2016-2025 Hunter Valley Corridor Capacity Strategy

September 2016

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Page 30 - Henry Owen, Pages 23 & 33 - Michelle Delaney
Front Cover and Pages 1 & 27 - ARTC

1 Introduction

Context

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 2016—2025 Hunter Valley Corridor Capacity Strategy (the "Strategy") is the tenth of these annual strategies. It updates the 2015 - 2024 Hunter Valley Corridor Capacity Strategy (2015 Strategy).

The Hunter Valley rail network (figure 1) is an integral part of the world's largest coal export supply chain. It 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, and a shared single track with passing loops from that point north and west.

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

In common with the earlier strategies, this Strategy 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). It also identifies those projects that would be required to accommodate prospective volumes that have not yet been the subject of a contractual commitment, though this is a hypothetical scenario only and does not imply that those volumes will be contracted.

This Strategy identifies a preliminary scope of work to accommodate contracted plus prospective volumes of up to 254 mtpa. This is a reduction in the peak volume compared to recent previous years, reflecting current market conditions. Notwithstanding this, there remains a clear pathway to achieving the peak volumes in the 280—290 mtpa range identified in previous Strategies.

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.

Capacity analysis in this Strategy takes 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 hunter Valley Coal Chain Coordinator (HVCCC).

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.

Responding to Changing Needs

ARTC and its Hunter Valley customers have recently completed a period of significant capital investment in the rail network infrastructure to service increased contracted export coal volumes. With the consolidation of the investment phase, there is an increasing focus on rail network operating efficiencies to reduce overall supply chain operating costs. ARTC is in a unique position to provide services and develop initiatives with its supply chain partners to create value for its customers.

Underpinning this phase will be the introduction of new processes and technology to optimise ARTC's train network management in the Hunter Valley through enhance dynamic capability to manage variation.

This will involve ensuring that the ARTC Network Control Optimisation (ANCO) project encompasses a whole of supply chain focus, and improves the transfer and transformation of information across stakeholders to allow for an increase in economies of flow for the Hunter Valley.

ARTC anticipates that system improvements, and in particular ANCO, will deliver significant benefits. Reflecting the changing needs of the coal chain and the increased emphasis on operations, this Strategy has expanded its coverage of these issues.

Volume Forecasts

Currently contracted export coal volumes are 190.9 mtpa in 2016. They are essentially stable at approximately this level until they start to decline in 2024, falling to 167.9 mtpa in 2025. ARTC contracts on a rolling 10 year “evergreen” basis and producers are choosing to not roll-over some volume. This volume is not being replaced by new volume contracts.

Contracted volumes include up to 9.5 mtpa of domestic coal.

In addition to contracted volumes, ARTC, in consultation with the HVCCC, has identified new mines

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

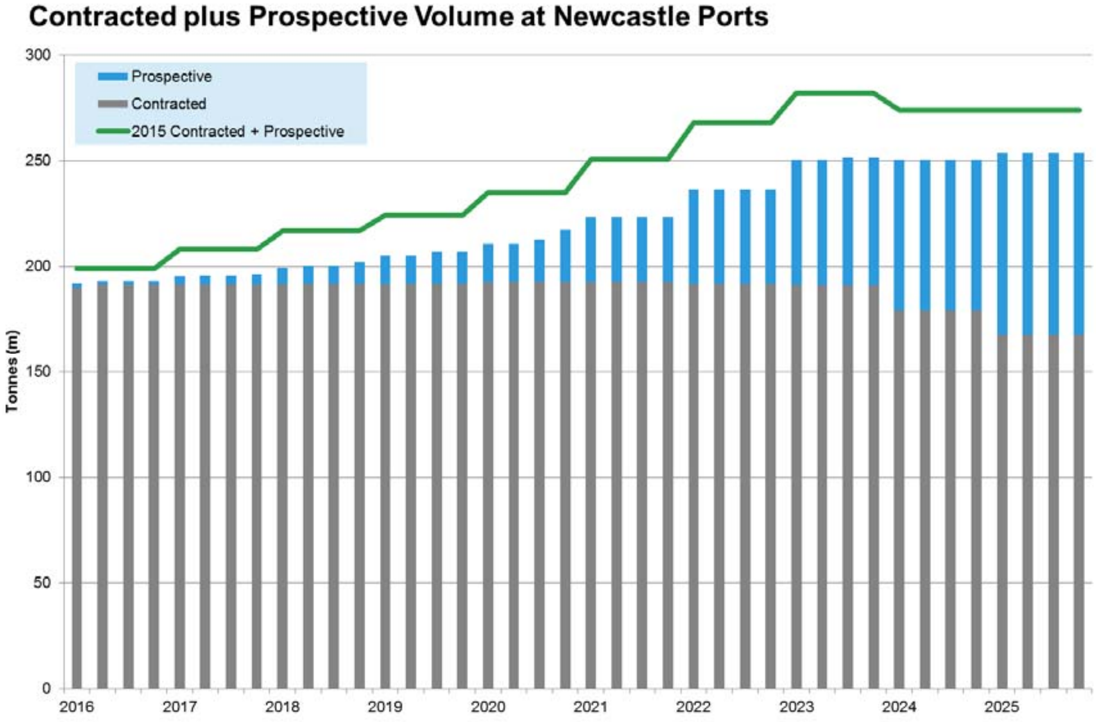


Figure 2 - Current Volume Forecasts vs. 2015 Strategy Volume Forecast, Newcastle Terminals (mtpa)

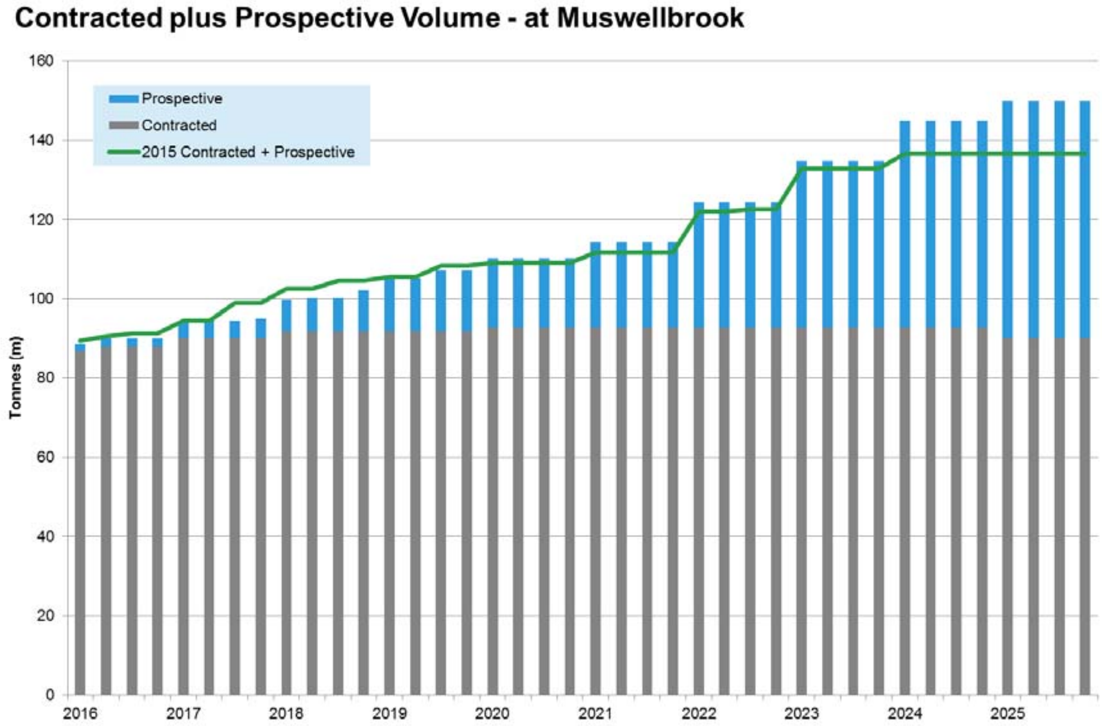


Figure 3 - Current Volume Forecasts vs. 2015 Strategy Volume Forecast, Muswellbrook (mtpa)

that producers could develop and existing mines where volumes could potentially grow. These projects have not proceeded to a stage where producers have any expectation of committing to take-or-pay contracts, but to ensure that ARTC is able to plan appropriately for possible future growth are considered in this Strategy as a prospective volume scenario. One new prospective mine was identified for this year's Strategy, West Muswellbrook. There are a total of 11 undeveloped mines in the prospective volumes.

