to 30 tonnes on the rest of the network. This track will be upgraded to 30 tonne axle loads by Q1 2015.

All of the network carrying coal is Centralised Traffic Controlled (CTC).

Axle Load Increase

Axle loads on the track north of Dartbrook are currently limited to 25 tonnes. Previous Strategies have highlighted that increasing axle loads to 30 tonnes would permit the use of 120 tonne wagons and thus increase the carrying capacity of each train. This was expected to provide significant cost savings for producers as well as allowing some capacity projects to be deferred.

In late 2013 the Gunnedah basin producers approved a project to proceed with the necessary track upgrading to permit 30 tonne axle loads from Q1 2015.

A key issue for 30 tonne axle loads is train performance given the introduction of train configurations and speed constraints not previously used in the Gunnedah basin. The necessary reduction in the permitted speed of loaded trains to 60 km/h, in line with 30 tonne axle loads elsewhere in the Hunter Valley, has different section time effects on different parts of the corridor. As a result, 30 tonne axle loads has an effect on the sequencing of projects as well as their timing.

It will also not be possible to be confident about actual performance until operational trials are undertaken, which may lead to some adjustments to the program in the future.

Liverpool Range

In 2007 ARTC completed a study looking at options for a new rail alignment across the Liverpool Range in the vicinity of Ardglen. This report assessed four tunnel options and two surface alignment options as well as duplication of the existing alignment.

In the 2011-2020 Strategy ARTC indicated that its assessment of the costs and benefits of the options suggested that staged duplication of the existing line on the existing gradient was the best solution and that duplication would be treated as the default solution.

The Liverpool Range poses some particular complexities due to grades, curvature and geology. However, the decision to proceed with, initially, additional loops, followed by progressive duplication, means that in practical terms the Liverpool Range will essentially see a similar approach to capacity enhancement as the rest of the corridor. As such the staging of the enhancements is discussed in the context of 'Loops & Passing Lanes' below.

Scone Reconfiguration

The passing loop at Scone is short (410 m) and has an asymmetric layout, requiring all trains to negotiate a curved turnout leg and slowing speeds through the station area to 25 km/h. Level crossings and the proximity of the town make an extension of the loop impractical.

Passenger trains are the only services that stop at Scone. It was therefore proposed that the track arrangement at Scone should be altered to give an unrestricted run for through trains saving approximately 4 minutes in the section between Togar and Parkville.

This project is currently underway and expected to be complete in November 2014. The scope of this project has been extended to include additional formation work as geotechnical investigations determined that the existing formation was not suitable for 30 tonne axle loads. With the increase in train speed it has also been necessary to incorporate some noise mitigation works.

Gunnedah Yard

Gunnedah Yard is an important rail hub. As outlined in the 2013 Strategy, the yard's configuration and condition is such that it risked becoming a constraint on the network between the Gunnedah Basin and the Port of Newcastle. This included the track condition, speed constraints and signalling configuration.

The RCG has now endorsed phase 5 with commissioning targeted for Q4 2014. This has allowed the deferral of construction of South Gunnedah loop by increasing the speed through Gunnedah yard.

There is a correlation between increased speed and noise impact. Therefore to minimise the noise impact on surrounding residents a 40km/hr speed limit in the down (empty) direction which will still provide the required capacity for contracted volumes.

Train Lengths

ARTC has an approved train length of up to 1329 metres. This represents a practical limit given current loop lengths, existing train configurations and the need to allow a margin at the loop ends. There will be no further increase in length until the track configuration changes to facilitate it.

For various operational reasons ARTC has been building an increasing number of loops with a 'simultaneous entry' configuration. This configuration allows for a more efficient cross to occur when opposing trains arrive at the loop at around the same time, an event which becomes increasingly probable as the distance between loops decreases. A simultaneous entry configuration requires a minimum extra 300 metres 'overlap' to be added to the loop length, making the loops nominally 1650 metres, though in the simultaneous entry configuration the extra length is not available to use for longer trains. However, if and when ATMS is introduced into the Hunter Valley it will be possible to allow simultaneous entry without the additional overlap, meaning that loops built in this style would immediately be available for trains of the standard Hunter Valley length of 1543 metres.

Given this opportunity to move progressively towards the introduction of the standard Hunter Valley train to the Gunnedah basin, ARTC is adopting an approach of building all new loops to the simultaneous entry configuration where this is cost effective, which provides short-term operational benefits and the ability to easily move to longer trains if and when ATMS is introduced.

Loops & Passing Lanes

Progressive lengthening of selected existing passing loops, and constructing additional passing loops, has been the primary mechanism for accommodating volume growth to date. However, only two loops (Aberdeen and Murrurundi) remain for potential extension. Opportunities to insert additional mid-section loops are becoming constrained due to the effects of grades and level crossings, while the increasingly short distances between loops mean that additional mid-section loops are of declining benefit due to the transaction times at the loop.

Notwithstanding this, the concept assessments undertaken in 2012 on projects required to accommodate prospective volumes have tended to conclude that a mid-section loop remains the preferred solution. In some cases these new loops will be quite close to existing loops. However, where it is practical to construct a mid-section loop the additional cost associated with building a passing lane does not justify the additional benefit. As a result, passing lanes have only been recommended where there are physical constraints to a mid-section loop.

Specifically, the previous Togar North extension has been replaced by a loop centred around the 311 km point while the Parkville south extension on the north of Scone has been replaced by a loop cantered around the 316 km point. The earlier concept for a Werris Creek bypass has been replaced with a proposal for two loops, one either side of Werris Creek.

The passing lane / double-track sections on the Liverpool Range remain as it is not practical to stop trains on either the up or down grade across the range, while Bells Gate south extension is preferred to Quipolly due to the high cost of extending the existing loop at Quipolly given level crossing and environmental constraints. The length of each of these passing lanes is determined by physical constraints.

Table 3 shows the new loops, loop extensions and passing lanes proposed on the basis of addressing the capacity constraint on each local section as demand requires, for both contracted and prospective volume assuming 30 tonne axle loads from Q1 2015. The location of each of the projects is shown on Figure 9.

HVCCC Modelling of Gunnedah basin operations

During early 2014 the HVCCC reported on modelling that it had undertaken on the Gunnedah and Ulan lines. The background to the modelling was the desire of HVCCC to be able to assess the need for relief hubs either at the main mine areas of each line (nominally Boggabri and Bylong) or at the junction at Muswellbrook.

It has been apparent for some time that the need to program trains onto fixed paths to the Gunnedah basin causes a loss of capacity. This could to some extent be mitigated by creating a timetable that incorporates as many paths as possible. However, the consequence of such a timetable is that, since not every path is used in practice, it creates 'phantom' crosses. These phantom crosses cause problems for live-run and in themselves artificially consume train hours.

The solution to this problem is 'dynamic' pathing, that is, adoption of a system that creates a daily timetable tailored to the requirements of the specific trains that will actually be running on that day.

HVCCC's modelling concluded that in a scenario where trains arrive at Muswellbrook at random, in the absence of dynamic pathing there would be considerable congestion at Muswellbrook as trains may need to occupy the mainline for up to 2 hours waiting for the next timetabled path. These waiting trains would block the Ulan line. The HVCCC has suggested that an alternative to dynamic pathing would be the construction of one or more holding roads at Muswellbrook.

ARTC believes that dynamic pathing is technically possible and has significant potential to increase productivity, not just for the Gunnedah line, but for the entire coal chain. A project to develop a dynamic pathing system is now well underway.

The HVCCC modelling did not find a need for a holding track near Boggabri.

An additional output of the modelling was electronically generated timetables for the Gunnedah basin. These timetables demonstrated that it was possible to create theoretical timetables that achieved greater than the 65% utilisation which ARTC currently adopts as the track utilisation threshold for calculating saleable paths. It should be noted though that ARTC's timetables already include path numbers that exceed the 65% utilisation levels. ARTC does not sell all of the paths as given natural variability the HVCCC would be unable to timetable a train onto every path.

ARTC is of the view though that with dynamic pathing it is likely to be possible to increase track utilisation. As the dynamic pathing project progresses ARTC will further assess the extent to which it may be possible to set a higher single track utilisation limit.

In the meantime ARTC will also continue to apply the principle that utilisation levels above 65% may be appropriate where projected utilisation would only exceed the threshold by a small amount and the projects required to keep utilisation below 65% are expensive. Any decision on whether to accept a higher utilisation level would be made in consultation with the relevant producers.

Project Name	Contracted	Prospective
Scone reconfiguration	Q3 2014	Q3 2014
Gunnedah Yard Upgrade	Q4 2014	Q3 2014
Aberdeen loop extension		Q1 2017
Togar North Loop (previously 311 km loop)		Q1 2016
316 km loop (North Scone)		Not Required
Wingen loop		Q1 2016
Blandford loop		Q1 2017
Kankool - Ardglen		Q3 2017
Bells Gate south extension		Q1 2018
414 km loop (Werris Creek North)		Q1 2021
South Gunnedah loop		Q1 2016
Collygra loop (504 km)		Not required

Table 3 - Narrabri to Muswellbrook Loops - Timing under contracted and prospective volume scenarios assuming 30 tonne axle loads from Q1 2015

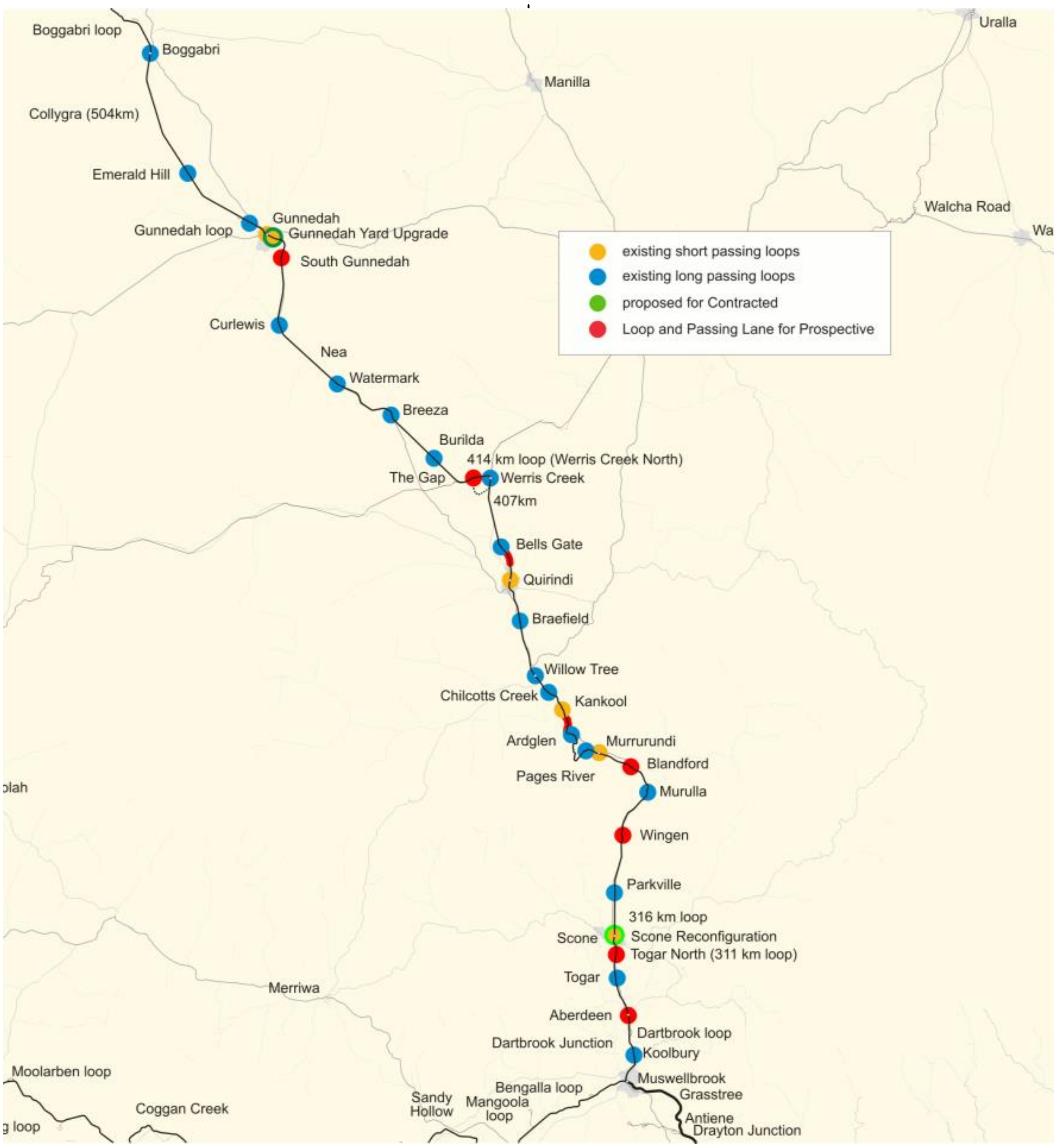
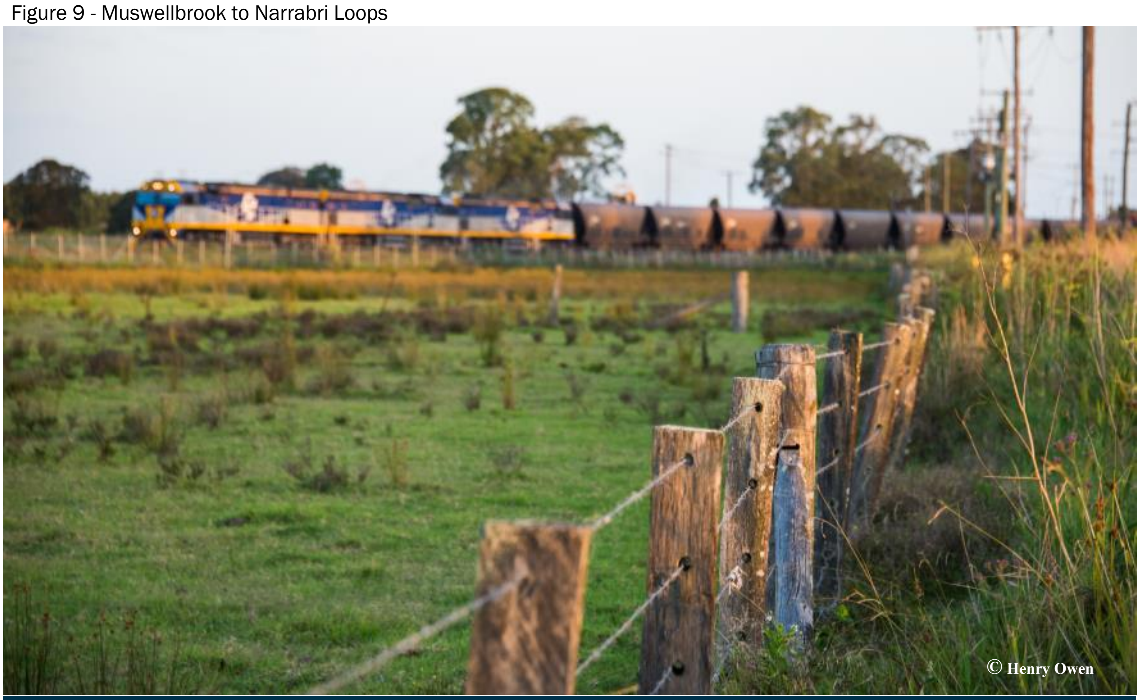


Figure 9 - Muswellbrook to Narrabri Loops



ARTC

4

Increasing capacity between Ulan and Muswellbrook

Context

The Ulan line extends approximately 170 km, from Ulan, west of the dividing range, to Muswellbrook in the upper Hunter Valley. It is a single track line, with passing loops at Bengalla, Mangoola, Yarrawa, Sandy Hollow, Kerrabee, Baraemi, Murrumbo, Bylong, Coggan Creek, Wollar, Wilpinjong and Ulan (though the Ulan loop is only 980 m), and is CTC controlled.

Although the line is used mainly by coal trains, it is also used by one or two country ore and grain trains per day and occasionally by interstate freight trains that are bypassing Sydney during possessions. The line services long-standing mines at Bengalla and Ulan. The Wilpinjong, Moolarben and Mangoola mines have all commenced production in recent years.

Five new export coal mines are at various stages of the development and approval process. Since last years strategy a additional prospective mine at Spur Hill has been added to the prospective future volumes.

A sixth mine, Cobbora, located approximately 33 km north-west of Gulgong, was being developed by the NSW Government primarily to produce coal suitable for domestic power generation. The future of this project is now uncertain. Although there have been suggestions that the mine may be developed as an export mine, the probability of this occurring in the medium term is low and it has therefore been excluded from the prospective volumes.

The mines on this sector are clustered either at the start of the line near Muswellbrook (Bengalla, Mangoola, Mt Pleasant) or at the end of the line around Ulan (Ulan, Wilpingjong, Moolarben). This gives rise to a long section in the middle with homogenous demand. The proposed Mt Penny and Bylong mines will be toward the Ulan end, but 30 km closer to Muswellbrook.

The Ulan line has some difficult geography which constrains the location of loops. As sections become shorter, the scope to adjust the location of the loop declines. Accordingly, as investigation of nominal sites has progressed, it has become necessary to consider alternative solutions. Specifically, in some cases it has become necessary to construct “passing lanes”, which are effectively short sections of double track. These will necessarily be materially more expensive than straightforward loops.

An unusual capacity constraint is posed by the ventilation in the tunnels on the Ulan line, in particular the Bylong tunnel. Although the line only opened in 1982, the four tunnels were built as part of the original uncompleted construction of the line which commenced in 1915. Accordingly the tunnels were built to a relatively small outline and ventilation in the tunnels has been considered a problem. Train spacing and track maintenance has been limited by the ‘purge times’ for air in the tunnel. However, extensive monitoring and analysis has allowed the previous operating rule that limited trains to operating at an arbitrary 30 minute minimum frequency to be reduced to 20 minutes. This has largely addressed the ventilation issue.

This analysis of the Ulan line assumes that there is no change to the current pattern of limited background (non-coal) trains on this line.

Tunnel Ventilation

As noted above, it has been possible to manage the immediate tunnel ventilation issue.

In the longer term, it will be necessary to extend the Bylong loop to the western tunnel portal for prospective volumes. This extension would be built to a new vertical alignment, with the track cresting at a point around one kilometre before the portal so that trains are able to start on an acceptable gradient. This will also reduce the requirement for trains to be powering as they enter the tunnel, providing further mitigation of the air quality issue.

Denman Bypass

The 2011 Strategy identified an option to construct a bypass of Denman, from just east of Sandy Hollow to just west of Mangoola, as an alternative to an additional loop (nominally at 324 km) on this section. The 11.5 km bypass would provide operational efficiencies (reducing route length by 8.7 km) as well as creating capacity by effectively making the section double track.

The HVCCC has identified the Denman bypass as a potential option for creating additional train park-up capacity. The bypass option will continue to be assessed in the context of all three of these potential sources of benefit noting that the likely trigger for such a project, the construction of a loop at 324 km, is no longer required under the prospective volume scenario.

Increasing Train Speed

The default solution for increasing capacity is to build additional loops or track. However, there is also an option to reduce section running times, and hence increase capacity, by lifting train speed. This option was reviewed in the context of the 2011 Strategy and it was determined that there was no scope for significant benefit from this option since in most cases speed is limited by train performance and curve speeds rather than the maximum speed. However, to ensure that the program is optimised this option will be reviewed periodically.

Increasing Train Length

ARTC has been working with operators to explore the benefits to increase the length of trains to circa 1610 metres. Generally the preference would be to operate standard train sets across the network. To achieve this on the Ulan line will require a short extension to two of the older loops, Sandy Hollow and Kerabbi.

At this time there is adequate capacity for all contracted volume. This proposal would therefore be primarily a productivity initiative. The order of magnitude cost of the two extensions is a total of $15m.

ARTC will work together with Freightliner, Aurizon and PN to identify whether this is a proposal worth further progressing for consideration by the RCG.

Additional Passing Loops/Passing Lanes

Additional passing loops, or where necessary passing lanes, represent the main mechanism to deliver further incremental increases in capacity on the line.

The currently identified scope is set out in Table 5. The location of existing and proposed loops is shown in Figure 10.