Under the provisions of the ARTC 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 the HVCCC and rail operators. An initial

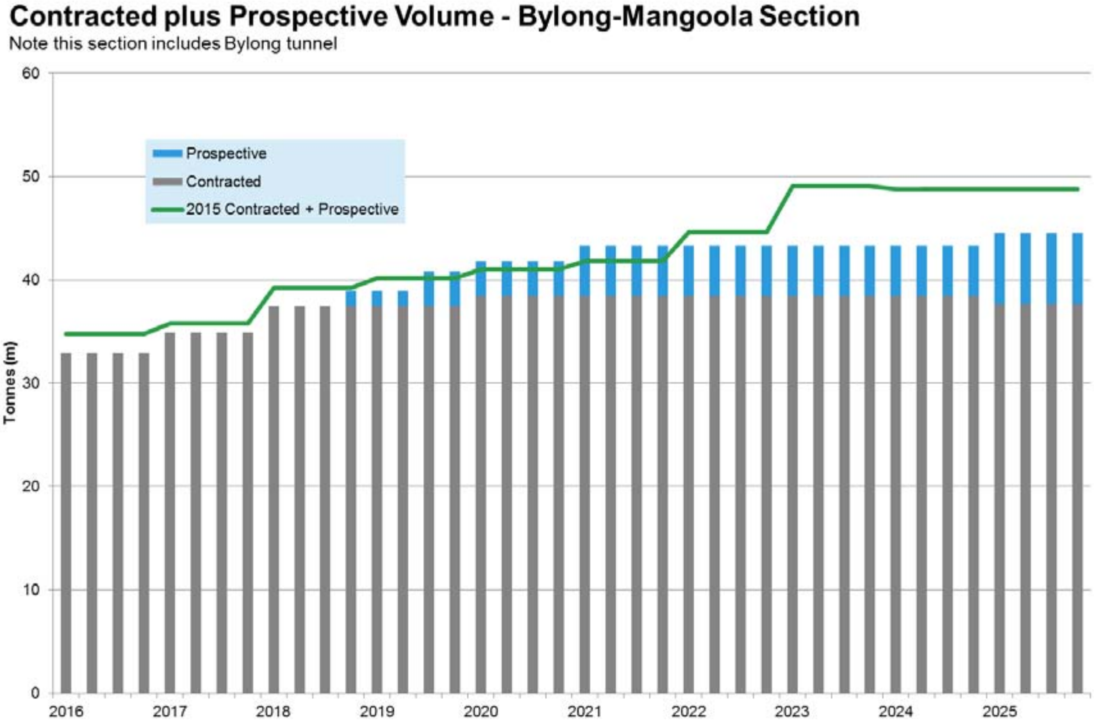


Figure 4 - Current Volume Forecasts vs. 2015 Strategy Volume Forecast, Bylong—Mangoola (mtpa)

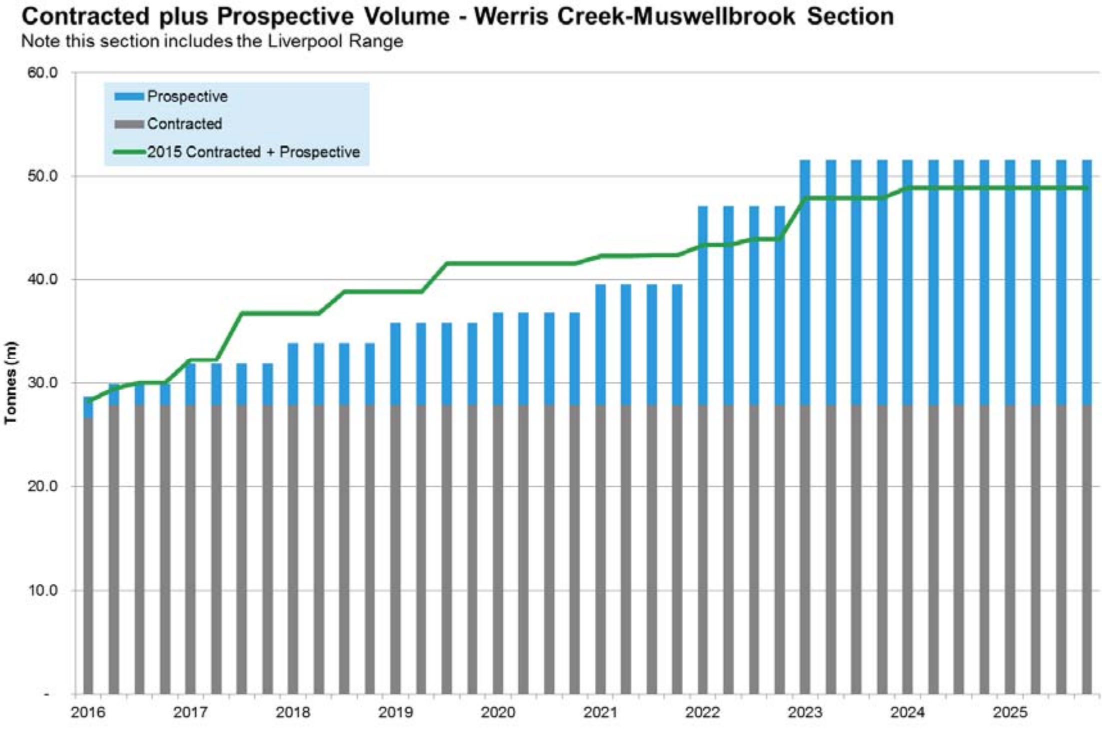


Figure 5 - Current Volume Forecast vs. 2015 Strategy Volume Forecast, Werris Creek—Muswellbrook (mtpa)

proposal for prospective volumes was provided to the April RCG meeting and subsequently approved following some minor adjustments.

The prospective volumes adopted are hypothetical and have been used for modelling purposes with no firm commitment that the prospective volumes will be realised. Prospective volume is estimated at around 2.0 mtpa in 2016, 4.5 mtpa in 2017, 8.8 mtpa in 2018, 14.4 mtpa in 2019, 20.3 mtpa in 2020, 30.9 mtpa in 2021, 44.4 mtpa in 2022, 59.9 mtpa in 2023, 71.3 in 2024 and 85.8 mtpa in 2025.

These prospective volumes are similar to those adopted last year. The reduction in peak total volume reflects the decision of some producers to not roll-over contracts for existing volumes as part of the 10 year rolling contract arrangement.

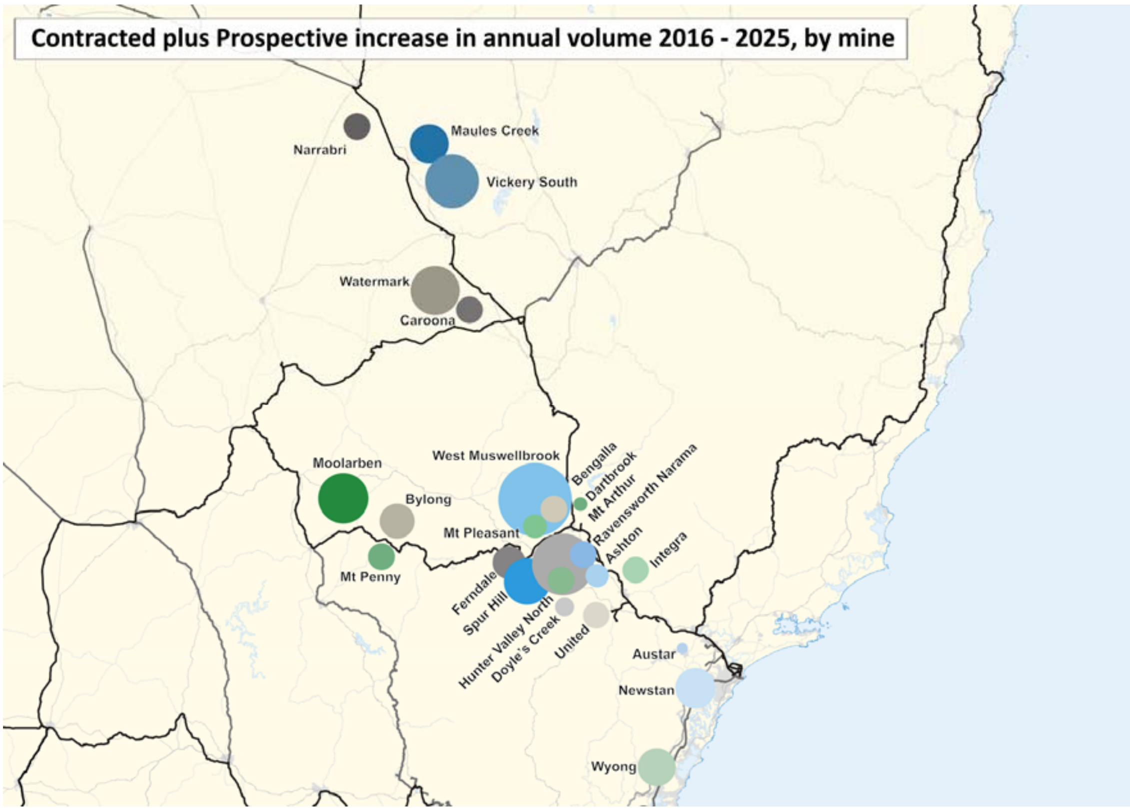


Figure 6 - Volume forecasts by mine, contracted plus prospective. Note that growth is represented by diameter

Figures 2 to 5 compare the forecast volumes from the 2015 Strategy with the forecasts used for this Strategy. A comparison is made at the Newcastle terminals, 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). Figure 6 shows net growth under the prospective scenario geographically, while figure 7 shows train numbers by zone. These figures highlight the ongoing transition of volume to the north and west of Muswellbrook.