Project Name	Contracted Volumes	Prospective Volumes
Mt Pleasant loop (previously Bengalla west extension)	-	Q1 2021
Mangoola West Extension (to 310.5)	-	Not Required
324 km loop (or Denman bypass)	-	Not Required
337 km loop	-	Not Required
Baerami West Extension	-	Not Required
Widden Creek loop	-	Q1 2021
Bylong East Extension (to 377.0 km)	-	Not Required
Coggan Creek west extension (to 399.6)	-	Not Required
Gulgong loop	-	Not Required
Gulgong - Tallawang CTC	-	Not Required
Ulan - Tallawang track upgrading	-	Not Required

Table 4 - Ulan - Muswellbrook Loops, timing under contracted and prospective volume scenarios

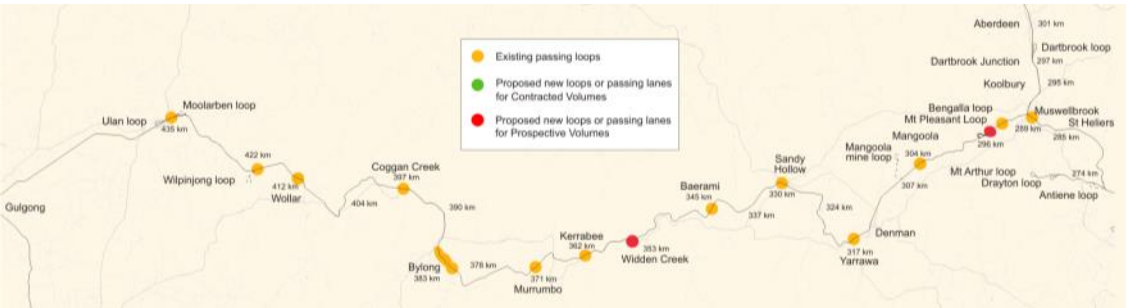


Figure 10 - Ulan Loops

5

Increasing capacity between Muswellbrook and Hexham

Context

The major issues affecting the line between Maitland and Muswellbrook are:

- Headways
- Junctions
- Continuous flow of trains

Headways are fundamentally a function of signal spacing and design. Drivers should ideally only ever see a green signal on double track, so that they do not slow down in anticipation of potentially encountering a red signal. To achieve this outcome, a train needs to be at least 4 signals behind the train in front so that the signal a driver encounters, and the next one beyond, are both at green. Signal spacing also needs to take into account train speed and braking capability. Signals need to be spaced such that a train travelling at its maximum speed and with a given braking capability can stop in the distance between a yellow and a red signal. In some cases these constraints start to overlap, in which case it becomes necessary to go to a fifth signal, with a pulsating yellow indication.

Ideally, headways on the whole corridor from Muswellbrook to the Terminal should be consistent so that trains can depart at regular intervals, and as additional trains join the network they can slot in to a spare path without impacting a mainline train. This headway target needs to be around 8 minutes[3] once volume exceeds around an average of 84 paths per day, or 245 mtpa at current train lengths.

While this principle has been adopted in the signalling design for new works, there have not as yet been any specific projects directed specifically at reducing signal spacing. At this stage effective headway is at around 8 minutes south of Minimbah, but increases further up the line. Spacing is as high as 16 minutes in the vicinity of Drayton Junction.

It should also be noted that in a live operating environment, all trains will ideally operate at consistent speeds and achieve the section run time. To the extent that they do not it results in drivers encountering yellow signals, which causes them to slow, creating a cascading effect on following trains that will cause a loss of capacity.

There are three major banks (sections of steep grade) on the Muswellbrook - Maitland section that particularly affect the headways for trains; Nundah Bank, Minimbah Bank and Allandale Bank (Figure 11). The steep grades on these banks slow down trains to such an extent that it is not possible to obtain an adequate frequency of trains irrespective of how closely the signals are spaced. This requires a third track to be constructed at the banks. All three of track sections are now on three major banks.

There are numerous junctions on the Hunter Valley rail network where train conflicts at the at-grade interfaces impact on capacity (Figure 12).

The connection between the main lines north of Maitland and the main lines to the east is through a set of old slow-speed high-maintenance turnouts. There are also a number of similar turnouts on the city side of Maitland. The main issue this raises is the amount of possession time required to maintain these turnouts. Congestion is also exacerbated by the slow speed turnouts, but at current forecast volumes this is manageable. There is also a small amount of conflict with trains off the Pelton branch line.

Whittingham junction turnout speeds were upgraded to 70 km/h in conjunction with the 80 km/h approach to Minimbah bank project, and the junction now has a three track configuration as a result of the Minimbah bank third track project. This allows loaded trains to exit the branch without needing to find a slot between loaded mainline trains. Accordingly this junction is now highly efficient.

Camberwell Junction was upgraded to high speed turnouts in conjunction with the Nundah bank third track project, though the speed on the balloon loop limits the practical speed.

Mt Owen Junction has slow speed turnouts. However, the volume from Mt Owen means that its junction does not have a significant impact on capacity.

Newdell and Drayton Junctions have been upgraded with high-speed, low maintenance turnouts. While this was primarily maintenance driven, the speed upgrade means that these junctions are now highly efficient.

With the strong growth of coal volume from both the Ulan and Gunnedah basin lines, the junction of these two lines at Muswellbrook will come under increasing pressure.

3. Signal clearance times depend on the length and speed of trains, so there is no single absolute number for actual signal spacing.

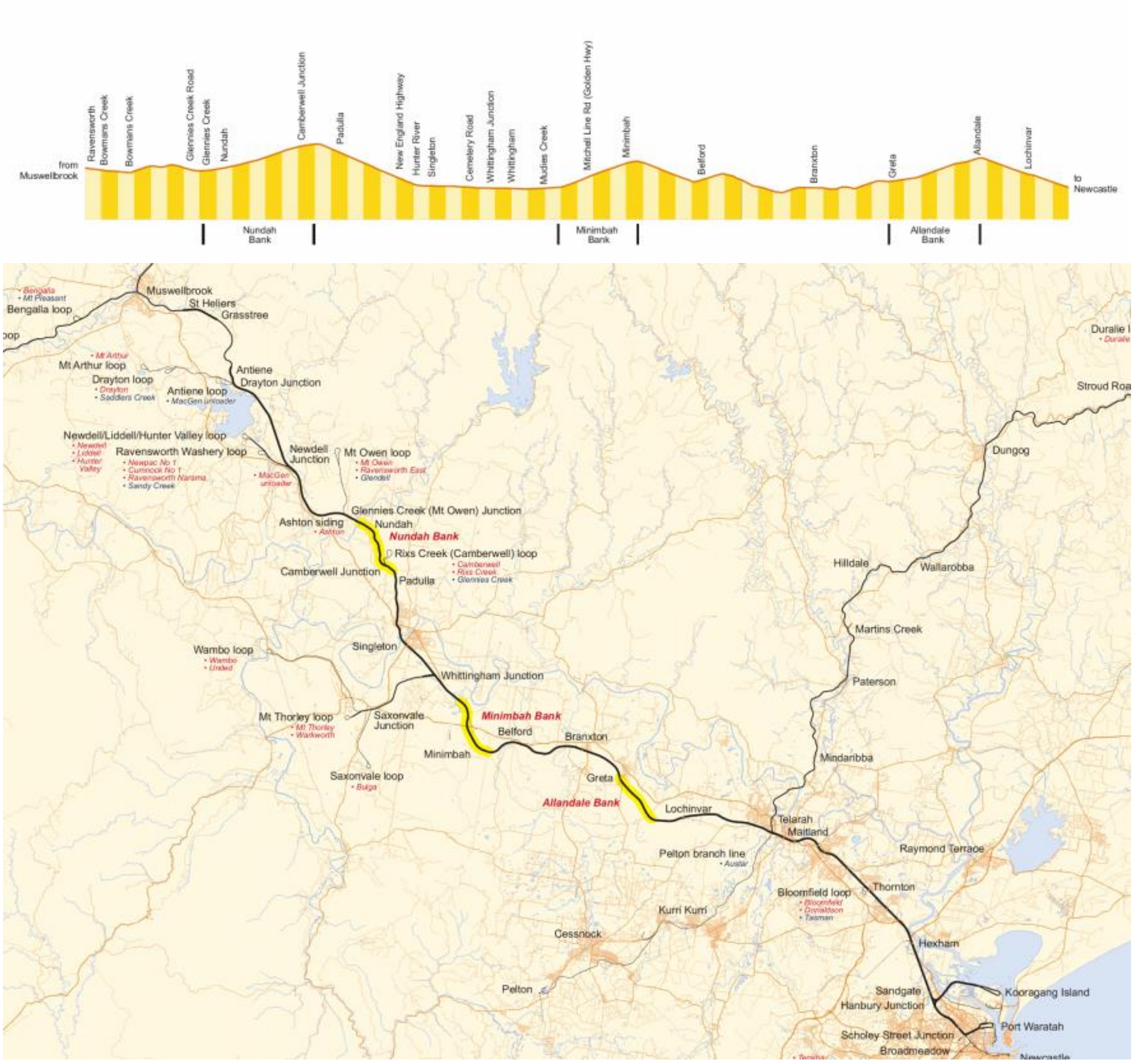


Figure 11 - The Nundah, Minimbah and Allandale Banks.

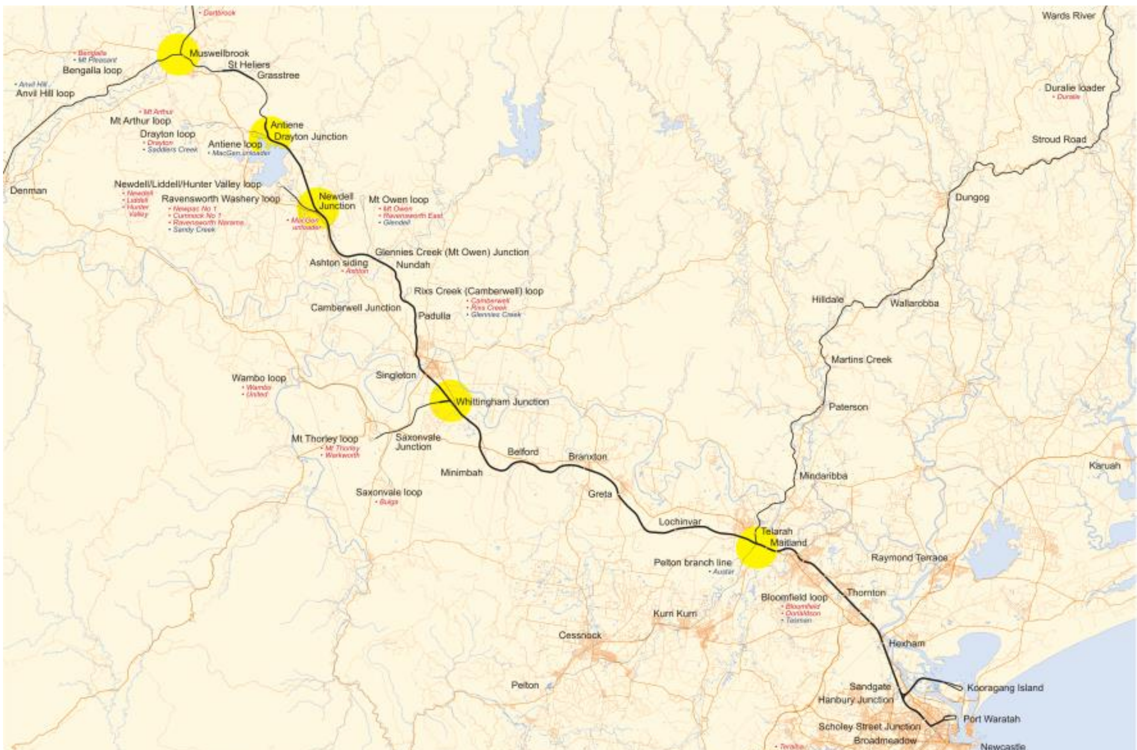


Figure 12 - Maitland, Whittingham, Newdell, Drayton and Muswellbrook Junctions

Ravensworth loop, which was integrated into the Newdell loop, was separated in 2013 and given a new junction with high-speed turnout at approximately the 259.9 km point, along with a holding loop.

A key issue for efficiency at the terminal is the need for the dump stations to receive a continuous flow of trains. When the flow of trains at the dump station is interrupted, this creates a direct unrecoverable loss of coal chain capacity, except to the extent that maintenance downtime of the terminal infrastructure can be aligned to the rail side disruption. A critical consideration for the coal chain as a whole is therefore maximising the continuity of trains rather than simply total track capacity.

The following sections discuss in turn each of the major projects arising from the need to address these issues:

Muswellbrook Junction

In the medium term, the continuing growth from both the Ulan and Gunnedah basin lines means that the capacity of the at-grade junction at Muswellbrook will come under pressure. The 2011 Strategy included a discussion that noted that for the then indicatively contracted volumes:

- Southbound trains are likely to be delayed around 20% of the time for an average of 6 minutes.
- Northbound trains are likely to be delayed around 16% - 20% of the time for an average of 10 minutes.

It noted that while these levels of delay are material, they do not reach a level where they are likely to have a major negative impact on capacity, or the efficient operation of the coal chain, and that on this basis it would be possible to do nothing at Muswellbrook for contractual volumes.

However, it also noted that the HVCCC had floated the concept of having some holding / re-sequencing capacity in the vicinity of Muswellbrook and recommended that further assessment of options be undertaken, including the feasibility of a long-standing concept to bypass Muswellbrook by connecting the Drayton branch to the Ulan line in the vicinity of Bengalla.

The 2012 Strategy noted that both the Muswellbrook Junction third track and Muswellbrook Bypass options had had further analysis undertaken on them and that the best solution for the Muswellbrook Junction Third Track involved building a new track mostly on the Up side. Due to track geometry issues this would need to extend to the 286.3 km point, giving a third track of approximately 2.6 km standing room.

Further options, including a flyover in Muswellbrook, and duplication of both the Ulan line between Muswellbrook and Bengalla and the Gunnedah line between Muswellbrook and Koolbury, have been assessed, and it has been concluded that the option of a Third Track heading east from Muswellbrook offers the best operational outcome and value for money.

As noted in the 2011 Strategy, the level of congestion at Muswellbrook, while material under contracted volumes, is tolerable, and the work done to date would suggest that all of the solutions are only worth pursuing once volume growth, and hence congestion, approach a level where a solution is unavoidable. This threshold was nominally set at 130 mtpa, which equated to approximately 45 paths/day. Given the increase in average train size and changes to volume forecasts this threshold is anticipated to now not be reached until after 2023 under the prospective volume scenario.

As discussed in Chapter 3, HVCCC undertook modelling during 2013 that suggested there may be a need for a holding track at Muswellbrook assuming that trains arrive at Muswellbrook at random but there are only a limited number of fixed paths on the Ulan and Gunnedah lines. Dynamic pathing may be a solution to this, but it as yet an unproven technology and as a contingency measure ARTC will, as recommended by the HVCCC, take a proposal to the RCG to continue work on the Muswellbrook project.

Muswellbrook—Drayton Signal Headways

Signal headways on the Muswellbrook—Drayton section are currently as high as 16 minutes based on the double-green principle. Under the prospective volume scenario this headway will only limit capacity from 2023 onwards.

A concept assessment was undertaken of options to address this headway constraint with the objective of achieving 8 minute headways. This would then allow a consistent path pattern from Muswellbrook to the port terminals.

This analysis concluded that due to the rising gradient encountered by loaded trains an 8 minute headway would only be possible by construction of a third track or with ATMS.

A 14 minute headway is the best achievable with a conventional signalling solution on its own. However, this is largely dictated by differentials in speed and hence braking capability of different train types. If non-coal freight trains are limited to a lower speed it would be possible to achieve either 12 minute or 10 minute headways with a conventional signalling solution.

On this basis the preferred way forward is to pursue a 12 minute headway. While this does not allow an 8 minute pattern of trains from Muswellbrook, it will allow for an 8 minute pattern from Drayton with 2/3 paths able to start from Muswellbrook based on a 24 minute repeating pattern and a 4 minute dwell for trains from Muswellbrook when they are approaching Drayton.

As previously noted, ARTC is now proposing to progress ATMS as the base case for future planning. The implementation of ATMS will eliminate the need for conventional signalling and hence negates the need for this project.

Drayton—Whittingham Bi-directional Signalling

The 2012 Strategy identified that there was increasing pressure for the bi-directional signalling of the Drayton – Whittingham section (the balance of the Muswellbrook—Mailtand corridor is already bi-directionally signalled). This is primarily driven by the growing pressure on maintenance, with maintenance demands growing as volume increases, while the tonnage loss from the same amount of maintenance possession time is also increasing with train frequency. The proposed timing of the project equated to a volume of approximately 63 trains / day.

However, ARTC has now implemented from 2014 an alternative maintenance strategy whereby all renewals and capital tie-ins take place during six major shutdowns per year. This new regime will be monitored and it may allow the requirement for further bi-directional signalling to be deferred.

Bi-directional functionality would largely be achieved by installation of ATMS and the decision to plan on the basis of ATMS means that the need for projected is likely to be negated.

Drayton—Whittingham Signal Headways

The Nundah Bank Third Track project was completed in late 2012 and cleared the Newdell—Whittingham section for 10 minute headways.

The 2012 Strategy indicated that to achieve an 8 minute headway it may be necessary to extend the Nundah Bank third track toward Singleton as well as undertaking some re-signalling.

A concept assessment of the requirements for this section to achieve 8 minute headways concluded that it would not be necessary to extend the Nundah Bank third track. However, there will be some requirement for re-signalling to reduce the headway in some locations between Drayton and Whittingham. It is important to note that this applies in both the Up and Down directions. It is also important to note that this approach will require coal trains to pass a key signal on Nundah bank under full power even when it is at yellow. This approach would be technically acceptable as loaded coal trains are travelling at around 20 km/h at this point and would still have adequate ability to stop if the following signal was red. However, this solution breaches the double-green principle and will therefore require further investigation with rail operators before a solution is confirmed.

At the time of the 2012 Strategy it was anticipated that any re-signalling would be undertaken in conjunction with the installation of bi-directional signalling between Drayton and Whittingham, to ease the impact of track possessions and achieve cost synergies. However, the new maintenance regime (discussed above) may make the bi-directional signalling unnecessary. The Nundah—Whittingham re-signalling has therefore been split out of the bi-di project and the two projects will be assessed separately.

It would be desirable to implement 9 minute headways once train numbers at Whittingham Jct exceed an average of 80 per day. However, it is now anticipated that ATMS will be rolled out before this threshold is reached, negating the need for this conventional signalling solution.

Minimbah Bank Re-signalling

The 2013 Strategy identified that trains can operate to an 8-minute headway on Minimbah bank provided they alternate between the Up Main and Up Relief and two additional signals are provided on the Up Main to close up the signal spacing.

Minimbah bank has a tonnage signal on the Up Main that ensures a train does not get onto the bank unless it has a clear run to the top of the bank. This applies to the Up Main due to its 1 in 80 grade but not the Up Relief, which has a 1 in 100 grade. This solution would retain the tonnage signal.

Better than 10—minute headways are desirable south of Whittingham Junction in Q1 2020. However, it is now anticipated that ATMS will be rolled out before this threshold is reached, negating the need for this signalling solution.

Branxton—Greta Third Track

The 2012 Strategy identified that it may be necessary to complete the Third Track between Branxton and Greta as part of the works to achieve a consistent 8 minute double-green headway.

Detailed analysis of headways has found that it will not be necessary from a headway perspective. There was also a question as to whether the merging of the Main and Relief tracks at Branxton will create undesirable delay. However, the approach developed as part of the concept assessment provides for trains to alternate between the Up Main and Up Relief to achieve 8 minute headways on Minimbah bank. Trains should therefore remerge at Branxton in a regular pattern provided all coal trains operate at a consistent speed.

Farley—Maitland and Maitland Junction

The primary issues at Maitland are related to the maintenance of the old slow-speed turnouts and accordingly the primary focus in the past has been the most effective way to replace these turnouts with low-maintenance high-speed units. Leveraging this renewal to increase capacity by improving train speeds and reducing crossing conflicts has been a secondary consideration, but the 2012 Strategy noted that under the prospective volumes it may be desirable to review the junction arrangement. The primary objective of a reconfiguration would be to ensure that conflicts between Up coal services and Down non-coal services, which conflict to the west of Maitland, can be efficiently managed.