How this Strategy has been developed

The development of this Strategy retains the methodology of the 2015 Strategy.

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

- The RCG, which is the official approval body representing access holders under the HVAU, has endorsed 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 terminal capacity alignment.
- Additional consultation has been undertaken with the HVCCC on system issues.

In common with 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 the '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

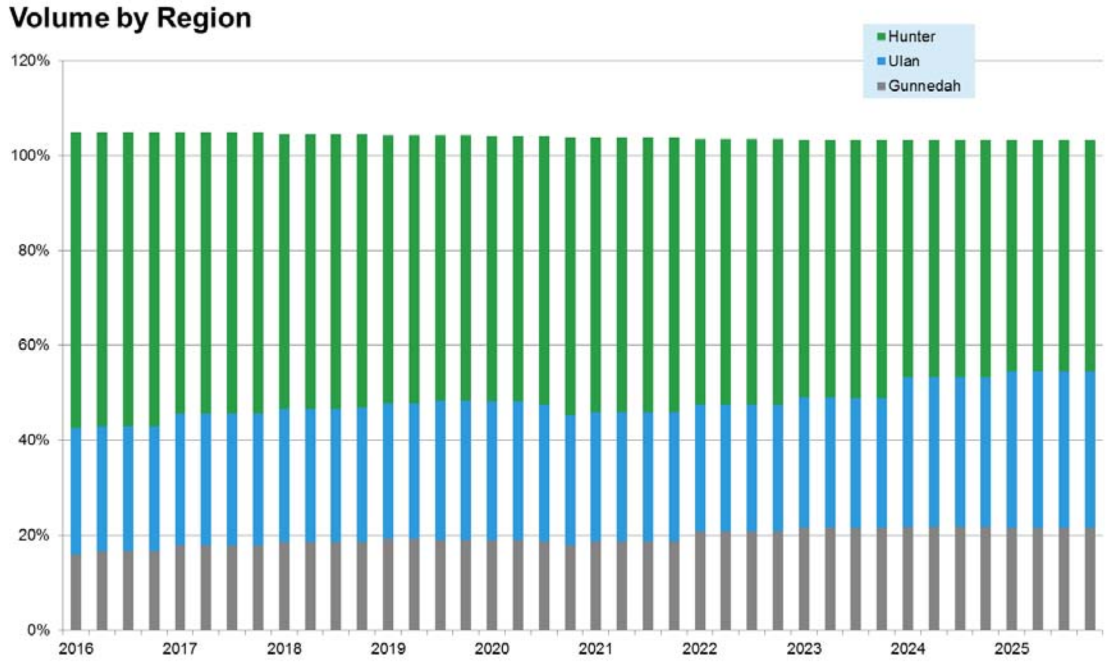


Figure 7 - Percentage of Trains by Sub-Network by Year, including prospective volume (see Note 1)

Note 1: Total train numbers in figure 7 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.

3 minutes where a passing lane or the start of double track is involved.

After removing capacity lost to non-coal trains, recognising the different performance characteristics of those trains, saleable paths are calculated as a percentage of practical coal paths. This adjustment covers maintenance, cancellations and a buffer.

Consistent with the ARTC 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.

The consequent calculation of the adjustment factor, based on cancellation and maintenance loss assumptions as determined by the HVCCC for 2016, 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.

Adjustment factor	2015	2016
Cancellations	8.0%	8.0%
Maintenance	9.7%	11.5%
TMTC	10.0%	10.0%
Adjustment Factor	**76.7%**	**75.5%**

Table 1 - Adjustment Factor

The adjustment factor of 75.5% used in this Strategy is 1.2 percentage points less than used in the 2015 Strategy, meaning that the modelled capacity of the network has reduced slightly.

Ideally this 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 Strategy is based on the HVCCC estimates of cancellations and maintenance losses for 2016.

For this Strategy the estimated cancellations rate remains unchanged at 8.0%, which equates to the 7.4% loss rate as per the 2016 DIT assumptions released by the HVCCC. It is expressed as 8.0% as it is applied as an escalation rather than a reduction. The increase in the effective maintenance loss from 9.7% to 11.5% reflects a slight change in the HVCCC calculation methodology.

Headways in past Capacity Strategies have been based on the simulated performance of the dominant train type. This approach allows a high level of granularity to assess the effect of adding new loops or other changes to the network. In the case of the Gunnedah Basin it also allowed the performance of the 30 tal trains to be assessed in advance of their introduction.

With the implementation of the ARTC's digital train radio system, ARTC now has access to a large data set of actual train performance at a reasonable level of granularity. During the past year techniques have been developed to analyse this data to provide better quantification of actual performance. This involves interpolation of the data to 50 metre intervals and cleansing it to remove the effects of trains stopping and temporary speed restrictions.

Train performance developed on this basis has been adopted for the purposes of the Gunnedah Basin capacity analysis in this 2016 Strategy. The effects of this are discussed in more detail in Section 3.

It is intended that this methodology will be extended to other parts of the network in future years.

Terminal Capacity

ARTC's understanding of terminal 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). The T4 project was granted planning approval on 30 September 2015. However, it is understood that there is no immediate intention to proceed to construction. There is also a prospect of modest increases in terminal capacity in advance of T4. For the purposes of this Strategy it has been assumed that incremental capacity could be available in 2018 and that T4 could start to ramp up in 2020. This is the same as the assumption in the 2015 Strategy, but with the ramp-up delayed by one year. With current volume forecasts there is no requirement for any additional terminal capacity before 2020.

The relationship between contractual volumes, prospective volumes as endorsed by the RCG, and potential terminal capacity as assumed for this Strategy, is shown in Figure 8.

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 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.

The HVCCC also makes an annual declaration of the system capacity of the Hunter Valley coal chain. This is the lesser of terminal capacity, rail capacity and demand. Terminal and rail capacity are determined through simulation modelling.

For 2016, the HVCCC determined a declared inbound throughput (DIT) that was less than track system capacity. HVCCC has forecast that track system capacity will not constrain currently contracted rail volumes.

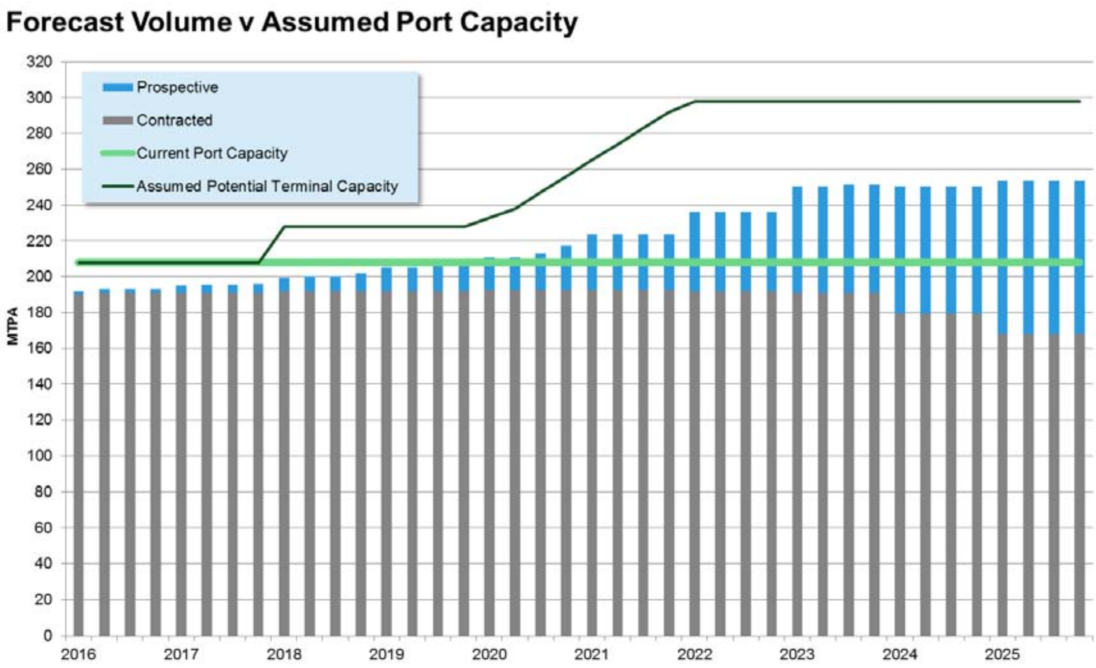


Figure 8 - Forecast volume at Newcastle Port compared to assumed port capacity (mtpa)

2

Operational and System Opportunities

Context

Operational and system opportunities have become increasingly important as the coal chain moves out of its growth phase and optimising efficiency within the constraints of the existing infrastructure becomes a key focus. Increasing efficiency provides the platform for the Hunter Valley to maximise its competitive advantage within the global export coal market.