A concept assessment of the Farley—Maitland section has been undertaken and has identified that the most effective option would provide for a bi-directional third track between Farley and Maitland, which would allow both Up and Down non-coal trains to stand waiting for a path q without blocking the flow of coal trains. Analysis to date has found that the path benefits of the reconfiguration are relatively modest and that the main benefit would be experienced in live-run. However, at this stage there has

Project Name	Contracted Volumes	Prospective Volumes
Muswellbrook Junction	Note 1	Note Required
Muswellbrook - Drayton Re-signalling	-	Note Required
Drayton - Whittingham Bi-Di	-	Note Required
Drayton—Whittingham re-signalling	-	Note Required
Minimbah bank re-signalling	-	Note Required

Table 5 - Muswellbrook—Maitland Projects, timing under different volume scenarios

Note 1— ARTC continues to develop an alternative to the relief hub at Muswellbrook.

Figure 13 - Muswellbrook—Terminal Projects

6

Terminals, Congestion and System Issues

Context

The Hunter Valley coal industry is serviced by three coal loader terminals, PWCS Carrington (CCT), PWCS Kooragang Island (KCT) and NCIG Kooragang Island. While the coal loaders are owned by Port Waratah Coal Services (PWCS) and the Newcastle Coal Infrastructure Group (NCIG), most of the track in and around the terminals is leased by ARTC and all train operations are controlled by ARTC.

The Carrington loader is the oldest of the facilities and is located in the highly developed and constrained Port Waratah yard area, with extensive rail facilities servicing a variety of activities. This includes steel products for OneSteel, grain for the GrainCorp loader, ore for the Pasminco loader, general freight through Toll / R & H Transport and other minor customers. There are also locomotive and wagon servicing and maintenance facilities.

The Carrington coal facilities include 3 arrival roads and 2 unloaders. While there are nominally 10 departure roads, these range in length from 414 metres to 863 metres, all of which are shorter than all coal trains, other than the short trains used for Pelton services. Only two of the 3 arrival roads can accommodate 80 wagon and longer trains.

The Carrington facility has an environmental approval limit of 25 mtpa. There is some opportunity to expand this slightly, though there may be environmental challenges in doing so.

PWCS Kooragang Island is better configured for modern rail operations. However, while it now has 9 departure roads for its four dump stations , there is only one arrival road for each dump station. As a result, trains need to queue on the mainline before being called forward into the arrival road as the preceding train moves through the dump station.

Provisioning and inspection activity, which had contributed to congestion, has been moved out of the departure roads. Departure road No 3, which had been dedicated to PN use as a provisioning road, has now been acquired by ARTC and extended to become an additional dedicated departure track.

Aurizon has also discontinued all provisioning and maintenance activities on Kooragang Island. Locomotives are instead shuttled between Kooragang and Port Waratah and this is expected to continue until its Hexham provisioning facility is constructed in late 2014.

With the opening of KCT dump station four (DS4), PWCS nameplate capacity as a whole is 143 mtpa.

NCIG has also completed all works required to achieve nameplate capacity of 66 mtpa, other than the flyover of the Kooragang branch at NCIG Junction, which will eliminate conflicts between loaded NCIG trains and empty trains from KCT. NCIG now has three arrival roads for its two dump stations.

ARTC's objective in its infrastructure strategies has been to provide track capacity ahead of demand. ARTC is in a good position to assess the track capacity required and to identify optimised solutions and timing to provide that capacity.

There are, however, a number of operational challenges that potentially constrain capacity and for which the provision of additional track is one potential mitigation. 'Congestion' has become a common term used to describe these challenges, which include re-sequencing, provisioning, crew changes, brake tests, roll-by inspections, empty train holding and the management in general of peaks and troughs caused by the demand profile. These challenges are whole-of-chain issues that ARTC has not been in a good position to model and for which it has looked to the HVCCC to take the lead through its analysis of system capacity.

In seeking to mitigate congestion it is important to understand that these 'congestion' issues are system issues for which additional rail infrastructure is one option to enable the full capacity of the rail network to be realised. Equally, delivering improvements to network operations to ensure that utilisation of the network is optimised offers other potential solutions. Infrastructure solutions can offer a high degree of confidence in the outcome but usually require a much longer lead time than operational solutions.

ARTC has provided commentary on the congestion issues in the Capacity Strategies over a number of years. Congestion has remained a dominant issue in coal chain capacity modelling and for 2014 the congestion issues again resulted in the HVCCC declared inbound throughput falling short of contracted volumes.

HVCCC has nominated a number of projects to deal with the congestion issue and ARTC has been working with the HVCCC on concept assessments of these projects for consideration by the RCG. The focus has primarily been in relation to the challenges of managing empty trains given variability in the task, and constraints on train arrivals due to train speeds into KCT.

Finally, any future development of T4 would push the double track corridor between Hexham and the terminals toward its limits. To accommodate the full T4 potential volume of 120 mtpa it would be necessary to provide at least an additional track for arriving trains. Notwithstanding that PWCS has now deferred T4, this Strategy retains the overview of the options for a third track between Hexham and Kooragang.

Hexham Holding Roads

Past Capacity Strategies have highlighted analysis that found that a four track re-sequencing facility at Hexham was desirable to be able to manage disruption for volumes above 180 mtpa. It also noted that the number of trains out of sequence had been estimated to increase by 55% as a result of the 15% increase in volume in going from 180 mtpa to 208 mtpa and that in recognition of this it would be desirable to take advantage of the space available to construct a fifth holding track.

The RCG approved construction of a five track facility at Hexham in 2013 and construction of this project is now progressing rapidly. It will sit between the Up and Down coal roads and will only be accessible from the Up. The design allows for future use as a crew change facility but the physical works are not included in the approved scope. The facility is opposite the proposed Aurizon provisioning facility but does not have any operational interaction with it.

KCT Arrival Roads

Past HVCCC modelling found that the current configuration of the KCT arrival roads is not capable of processing the required volume of trains and is a major constraint on current volumes. Both permissible and observed speeds contribute to the issue.

The primary causes of the low speeds appear to be crew changes at the throat of the terminal (K3 signal) delaying trains, and the appropriate speed of trains in a yard environment, where drivers need to use discretion as to an appropriate speed given the conditions.

HVCCC has proposed that there should be the ability to hold four trains in parallel before the KCT arrival roads. ARTC developed concept designs for such an arrangement. However, the site constraints are significant and it became apparent that four parallel tracks would be a very high cost project with a long lead time due to the necessary environmental approvals.

As outlined in the 2013 Strategy, ARTC effectively split the project into three stages. Stage 1, which was completed in 2012, was a minor reconfiguration that allowed for two tracks to split 650 metres sooner. Stage 2 would extend this arrangement by a further 1000 m, which would allow two trains to be held in parallel in advance of the arrival roads. Stage 3 would provide for all four tracks to effectively be extended to allow 2 trains to be held clear in each arrival road.

Stage 2 can be done without the need to move the Jemena gas main that runs parallel to the track. ARTC has been able to create a design that achieves the required functionality, but with some compromises on the normal design standards. The design achieves a cost of less than $30 m, which would allow it to be constructed under a Review of Environmental Factors.

Provision of the full four track arrangement would require relocation of the gas pipeline and further encroaches on the wetlands. This stage would be a $130m project and would need approval under an Environmental Assessment, which is likely to have a minimum two year approval timeframe.

The 2013 Strategy discussed the issue of train speeds on the arrival roads and that ARTC would be undertaking further work on the extent to which improved signalling might mitigate the requirement for additional arrival roads.

This analysis has led to the KCT Arrival Roads Signalling Optimisation (ARSO) project. The project essentially provides for the full signalling of the arrival roads so that drivers have signal indications rather than relying on sight of the track ahead to handle their train in a safe manner.

A further project called Hexham to Kooragang re-signalling will complement the above work when coupled with the Hexham Holding Road project.

ARTC's expectation, which has been reinforced by consultation with train operators, is that the signalling will lead to a significant increase in train speed on the arrival roads. There is already a significant differential in average train speed between operators and it is expected that the project will, at a minimum, bring all operators up to the same level.

Crew changes was the other issue identified in the 2013 Strategy that were contributing to the low average speed into the arrival roads. ARTC has been working with operators on train crewing generally and crew changes at KCT specifically and is confident that the practice of crew changes at the K3 signal will cease in conjunction with the ARSO project, ensuring that the full benefits of the signalling works are achieved.

HVCCC recently undertook a new round of modelling of the operation of the KCT and NCIG terminals incorporating the effect of managing the re-sequencing of trains at Hexham. This new modelling concluded that stage 2 of the arrivals roads was not required until volumes reach around 195 mtpa and that stage 3 would not be required unless incremental capacity enhancements are pursued at KCT.

KCT Departure Roads

The HVCCC previously identified that to address congestion there was a need for eight to ten clear departure roads at KCT, at least two for each dump station (including dump station 4, then under construction). This physical infrastructure recognised that despite a focus on train departure compliance to plan a significant proportion of departures exceeded the target of departure within one hour of plan.

KCT originally had six departure roads, though one of these was used by PN for provisioning. As part of the DS4 project, PWCS constructed an additional three departure roads, of which one was to become the future exit track for T4. With the completion of the DS4 project, there are, therefore, the required eight departure roads.

During 2013 ARTC acquired departure road No 3 from PN and has now reconfigured the junction for this track to give an additional clear departure road. This will increase the number of clear departure roads to nine.

ARTC had also developed an initial concept to extend cripple roads 3 and 4, which are on the inside of the KCT balloon loop, to give an additional two departure roads (nominally called Departure Roads 7 & 8), which would deliver a total of 11.

HVCCC modelling concluded that these two tracks would not make a material difference to system throughput if built as departure tracks. This project has therefore been placed on hold. However, they do remain as options for construction as train park-up (discussed below) and will be further considered in that context.

Down Relief Hubs

An issue that was first highlighted in the 2012 Strategy is empty train management. This issue is essentially one of what to do with empty trains while they await departure for their next outbound trip. This wait can either be a matter of minutes, or at the extreme, a period of days, particularly when there is a major close-down.

On a day-to-day basis, the key issue is that there is regularly a mismatch between the time a train becomes available for its next trip and the time that that train can depart given path constraints (particularly on the single track sections), load point constraints, coal availability constraints and limitations on which load points a train type / operator can service.

To ensure that the departure roads at KCT and NCIG are kept clear to allow trains to dump, the HVCCC has set a target that all trains should depart within one hour. Essentially the issue that arises is where these trains go to if there is no load point ready to receive them.

HVCCC identified a proposal for a number of down relief hubs to address this issue. Since the 2012 Strategy, the primary focus has been on:

- Drayton Down Relief Hub, which is a single holding track adjacent to the mainline immediately before the Drayton Branch and connecting directly to both the mainline and the Drayton branch.
- Whittingham Down Relief Hub, which is a set of up to two holding tracks adjacent to the Whittingham branch somewhere between the junction and the Golden Highway overbridge.

The Drayton facility is now under construction with completion due in Q4 2014. The Whittingham facility has had concept design completed.

The current HVCCC analysis of the Whittingham facility suggests that the marginal benefit of each additional relief track declines significantly. ARTC is awaiting formal advice from HVCCC regarding the benefit of Whittingham before making a firm proposal to the RCG.

Train Park-up

The HVCCC has identified the need for additional train park-up options as among the measures to help address congestion. These options would be for the longer term standing of trains (say, longer than 6 hours), particularly on constrained days when it is preferable to get trains out of the system.

ARTC understands that HVCCC will be soon advising that there is a need for around 5-8 tracks for this year and 2014, rising to 8-10 in future years. A

The preferred configuration of the park-up locations is that they be located close to crew sign-on points, suitable for trains to be stabled un-crewed, and away from possible vandalism.

A preliminary report has been prepared indicating possible locations for train park-up. No further work on train park-up will be progressed until a HVCCC train park-up strategy is finalised.

ARTC has identified locations to construct up to 15 train park-up tracks ranging in cost per track from $8.6 m to $40 m as shown in table 7. The total cost of all 15 tracks would be $300 m. Not all of the options are consistent with the preferred features for a park-up location.

The RCG has previously approved work proceeding on KCT departure roads 7 & 8. These have the potential to be used as either train park-up if they are built in an un-signalled form, or both park-up and short term holding if they are fully signalled.

Hexham – Kooragang Third Track

The 2013 Strategy highlighted that the focus of work on the Hexham - Kooragang Third Track was to determine an optimised signalling solution for both the current and proposed future third track with a view to maximising the capability of the existing infrastructure. This analysis has developed into the Hexham - Kooragang re-signalling project.

A phase 1 analysis of the options for a third track was completed during the year. This analysis considered a number of infrastructure solutions. It is clear though that conventional signalling solutions are likely to provide adequate capacity for current prospective volumes. The decision to treat ATMS as the base case for future project assessment will further defer the need for additional track. On this basis the project Hexham - Kooragang Third Track project is on hold indefinitely. It will be further reviewed if and when a decision is made to restart the T4 project.

Option	Number of Tracks	Estimated Cost	Cost per track	Earliest Commissioning
KCT Departures 7 & 8	2	$ 25.0	$12.5	Q2 2015
Carrington Yard	3	$ 25.9	$8.6	Q1 2018
Bengalla to Mangoola Train 1 extension	1	$ 40.0	$40.0	Q1 2017
Bengalla to Mangoola Train 2 extension	1	$ 24.5	$ 24.5	Q1 2017
Bengalla to Mangoola Train 3 extension	1	$ 35.7	$ 35.7	Q1 2017
Bengalla to Mangoola Train 4 extension	1	$ 24.8	$ 24.8	Q1 2017
Rutherford	2	$ 35.1	$ 17.6	Q1 2018
Pothana Lane	2	$ 34.5	$ 17.3	Q1 2018
Minimbah bank	2	$ 34.5	$ 17.3	Q4 2017
Bylong	1	$ 7.0	$ 7.0	Q4 2015
Farley to Greta	1	$ 15.0	$15.0	Q1 2018

Table 6 - Potential train park-up options

7

Overview of the recommended projects

A summary of the recommended projects for contracted volumes comparing previous and new proposed delivery timeframes, together with estimated costs at a P75[4] level, is shown in Table 7.

Proposed delivery dates have been developed based on the 'required by' timing, recognising the need to manage resource levels, particularly for project commissioning.

Table 8 shows the same detail as Table 7, for the scope of work required for prospective volumes. In Table 8, costs are shown as both un-escalated and escalated based on the 'proposed by' delivery dates.

Projects required for both contracted and prospective volumes are shown in both tables as the timing can vary, though congestion projects only appear in table 7.

ATMS

As noted in Chapter 1, ATMS has the potential to replace a number of signalling projects as well as defer and / or save on the costs of other projects. Of the projects required for prospective volumes it could replace:

- Drayton—Whittingham bi-di
- Drayton—Whittingham re-signalling, and
- Muswellbrook—Drayton re-signalling

4 A P75 value indicates that the project has been assessed as having a 75% probability of being delivered for the identified cost, or less.

Contracted Volume	2013 Strategy – Proposed by	2014 Strategy – Required by	2014 Strategy – Proposed by	Change 2013 Strategy to 2014 Strategy (Proposed)	Estimated Cost ($m, escalated P75)
Port—Muswellbrook					
Nil	-	-	-	-	-
Ulan Line					
Nil	-	-	-	-	-
Gunnedah Line					
30 tonne axle load upgrade	Q1 2015	Q1 2015	Q1 2015	-	$23
Scone reconfiguration	Q1 2014	Q3 2014	Q3 2014	-	$8
Gunnedah Yard Upgrade	Q4 2014	Q1 2015	Q1 2015	-	$19
Congestion Projects					
Port Holding Roads (Hexham)	Q4 2014	ASAP	Q1 2015	-	$163
KCT Arrival Road Signaling Optimisation	New	ASAP	Q1 2015	-	$8
Kooragang Arrival Roads Stage 2	Q3 2015	see note 1	Q2 2016	-	$29
Kooragang Arrival Roads Stage 3	Q2 2016	Not required	Not required	-	-
Drayton Relief Hub	Q1 2015	ASAP	Q1 2015	-	$33
Mt Thorley signaling changes	New	ASAP	Q1 2015	-	$1
Whittingham Relief Hub	Q1 2016	see note 2	Q1 2017	-	$42
Train Parkup - KCT Departure Roads 7 & 8	New	TBD	TBD	-	$25
Train Parkup - Carrington Yard	New	TBD	TBD	-	$26
Kooragang Island CBI	New	Q2 2016	Q2 2016	-	$10
Hexham—Kooragang Re-signalling	New	ASAP	Progressive to Q2 2016	-	$16
Productivity Projects					
ARTC Network Control Optimisation (ANCO)	New	n/a	Q1 2019	-	$30
ATMS	New	n/a	Q1 2020	-	$260

Table 7 - Recommended Projects, Delivery Schedule and Costs for Contracted Volumes

General Notes:

All the above projects (including scope, timing, and funding arrangements) are subject to consultation with and endorsement by the industry.

Dollar estimates are based on current known: Scope; survey and geotechnical knowledge; legislation and tax regimes. Project dollars are order of magnitude estimates only and do not represent concluded project dollars.

The HVCCC has identified other relief hub options that may be progressed subject to further operational and engineering analysis . At this stage the scope of such projects is too uncertain to provide indicative timeframes or costs.

Note 1: Whilst KCT Stage 2 is not strictly required for ARTC contracted capacity, the project is well advanced and HVCCC have indicated it provides other benefits to the system.

Note 2: Awaiting formal advice from HVCCC regarding the status of this project.

Contracted plus Prospective Volume	2013 Strategy – Required by	2014 Strategy - Required by	Estimated Cost ($m) un-escalated 2014, order-of-magnitude	Estimated Cost($m) escalated, order-of-magnitude
Port—Maitland				
Nil	-	-	-	-
Maitland - Muswellbrook				
Minimbah Bank re-signalling	Q1 2020	Not required		
Drayton - Whittingham bi-di	Q1 2019	Not required		
Drayton - Whittingham re-signalling (incl Nundah)	Q1 2020	Not required		
Muswellbrook - Drayton re-signalling	Q1 2020	Not required		
Ulan Line				
Mt Pleasant	Q3 2016	Q1 2021	$23	$27
Mangoola west	Q1 2020	Beyond 2023		
324 km	Q1 2018	Beyond 2023		
337 km	Q1 2019	Beyond 2023		
Baerami west	Q1 2020	Beyond 2023		
Widden Creek	Q1 2016	Q1 2021	$39	$47
Bylong east	Q1 2018	Beyond 2023		
Coggan Creek west	Q3 2021	Beyond 2023		
Gulgong	Q3 2016	Beyond 2023		
Gulgong - Tallawang CTC	Q3 2015	Beyond 2023		
Ulan - Tallawang upgrading	Q3 2015	Beyond 2023		
Gunnedah Basin Line				
Aberdeen	Q4 2014	Q1 2017	$16	$17
Togar North Loop (previously 311km loop)	Q3 2014	Q1 2016	$23	$24
Scone reconfiguration	Q3 2013	Q3 2014	$8	$8
316 km loop (North Scone)	Q1 2020	Beyond 2023		
Wingen loop	Q3 2014	Q1 2016	$23	$24
Blandford loop	Q1 2015	Q1 2017	$32	$34
Pages River—Pages River North	Q1 2020	Beyond 2023		
Kankool—Ardglen	Q1 2016	Q3 2017	$78	$83
Bells Gate south extension	Q1 2016	Q1 2018	$40	$46
407 km loop (Werris Creek South)	Q1 2020	Beyond 2023		
414 km loop (Werris Creek North)	Q1 2018	Q1 2021	$26	$31
South Gunnedah loop	Q1 2015	Q1 2016	$22	$24
Gunnedah Yard Upgrade	Q3 2014	Q4 2014	$15	$15
Collygra	Q1 2015	Beyond 2023		
Dynamic pathing/Mussellbrook relief track (see note 1)	New	Q1 2017	$1	$1
System Projects				
Kooragang Arrival Roads Stage 3	Q2 2016	Q1 2018	$130 m	
Train Parkup	See Table 7	See Table 7	See Table 7	-
Train Re-sequencing		see note 2		

General Notes:

All the above projects (including scope, timing, and funding arrangements) are subject to consultation with and endorsement by the industry.

Dollar estimates are based on current known: Scope; Survey and geotechnical knowledge; legislation and tax regimes. Project dollars are order of magnitude estimates only and do not represent concluded project dollars.

Note 1: ARTC will put a proposal for further analysis of the Muswellbrook options to the RCG, but will continue to progress dynamic pathing as the preferred method for management of the 8mtpa of prospective volume as identified by the HVCCC.