The Hunter Valley coal chain is built around the need to feed coal into the three export terminals owned by Port Waratah Coal Services (PWCS) and Newcastle Coal Infrastructure Group (NCIG). These two terminal managers run to different operational modes. PWCS, which provides approximately 65% of export capacity, utilises a pull based system assembling discrete cargoes to meet vessel arrivals. NCIG, responsible for the remaining 35% of export capacity, operates largely on a push based system with a large percentage of its stockpiling capability allocated to dedicated storage for individual customers.

Operational planning and live-run coordination is undertaken by the HVCCC. The daily schedule is constructed by the HVCCC to achieve coal deliveries in accordance with the Cargo Assembly Plan (CAP). Execution of the plan is optimised through real time decision making undertaken in accordance with principles and protocols agreed by the industry.

ARTC is actively engaged with the HVCCC, rail operators and other supply chain partners in working together to review planning and operational processes to reduce waste and to identify opportunities to improve operational performance. This includes extensive consultation on ANCO and ATMS.

Rail 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 North Coast line to Stratford is 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).

Train lengths vary from around 1,250 metres to 1,572 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.

Weighted average coal capacity per train was 8,110 net tonnes in 2015. This compares to a figure of approximately 7,819 net tonnes in 2014. Average train size as contracted with ARTC is 7,987 tonnes in 2016. Figure 9 shows the historical growth in average train size and the current contracted train sizes at the Newcastle terminals for the period forecast in the Strategy. While the Strategy is based on the contracted train sizes, ARTC expects that in practice there will be a continuing increase in average train size, though probably not to the same extent as the growth over the past five years.

At the 2016 Hunter Valley system capacity declared by the HVCCC, an average of around 60 loaded trains need to be operated each day, or one train every 24 minutes.

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 and are assumed to be, on average, loaded to 98% of their theoretical capacity.

The coal chain is supported by a captive rail fleet operated by four above-rail operators: Pacific National (PN); Aurizon; Freightliner (as the operator in a joint venture with Glencore) and; Southern Shorthaul Railroad (SSR).

While rail operations are dominated by coal arriving from the north, coal also arrives at the terminals from a number of smaller mines to the south of Newcastle, and in recent times in increasing volumes from mines in the Lithgow and Southern Highlands areas. This traffic operates on the Sydney Trains 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.

Although there are no identified capacity issues, the timetabling requirements of trains accessing the Sydney network provides operational challenges that have the potential to impact on the Southern Coal trains as they work in with the variability of the unloading events at the Newcastle coal terminals.

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

Operational Improvement Initiatives

ARTC is actively engaged in multiple initiatives with its supply chain partners including:

- Regular improvement forums focused on operational practices and interfaces.
- Continuous review and improvement of the corridor shutdown program.
- Continued assessment of maintenance practices.
- Developing and refining train planning and management principles.
- Reviewing and updating ARTC's operational safety and incident management and business continuity plans.

Crew change management, and Gunnedah basin train flow are three of the regular improvement forums currently underway.

The Crew Change Improvement project is focused on the alignment of the operational practices of all relevant supply chain stakeholders to ensure that crew relief events occur at the right locations to support system flow and that these changes are managed to a low safety risk.

In Q4 2015 ARTC along with rail operators in the Gunnedah Basin coal chain began a dedicated operations forum to work together in identifying opportunities for improving throughput by drilling into the root cause of issues that were identified as having a negative impact on train flow from the region. This work has resulted in the ability to plan more cycles into the Gunnedah Basin and deliver record tonnages to the Newcastle Terminals. This work will continue over the course of 2016 and the learning's that enable efficiency gains will be incorporated into "business as usual" processes.

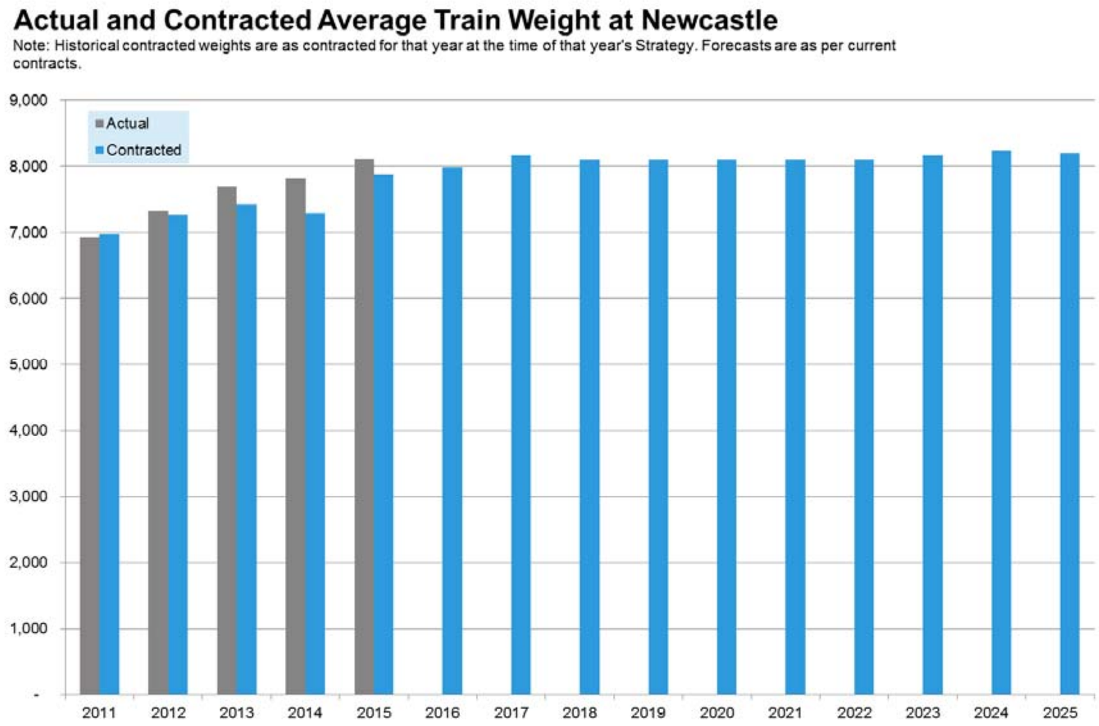


Figure 9 - Average Train Capacity under Contracted Volumes (tonnes)

The corridor shutdown program is under continuous review and improvement. A recent focus has been the incorporation of previously unutilised network locations (such as passing loops) to allow an optimal mix of loaded and unloaded train stowage locations across the network. The aim is to minimise the losses in the lead in and lead out periods of network shutdowns. This is particularly important to those areas at the extremities of the network, where historically trains have been stowed in excess of 24hrs prior to the major network shutdowns.

ARTC has been working with the above rail operators through a process of risk assessing and trialling identified locations. Although in its early days, the program has already allowed for the stowage of loaded and unloaded trains at new and more efficient locations on the network during major shutdowns in the first half of 2016. This work will continue through the remainder of 2016 to identify and risk assess additional suitable network locations to provide even greater flexibility to limit losses around major shutdowns.

Balancing customer and other stakeholder requirements with maintenance needs is a key focus of the continued assessment of maintenance practices and the associated possessions process. The process needs to respond to market conditions, and align the need for track based inspections and physical maintenance interventions with the actual condition of the asset to ensure the forecast customer delivery requirements.

Development, refinement and implementation of train planning and management principles is a key mechanism for optimising performance. ARTC is pursuing targeted data-driven, operational improvement initiatives with the active management of empty (down) trains a key current project as discussed below.

Empty (Down) Train Management

A particular issue for volatility 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.

At present, the operation of down trains is not subject to highly active management. The HVCCC plans to a target that all trains ideally depart within one hour of their unloading event. However, within this target actual train operations are relatively ad hoc and depend on the decision making of drivers and train controllers with limited coordination. Furthermore, while the objective of keeping departure roads clear is valid in general, in the event that an empty train isn't blocking unloading, occupying a departure road for longer may be a better outcome for the system as a whole.

The Live Run Integration Team are working through this issue with the affected stakeholders to implement a set of agreed principles that have been developed to improve operating performance in this area. It is proposed that the down departure sequence will in future be set with the following principles guiding the process:

- Principle 1: Maintain Discharge Events. To ensure consistent flow in and out of the terminals.
- Principle 2: Maintain Load Events. To ensure consistent flow in and out of constrained and/or load points subjected to heavy demand.
- Principle 3: Manage to the Constraints of the Day. By considering constraints impacting off-plan trains to support system flow requirements.
- Principle 4: Live Run Execute to Plan. A process to execute efficient train departures.

These principles are listed in no particular order. The principles are equally weighted and no individual principle takes precedence over another. The application of the principles may vary as it is dependent on the state of coal chain operations at any given time.

Ultimately the aim is to manage all trains through their complete journey in such a way as to maximise the system efficiencies thereby minimising both the number of train sets required and the demand on the infrastructure. Development of these principles for optimisation of operations in the down direction to provide for more active decision making and coordination is an important step in that direction.

ANCO & ATMS

While the current operational improvement initiatives will enhance ARTC's ability to provide efficient product delivery and meet customer expectations, the vast majority of improvement opportunities lie in the day to day operational decision making processes. There is a lack of real time, overall network visibility and an inability to dynamically consider alternative scenarios and assess the potential flow-on impacts. This often results in localised optimisations rather than optimisation to deliver maximum performance for the supply chain as a whole. To address this gap and deliver a step change in supply chain performance, ARTC has embarked on two significant projects, ANCO and ATMS.

The ANCO project is ARTC's initiative to introduce new processes and technology to improve and optimise train network management in the Hunter Valley over the coming years. ANCO aims to deliver a more synergistic and coordinated approach to decision making. Underpinning this project will be real time data feeds across organisations (including train forecast times based on live operational information) and the capacity to manage disruption through optimised scenario testing.

ANCO will combine planning information and context with real time performance data to predict outcomes and dynamically adjust the train plan. This will realise:

- More efficient train management;
- System decision making aligned to our customers' coal movement priorities;
- Potential to reduce peak loading and congestion on the network;
- Increased visibility and integration between above rail, network control, terminal operations and asset delivery teams;
- Automation of manual processes in network management; and
- More efficient management of disruption events through the ability of decision makers to access automatically generated scenarios.

By increasing the efficiency of both train planning and execution, ANCO will enable improved utilisation of the available track capacity, reduced cycle times and a supply chain which is more responsive to customers' dynamic needs.

Planned elements of the project include:

- Dynamic pathing: Provision of a detailed daily rail schedule reflecting all occupations, including track maintenance.
- Train management execution: Automatic route setting and clearing, and issuing of movement authorities, allowing train controllers to focus on train flow.
- Disruption prediction: Monitoring of potential disruption in live run and using dynamic pathing to adjust the plan to minimise time and throughput losses.
- Infrastructure monitoring: Continuous monitoring of track infrastructure health to maximise availability.
- Integration with the Advanced Train Management System.

Dynamic pathing is of particular significance for the determination of track capacity. As discussed elsewhere in this Strategy, ARTC applies principles in determining capacity that make allowance for variations and unknowns. In particular, the 65% utilisation factor on single track is intended to deal with issues like uncertainty around actual train performance, temporary speed restrictions and manual decision making in the execution of crosses as well as the natural constraints on the efficiency with which train crosses can be timetabled. Dynamic pathing will enable these factors to be considered dynamically, effectively eliminating the need for additional contingency in the train plan. This creates potential for improved utilisation of available track capacity.

Ultimately, the key benefit of ANCO is that it will allow the daily train plan and live run execution to be optimally aligned with system and customer requirements. This alignment, when combined with the capability of the ATMS system, will allow for management of trains to ensure maximisation of efficiency in train flow.

ANCO is currently in the feasibility phase and as a major technology project, it will necessarily be a multi-year initiative. The implementation plan for ANCO will target delivery of the greatest value over a progressive timeline, with a particular focus on quick wins in live run operations. ARTC is committed to working with its supply chain stakeholders to ensure that ANCO is fully aligned with the needs and activities of all service providers.

The second initiative, the Advanced Train Management System (ATMS) being developed by ARTC, is highly synergistic with ANCO.

Since 2001, ARTC has been closely following developments in safeworking technology. ARTC is of the view that the next generation of train safeworking technology will be a key enabler in meeting the future requirements of the rail network.

ATMS is a communications based safeworking system that will allow much of the lineside signalling infrastructure to be removed. It provides the control, location accuracy and intervention ability to allow trains to operate at closer headways than is possible today.

The key basic principles that ATMS is built on are:

- A robust, reliable, digital communications backbone;
- Minimal field based infrastructure;
- 'Open' systems architecture;
- Flexibility and scalability; and
- An ability to support the operation of trains at safe braking distance intervals rather than by the traditional fixed block method of train working.

ATMS will provide significantly upgraded capabilities to the ARTC network, including the Hunter Valley. It will support ARTC's objectives of improving rail network capacity, operational flexibility, train service availability, transit times, rail safety and system reliability.

Importantly, it will enforce its track movement authorities through its ability to directly apply the train brakes in the event of any projected breach of permitted operations. This eliminates the risk of trains travelling beyond a safe location or overspeeding. It has a target of less than one safety critical failure per 100 years. This is achieved through a combination of the high safety integrity levels of individual elements, cross-checking vital information between the elements,

ATMS also provides full contextual information to network controllers and train drivers. This will give much greater network visibility and support better decision making.

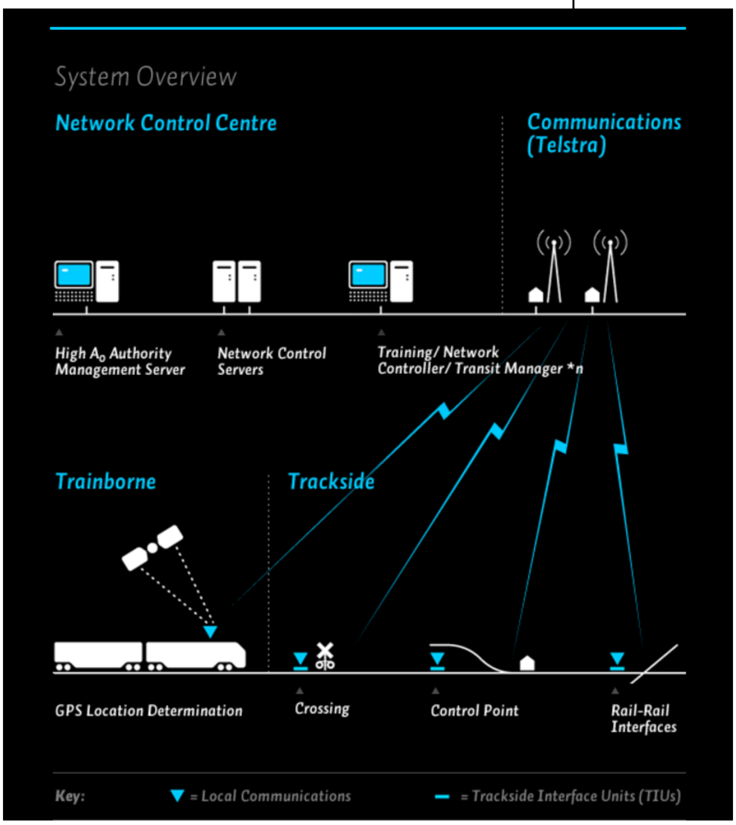
ATMS provides bidirectional working on all track. This gives flexibility in planning train movements around possessions, allowing track maintenance to happen more quickly with less impact on traffic. Train controllers will also have the ability to allow work on track to commence immediately after the passage of a train and to allow it to continue until shortly before a train arrives at a worksite, thereby giving larger work windows and improving productivity.

The bi-directional capability also gives more options in managing trains of differing priorities or performance, by providing more routing options. This will further increase capacity and reduce delays.

The combination of ANCO and ATMS has the capability to significantly reduce direct human intervention in train operations. This will increase the predictability and reduce the variability of the rail network, while optimising operations both for efficiency of utilisation of the network and to meet customer requirements.