Note 2: ARTC continue to work with HVCCC to identify the requirements for this project

ARTC

8

Network capacity with revised project scope and timing

Demand and capacity by sector, based on the project timings recommended in this Strategy, and using the calculation methodology set out in Chapter 1, is shown in figures 15, 16 and 17. These charts show both contracted and prospective volumes.

Saleable coal train capacity and coal tonnage capacity by sector for the contracted volume scenario is shown in tables 10 and 11 respectively. Tables 12 and 13 show the equivalent information for prospective volumes, for train numbers and tonnage respectively.

The HVAU also requires that the Capacity Strategy provide details of net capacity - that is, total capacity less contracted coal and non-coal volumes. This is shown in general in figures 15, 16 and 17. It is not possible to provide both total capacity and net capacity by line section as this would allow volume by load point to be back solved.

To give an indication of net capacity table 9 provides net capacity for 3 key line sections for contracted volumes and is intended to complement figures 15, 16 and 17.

Net Capacity (paths)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Pricing Zone 3 (at Werris Creek)	2.4	5.6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Pricing Zone 2 (at Bylong)	6.1	3.3	1.9	1.9	1.9	1.7	1.7	1.7	1.7	1.7
Pricing Zone 1 (at Whittingham)	42.9	37.1	31.0	31.0	30.4	29.6	29.1	29.1	29.1	29.1

Table 9 - Surplus coal path availability (total capacity less contracted volume) for indicative line sectors for each zone.

	2014				2015				2016				2017				2018				2019			
Narrabri - Boggabri	6.4	6.4	6.4	6.4	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Boggabri - Gunnedah	10.6	10.6	10.6	10.6	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
Gunnedah - Watermark Jct	11.5	11.5	11.5	11.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
Watermark Jct - Caroona Jct	17.5	17.5	17.5	17.5	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Caroona Jct - Werris Creek	14.3	14.3	14.3	14.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Werris Creek - Scone	13.7	13.7	13.7	13.7	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Scone - Dartbrook	11.7	11.7	11.7	11.7	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
Dartbrook - Muswellbrook	26.8	26.8	26.8	26.8	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6
Cobbora - Ulan	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Ulan - Moolarben	19	19	19	19	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Moolarben - Wilpingjong	19	19	19	19	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Wilpingjong - Bylong	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Bylong - Ferndale	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Ferndale - Mangoola	22	22	22	22	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Mangoola - Mt Pleasant	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Mt Pleasant - Bengalla	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Bengalla - Muswellbrook	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
Muswellbrook - Antiene	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
Antiene - Drayton	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
Drayton - Newdell	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81
Newdell - Mt Owen	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
Mt Owen - Camberwell	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
Camberwell - Whittingham	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
Whittingham - Maitland	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
Maitland - Bloomfield	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149
Bloomfield - Hexham	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149

Table 10 - Saleable capacity in coal train numbers (round-trips per day) for contracted volume

	2014				2015				2016				2017				2018				2019			
Narrabri - Boggabri	13.8	13.8	13.8	13.8	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Boggabri - Gunnedah	22.9	22.9	22.9	22.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
Gunnedah - Watermark Jct	24.9	24.9	24.9	24.9	26.6	26.6	26.6	26.6	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3
Watermark Jct - Caroona Jct	37.9	37.9	37.9	37.9	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Caroona Jct - Werris Creek	30.9	30.9	30.9	30.9	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1
Werris Creek - Scone	29.7	29.7	29.7	29.7	28.9	28.9	28.9	28.9	33.2	33.2	33.2	33.2	34.3	34.3	35.1	35.1	47.6	47.6	47.6	47.6	47.6	47.6	47.6	47.6
Scone - Dartbrook	25.2	25.2	25.2	25.2	28.1	28.1	28.1	28.1	32.4	32.4	32.4	32.4	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3
Dartbrook - Muswellbrook	58.0	58.0	58.0	58.0	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
Cobbora - Ulan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulan - Moolarben	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9
Moolarben - Wilpingjong	56.6	56.6	56.6	56.6	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4
Wilpingjong - Bylong	51.9	51.9	51.9	51.9	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8
Bylong - Ferndale	43.4	43.4	43.4	43.4	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3
Ferndale - Mangoola	65.8	65.8	65.8	65.8	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6
Mangoola - Mt Pleasant	61.9	61.9	61.9	61.9	61.8	61.8	61.8	61.8	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9
Mt Pleasant - Bengalla	62.0	62.0	62.0	62.0	61.9	61.9	61.9	61.9	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0	62.0
Bengalla - Muswellbrook	168	168	168	168	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
Muswellbrook - Antiene	130	130	130	130	139	139	139	139	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
Antiene - Drayton	260	260	259	259	274	274	274	274	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275	275
Drayton - Newdell	229	229	228	228	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238	238
Newdell - Mt Owen	328	328	327	327	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340	340
Mt Owen - Camberwell	252	252	251	251	261	261	260	260	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261
Camberwell - Whittingham	255	255	254	254	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262	262
Whittingham - Maitland	258	258	257	257	268	268	267	267	268	268	268	268	268	268	268	268	268	268	268	268	268	268	268	268
Maitland - Bloomfield	416	416	415	415	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432	432
Bloomfield - Hexham	397	397	396	396	412	412	412	412	413	413	413	413	413	413	413	413	413	413	413	413	413	413	413	413

Table 11 - Saleable capacity in tonnes for contracted volume

	2014				2015				2016				2017				2018				2019			
Narrabri - Boggabri	6.4	6.4	6.4	6.4	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Boggabri - Gunnedah	10.6	10.6	10.6	10.6	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3	9.3
Gunnedah - Watermark Jct	11.5	11.5	11.5	11.5	9.5	9.5	9.5	9.5	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0
Watermark Jct - Caroona Jct	17.5	17.5	17.5	17.5	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Caroona Jct - Werris Creek	14.3	14.3	14.3	14.3	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Werris Creek - Scone	13.7	13.7	13.7	13.7	10.4	10.4	10.4	10.4	11.9	11.9	11.9	11.9	12.3	12.3	12.6	12.6	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1
Scone - Dartbrook	11.7	11.7	11.7	11.7	10.1	10.1	10.1	10.1	11.6	11.6	11.6	11.6	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1	23.1
Dartbrook - Muswellbrook	26.8	26.8	26.8	26.8	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6	24.6
Cobbora - Ulan	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Ulan - Moolarben	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Moolarben - Wilpingjong	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Wilpingjong - Bylong	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
Bylong - Ferndale	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6	14.6
Ferndale - Mangoola	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Mangoola - Mt Pleasant	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Mt Pleasant - Bengalla	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Bengalla - Muswellbrook	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5	61.5
Muswellbrook - Antiene	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7	47.7
Antiene - Drayton	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4
Drayton - Newdell	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9	80.9
Newdell - Mt Owen	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115
Mt Owen - Camberwell	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9
Camberwell - Whittingham	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9	87.9
Whittingham - Maitland	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4	92.4
Maitland - Bloomfield	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149
Bloomfield - Hexham	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149	149

Table 12 - Saleable capacity in coal train numbers (round-trips per day) for prospective volume

	2014				2015				2016				2017				2018				2019			
Narrabri - Boggabri	13.8	13.8	13.8	13.8	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6
Boggabri - Gunnedah	22.9	22.9	22.9	22.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
Gunnedah - Watermark Jct	24.9	24.9	24.9	24.9	26.6	26.6	26.6	26.6	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3
Watermark Jct - Caroona Jct	37.9	37.9	37.9	37.9	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6	44.6
Caroona Jct - Werris Creek	30.9	30.9	30.9	30.9	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1
Werris Creek - Scone	29.7	29.7	29.7	29.7	28.9	28.9	28.9	28.9	33.2	33.2	33.2	33.2	34.3	34.3	35.1	35.1	47.6	47.6	47.6	47.6	47.6	47.6	47.6	47.6
Scone - Dartbrook	25.2	25.2	25.2	25.2	28.1	28.1	28.1	28.1	32.4	32.4	32.4	32.4	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3	64.3
Dartbrook - Muswellbrook	58.0	58.0	58.0	58.0	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6
Cobbora - Ulan	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ulan - Moolarben	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9	57.9
Moolarben - Wilpingjong	56.6	56.6	56.6	56.6	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.4	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3	56.3
Wilpingjong - Bylong	51.9	51.9	51.9	51.9	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.8	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7	51.7
Bylong - Ferndale	43.4	43.4	43.4	43.4	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3
Ferndale - Mangoola	65.8	65.8	65.8	65.8	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.6	65.5	65.5	65.5	65.5	65.4	65.4	65.4	65.4	65.3	65.3	65.3	65.3
Mangoola - Mt Pleasant	61.9	61.9	61.9	61.9	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.8	61.7	61.7	61.7	61.7	61.6	61.6	61.6	61.6
Mt Pleasant - Bengalla	62.0	62.0	62.0	62.0	61.9	61.9	61.9	61.9	62.0	62.0	62.0	62.0	61.9	61.9	61.9	61.9	61.8	61.8	61.8	61.8	61.7	61.7	61.7	61.7
Bengalla - Muswellbrook	168	168	168	168	180	180	180	180	180	180	180	180	180	180	179	179	179	179	179	179	179	179	179	179
Muswellbrook - Antiene	130	130	130	130	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139	139
Antiene - Drayton	260	260	259	259	274	274	274	274	274	274	273	273	273	273	273	273	273	273	273	273	273	273	273	273
Drayton - Newdell	229	229	228	228	238	238	238	238	238	238	238	238	237	237	237	237	237	237	237	237	237	237	237	237
Newdell - Mt Owen	328	328	327	327	340	339	339	339	339	339	339	339	339	339	339	339	338	338	338	338	339	339	339	339
Mt Owen - Camberwell	252	252	251	251	260	260	260	260	260	260	260	260	260	260	260	260	259	259	259	259	260	260	260	260
Camberwell - Whittingham	255	255	254	254	262	262	262	262	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261	261
Whittingham - Maitland	258	258	257	257	268	267	267	267	267	267	267	267	267	267	267	267	267	267	267	267	267	267	267	267
Maitland - Bloomfield	416	416	415	415	432	432	432	432	431	431	431	431	432	431	431	431	431	431	431	431	432	432	432	432
Bloomfield - Hexham	397	397	396	396	412	412	412	412	413	413	413	413	414	414	414	414	404	404	404	404	405	405	406	406