These improvements will materially increase the potential rate of utilisation of the track. On the single track sections in particular, it should be possible to lift the effective rate of utilisation from the current 65%. While the exact utilisation that can be achieved would need to be determined through analysis once the systems are better developed, and refined based on performance following implementation, it would not be unreasonable to target 75% utilisation as a realistic expectation of what could be achieved in the new environment.

Even higher rates of utilisation may be feasible. However, it also needs to be recognised that as utilisation increases, so does delay. The rate of increase in delay will increase faster than the rate of increase in utilisation, as trains are forced to dwell longer waiting for their turn on highly congested sections. As such, ATMS and ANCO will increase the potential capacity of any given section of track. Whether it is desirable to take advantage of that increase in capacity will depend on future assessments to optimise the total cost to producers of rail operations.



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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 (NSW Trains services to and from Scone and Moree / Armidale) and a proportionately high level of grain, cotton and flour train activity. This non-coal traffic is up to seven trains each way between Narrabri and Scone, and 10 trains each way per day south of Scone.

There are currently four coal origins along the route, at Turrawan, Boggabri, Gunnedah and Werris Creek. The currently closed Dartbrook mine, just north of Muswellbrook, was recently sold and there are proposals for it to be reopened.

Three major new Gunnedah basin mines are included in the prospective scenario: Vickery South, Caroona and Watermark. Vickery South is assumed to load in the vicinity of Gunnedah. It is understood that Watermark will load from a new load point north of Breeza, at approximately 443.5 km. The Caroona mine was assumed to load from a balloon loop connecting to the Binnaway line, which runs west from Werris Creek. Immediately prior to the release of this Strategy it was announced that the mining licence for this mine had been sold back to the NSW Government and that the mine would not be proceeding.

Liverpool Range

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.

Operational modelling assumes the following principles for the bank engines:

- There will be two sets of bank engines available at all times. Pacific National and Aurizon currently provide one set each.
- A train requiring banking will not have to wait for a bank engine.
- The attachment process will take 10 minutes to complete before the train will recommence its journey.
- Once the train has cleared Ardglen the bank engine will return to Chilcotts Creek in the shadow of a down train so as not to consume any additional network paths.
- Kankool loop will be used for the crossing of the returning bank engines to avoid any delay to a train in the up direction.

ARTC is working with rail operators to actively manage the banking process and work through any identified issues that have the potential to impact on the productivity of the line.

Train Performance and Capacity Utilisation

Section 1 commented on a new methodology for calculating actual train performance using the ICE train radio system. In this 2016 Strategy, this methodology has been adopted for the Gunnedah Basin capacity analysis rather than the previous approach of using simulated train performance.

In general the simulated performance was found to have;

- Underestimated the performance of a train on an uphill grade when loaded and overestimated the performance on a downhill grade.
- Accelerated and decelerated faster than the real world train.
- Maintained a higher consistent maximum permissible speed than trains achieve in practice.

A comparison of the transit time for an ‘average’ actual train and the simulated train found a net overestimate in both directions by the simulation. That is, the simulated train achieved a faster total journey. However, the differential varied depending on the track section and in some cases the performance of the actual train was faster than the simulation.

In conjunction with adopting actual train performance for the purposes of capacity modelling, a minor adjustment was also made to the capacity analysis to

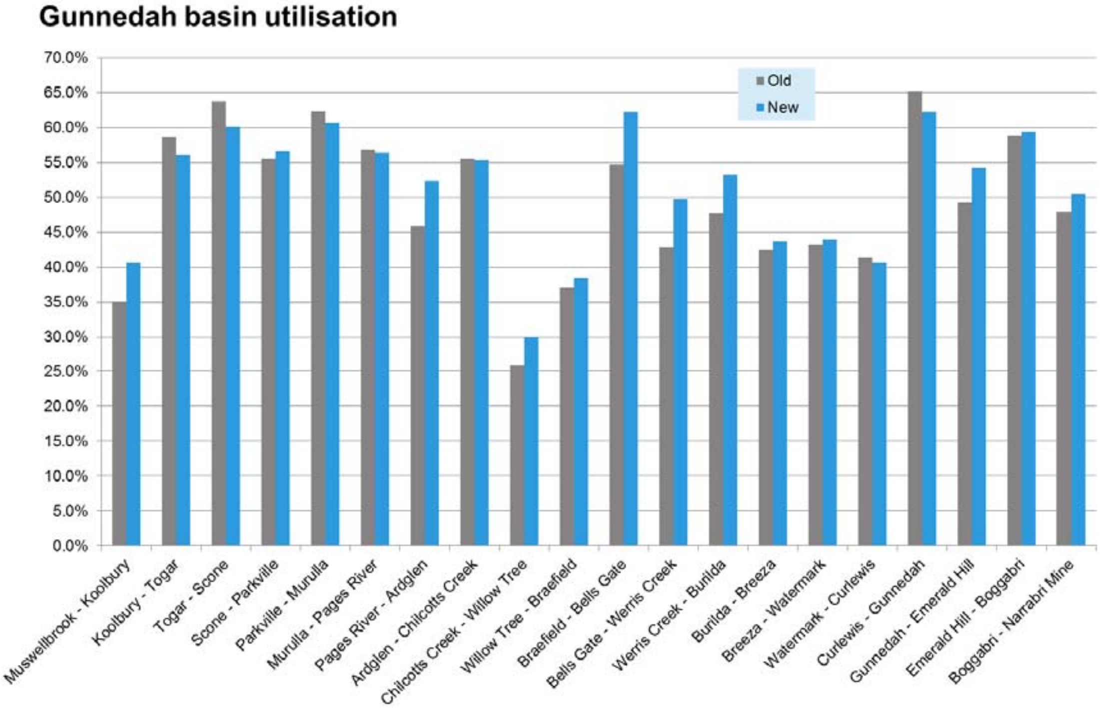

Figure 10 - Gunnedah Basin Q4 2016 section utilisation at contracted volumes under old and new methodology

better reflect actual non-coal freight and passenger train performance.

This updated methodology hasn't resulted in any capacity shortfalls for contracted volumes. Figure 10 shows a comparison of section utilisation in Q4 2016 using the old and new capacity analysis against the 65% utilisation limit.

However the new analysis, together with an increase in prospective volumes in the later years of this Strategy, leads to a requirement for a number of additional projects in the prospective scenario.

As detailed in Section 1, ARTC uses a capacity methodology that discounts capacity on single lines to 65% to reflect the practical constraints in scheduling trains on a single track line with imperfectly spaced loops and variable train speeds. This factor is relatively conservative and also provides a degree of latitude to accommodate other issues such as temporary speed restrictions and differences between actual and modelled train performance.

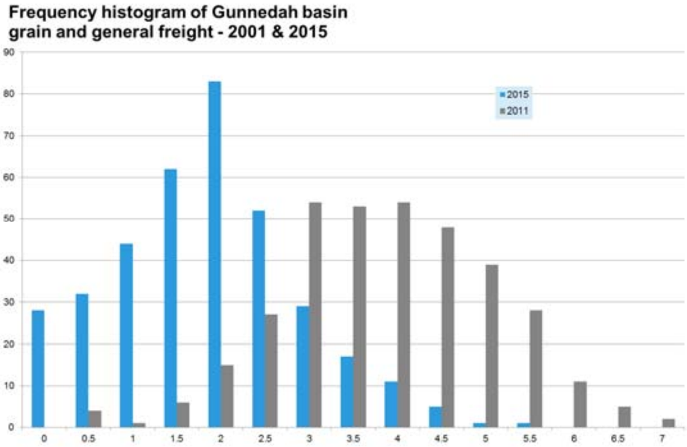

Figure 11 - General freight and grain trains at Werris Creek.

With the ability to now accurately determine actual train performance it mitigates that area of uncertainty. ARTC will be further considering whether on this basis it would be reasonable to increase the single track utilisation factor to something higher than 65%. If it were to be increased, this would flow through to an increase in the available capacity for any given infrastructure configuration.

Another issue that is important in the determination of capacity is the assumption of six non-coal freight trains in each direction per day. An analysis of non-coal freight trains in 2011 found that there were around 80 days per year where the number of non-coal freight trains was five or above, suggesting that the allowance of six trains was generous but necessary to meet demand on a large number of days. With smaller grain harvests in recent years this exercise has been repeated and found that in 2015 there had only been 2 days with 5 or more trains. These results are shown in figure 11.

When the concept of the target monthly tolerance cap was introduced, producers indicated that they wished to set it at 10%, which was the top end of the range proposed. This effectively drives the construction of sufficient capacity to allow for a peak day of 10% more coal trains than the average day. While this is probably appropriate across much of the network, given the high proportion of non-coal traffic to the Gunnedah basin and its high levels of variability, it may be desirable to take a different approach to peaking capacity.