Table 13 - Saleable capacity in tonnes for prospective volume

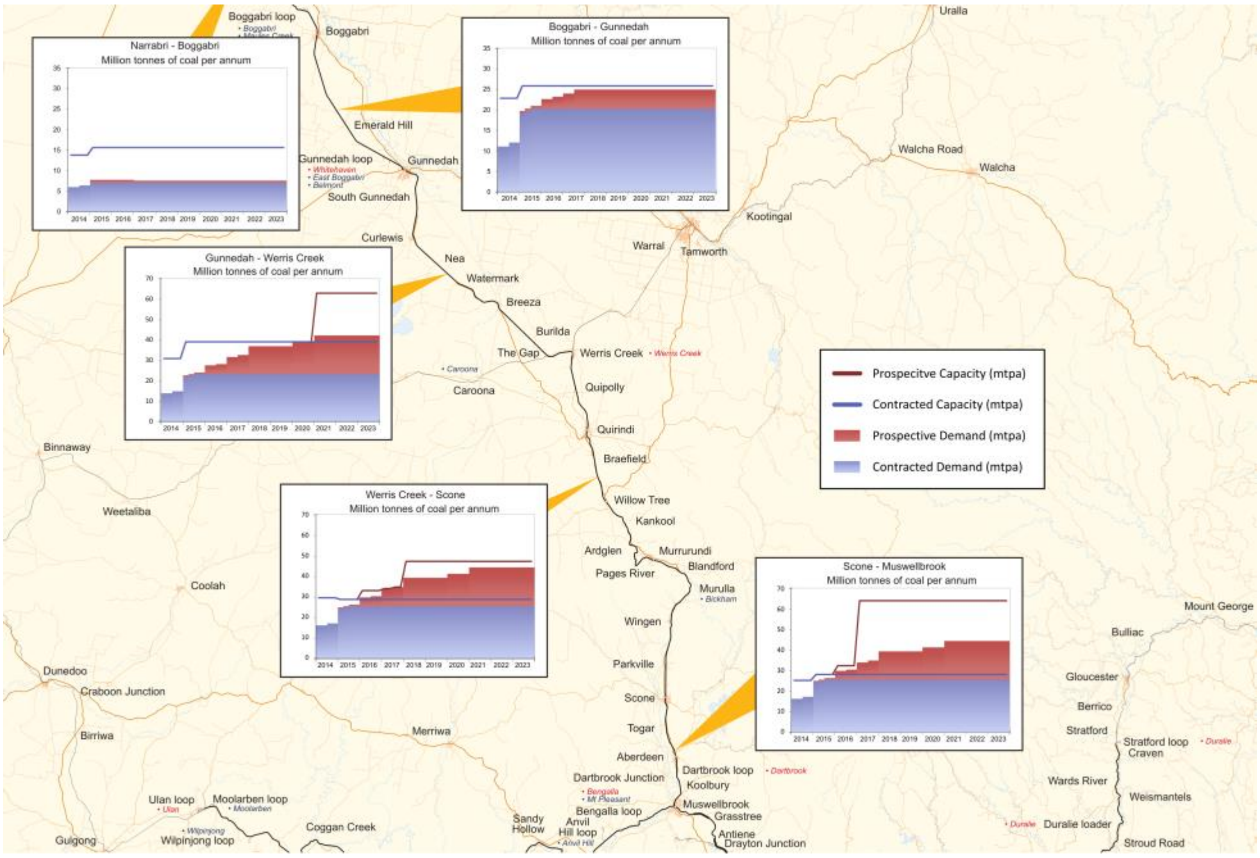


Figure 15 - Volume and capacity on the Gunnedah basin line.

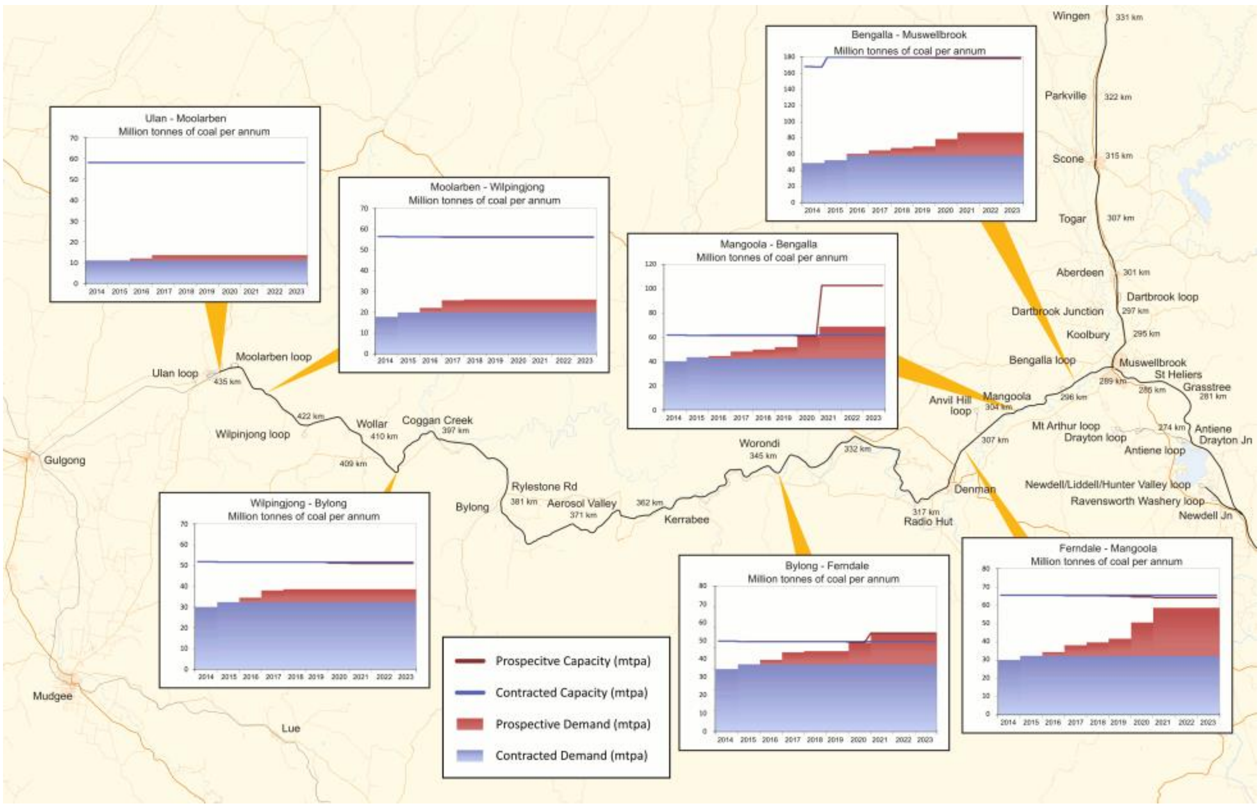


Figure 16 - Volume and capacity on the Ulan line

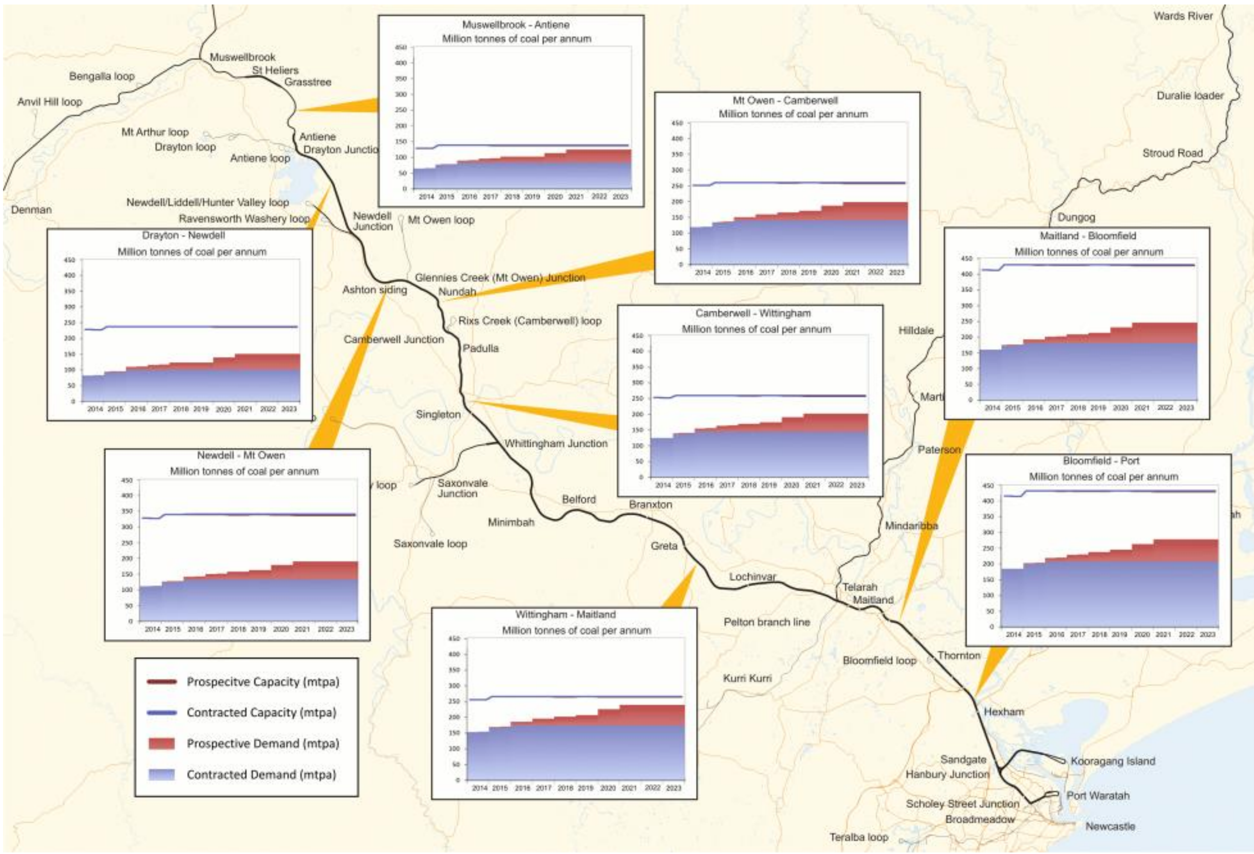


Figure 17—Volume and capacity Muswellbrook—Newcastle

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