The alternative would be have a lower TMTC and to use peaking capacity opportunistically on days when non-coal freight was low. Depending on the size of the grain harvest and other factors the available peaking capacity will vary, but is likely to be sufficient for two or three additional coal trains per day on a majority of days. This will inevitably mean that there will be days when a coal train set is forced to sit idle due to a lack of paths, but this is potentially a lower cost outcome than additional capacity projects that are only required to meet demand on a minority of days.

Implementing this approach would involve changes to the commercial relationship around ARTC's obligations to provide train paths and is ultimately a matter for negotiation with the Gunnedah Basin producers.

Train Lengths

ARTC has an approved train length of up to 1,329 metres in the Gunnedah basin. This represents a practical limit given current loop lengths and the need to allow a margin at the loop ends. There will be no further increase in train length until the track configuration changes to facilitate it.

For various operational reasons ARTC has built a 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 1,650 metres, though in the simultaneous entry configuration the extra length is not available to use for longer trains. 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 be available for trains of the standard Hunter Valley length of 1,543 metres.

Given this opportunity to move progressively towards the introduction of the standard Hunter Valley train to the Gunnedah basin, ARTC's recommendation is to build any new loops to the simultaneous entry configuration where this is cost effective. This provides short-term operational benefits and the ability to easily move to longer trains if and when ATMS is introduced.

ARTC has previously done some work on assessing whether there is a business case for extending all loops to achieve operational efficiencies. However, in the current environment this is not a priority.

Loops & Passing Lanes

Passing loops on the Muswellbrook–Narrabri route had highly variable lengths when ARTC first started investing in capacity enhancement on this corridor. Progressive lengthening of selected existing passing loops, and constructing additional passing loops, has been the primary mechanism for accommodating volume growth to date.

Project Name	Contracted	Prospective[2]
Aberdeen	-	Q1 2019
Togar North Loop	-	Q1 2017
316 km loop (Parkville South)	-	Q1 2022
Wingen loop	-	Q1 2017
Blandford loop	-	Q1 2019
Pages River North extension	-	Q1 2022
Kankool—Ardglen	-	Q1 2019
Braefield north extension	-	Q1 2022
Bells Gate south extension	-	Q1 2017
407 km loop (Werris Creek South)	-	Q1 2022
414 km loop (Werris Creek North)	-	Q1 2020
Breeza north extension	-	Q1 2023
South Gunnedah loop (Note 1)	-	Q1 2017
Collygra	-	Q1 2017

Table 2 - Narrabri to Muswellbrook Loops - Timing that would be required under contracted and prospective volume scenarios

Note 1 - Empty train speeds through Gunnedah have been limited to 40 km/h to ensure predicted noise levels do not exceed standards. Train speeds could be lifted to 80 km/h either on the basis of actual noise levels being less than predicted, or through additional noise mitigation treatments. Lifting speeds to 80 km/h would increase capacity by approximately 1.9 mtpa. This would allow South Gunnedah loop to be deferred by 6 months in the prospective volume scenario used for this Strategy.
Note 2—Project timing is based on the requirement to ensure adequate capacity. It does not imply that projects could be delivered in the required timeframe and it should explicitly be noted that projects required in 2017 could not physically be constructed in time to meet prospective volumes if producers sought to contract those volumes.

Figure 12 - Muswellbrook to Narrabri Loops

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 difficult. 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, 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.

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 extending Quipolly loop due to the high cost of extending the loop given level crossing and environmental constraints. The length of each of these passing lanes is determined by physical constraints.

Table 2 shows the projects proposed on the basis of addressing the capacity constraint on each local section as demand requires, for prospective volumes. The location of each of the projects is shown on Figure 12.

No additional projects are required for contracted volumes. The projects identified for prospective volumes assume that there is no change to current actual train performance or to the utilisation assumptions. To the extent that train performance improves, or a higher level of utilisation is agreed, some projects will be able to be deferred.

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.

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 mines on this sector are clustered either at the start of the line near Muswellbrook (Bengalla, Mangoola) or at the end of the line around Ulan (Ulan, Wilpinjong, Moolarben). This gives rise to a long section in the middle with homogenous demand.

Six new export coal mines are at various stages of the development and approval process and are included as prospective future volumes. The projects are at Bylong and to the east of Sandy Hollow.

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, past investigation of nominal sites has found it necessary to consider alternative solutions. Specifically, in some cases it has become necessary to consider "passing lanes", which are effectively short sections of double track. These will necessarily be materially more expensive than straightforward loops.

Capacity Analysis

No projects are assessed to be required for contracted volumes. With some downward revisions of prospective volume for this Strategy, only a single project, Mt Pleasant loop, has been identified as being required for that scenario.

As discussed in Section 1, a new methodology has been developed to facilitate the use of actual train performance in capacity modelling. This has not yet been applied to the Ulan line but is not expected to result in any significant changes to the conclusions.

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

The required scope of work is shown in table 3 and figure 13.

Project Name	Contracted Volumes	Prospective Volumes
Mt Pleasant loop	-	Q1 2022

Table 3 - Ulan - Muswellbrook Loops, timing under contracted and prospective volume scenarios

Figure 13 - Ulan Loops

5

Increasing capacity between Muswellbrook and the Terminals

Context

The Muswellbrook—Terminals section is the core of the Hunter Valley network. A majority of the coal mines in the Hunter Valley connect to this part of the network, with a number of branches servicing multiple mines. All of the corridor is at least double track with significant sections of triple track and dedicated double track for coal from Maitland to Hexham.

Although this section has all of the non-coal freight and passenger trains from the Gunnedah and Ulan lines, plus an additional daily Muswellbrook passenger service, the volume of coal means that it dominates operations across this corridor. The passenger services, which get priority and run down the coal services, do create a disproportionate loss of capacity, particularly in the loaded direction, but there is sufficient capacity on the corridor and flexibility created by the three track sections, that the shadow effect of the passenger services has a relatively limited effect.

The major issues affecting the line between Muswellbrook and the terminals are headways, junctions, the continuous flow of trains and efficient flows into the terminals.

Headways

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[1] once volume exceeds around an average of 84 paths per day, or 245 mtpa at current average train weights.

While this principle has been adopted in the signalling design for new works, there have not as yet been any 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 14). 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 then requires a third track to achieve the required capacity. All three of the major banks are now on three track sections.

Current contracted volumes do not trigger a requirement for any headway projects. In the event that ATMS proceeds it will fundamentally alter the operating environment with trains able to operate at the minimum safe distance in all circumstances. It has been assumed that for the purposes of the scope of work for prospective volumes that ATMS will proceed and negate the need for any signalling projects.

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

Junctions

There are numerous junctions on the Hunter Valley rail network where train conflicts at the at-grade interfaces impact on capacity (figure 15).

Upgrading of the low speed, high maintenance turnouts around Maitland is now planned for 2016/17. This upgrade is being undertaken to reduce the future maintenance task and will increase reliability but is not expected to have any significant effect on train speeds through the junction.

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.

Ravensworth loop, which was previously integrated into the Newdell loop, was separated in 2013 and given a new junction with high-speed turnouts and a holding loop.

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.

In the medium term, prospective volume growth from both the Ulan and Gunnedah basin lines would mean that the capacity of the at-grade junction at Muswellbrook will come under pressure.

However, the level of congestion at Muswellbrook, while material under contracted volumes, is tolerable, and the work done to date on potential infrastructure solutions has identified significant construction and environmental challenges that would suggest that any solution is only worth pursuing once volume growth, and hence congestion, approach a level where a solution is unavoidable.

The best solution identified is a Third Track heading east from Muswellbrook, which offers the best operational outcome and value for money given the constraints.

ARTC has assessed the threshold where a solution is required at approximately 45 paths/day. This threshold is not reached until after 2025 under the prospective volume scenario.

HVCCC undertook modelling during 2013 that suggested there may be a need for a holding track at Muswellbrook assuming that trains arrive at Muswellbrook off their designated path where there are only a limited number of fixed paths on the Ulan and Gunnedah lines. ARTC and HVCCC are both now working to the assumption that there will be increasing levels of dynamic management of the network, including enhanced principles for staging trains out of the terminals, and that these approaches make any additional work at Muswellbrook unnecessary.

Continuous Train Flow

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.

This was the primary driver of the decision to build the Minimbah—Maitland third track, and flexibility to achieve continuous flow has also been enhanced by the construction of the Hexham holding roads.

In the current environment there is no need for further infrastructure projects to support continuous flow.

Terminals

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), much 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 Port Waratah precinct, with extensive rail facilities servicing a variety of activities. This includes steel products, containerised product for both 3PL and mineral concentrate export in addition to bulk export grain for both GrainCorp and Newcastle Agri Terminal loader. There are also locomotive and wagon servicing and maintenance facilities. ARTC will continue to liaise with Port of Newcastle in relation to the execution of any initiatives of their master plan.

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 Austar services. Only two of the three 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

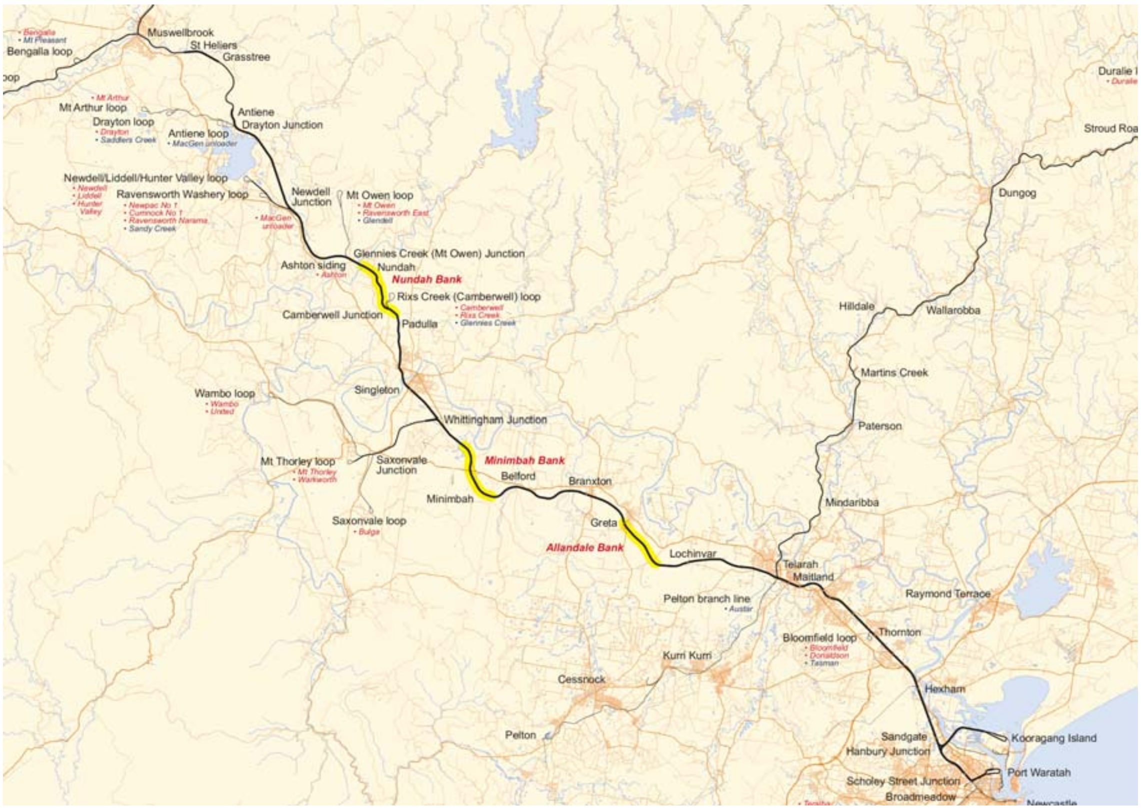

Figure 14 - The Nundah, Minimbah and Allandale Banks.

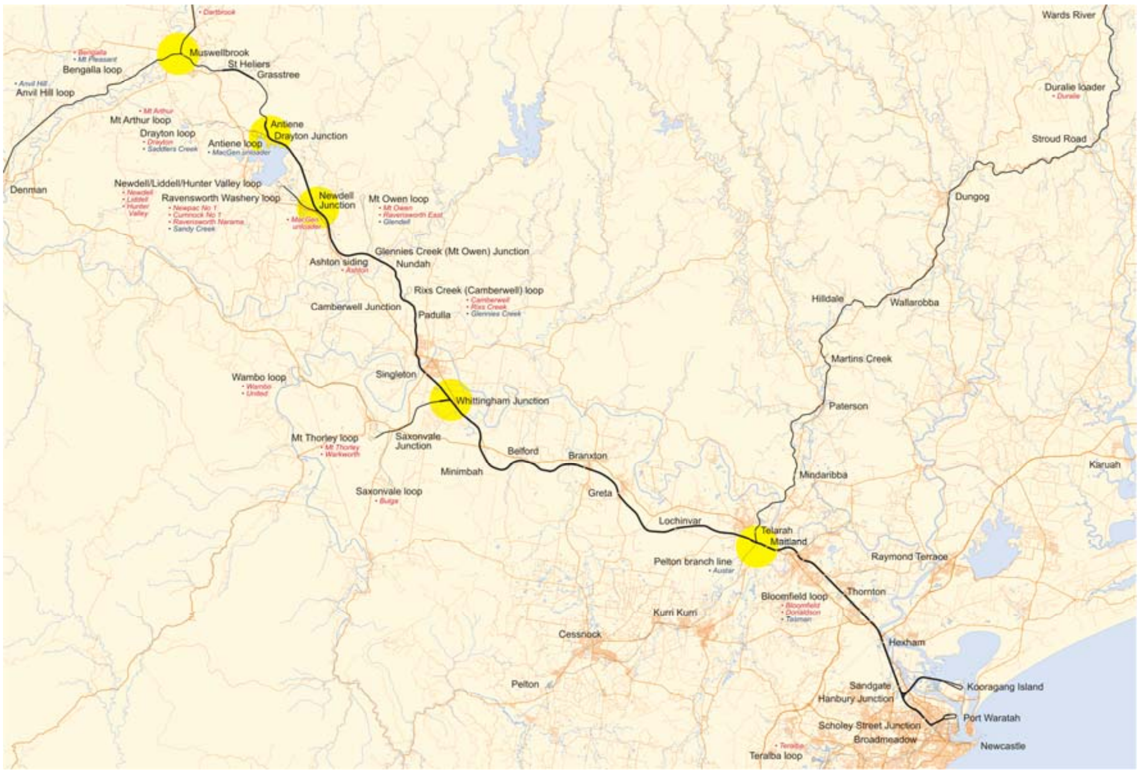

Figure 15 - Maitland, Whittingham, Newdell, Drayton and Muswellbrook Junctions

this slightly, though there may be environmental challenges in doing so.

PWCS Kooragang Island is better configured for modern rail operations. It now has 9 departure roads for its four dump stations and four fully signalled arrival roads.

Provisioning and inspection activity, which had historically contributed to congestion, has been moved out of the departure roads. Locomotives continue to shuttle between Kooragang and Port Waratah but this has a relatively minor impact on capacity.

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, including the flyover of the Kooragang branch at NCIG Junction, which has eliminated conflicts between loaded NCIG trains and empty trains from KCT. NCIG has three arrival roads for its two dump stations.

In February 2015 the RCG approved construction of the Kooragang Arrival Road Stage 2 project on the basis of advice from the HVCCC that it provided broader system benefits noting that it was not strictly required for capacity.

Stage 1, which was completed in 2012, was a minor reconfiguration that allowed for two tracks to split 650 metres sooner, which together with management of train departures from Hexham ensures that trains should never need to stop in advance of being fully clear in an arrival road. Stage 2 extends this arrangement by a further 1,000 m, which allows two trains to be held in parallel in advance of the arrival roads. Stage 2 is currently due for completion in Q4 2016.

With the completion of the Kooragang Arrival Roads Stage 2 project there will be no further projects required for contracted volumes.

The scope of work required for prospective volumes will be dependent on the details of any incremental enhancements to capacity at KCT or NCIG. In the event that T4 proceeds, all of the necessary terminal track is assumed to be provided within the scope of that project.

Hexham to Terminals Train Performance

The Hexham Holding Roads were commissioned in November 2014. The key objectives of the Hexham Holding Roads were to manage the sequencing of trains and, in conjunction with the Arrival Roads Signalling Optimisation project and better operational management, to reduce both the run time and the level of variability in the run time between Hexham and the terminals.

The 2015 Strategy highlighted the dramatic improvements made between 2012 and 2015 with the mean transit time falling from 35.7 minutes to 14.5 and the median from 21.0 minutes to 13.0. Due to a change in the location of the timing points it is not possible to extend the previous analysis, but a year on year comparison of 2015 and 2016 shows a further small improvement, most likely due to the commissioning of the flyover into NCIG.

The specific metric being applied for analysis of Hexham—Kooragang performance is for 80% of trains to achieve the nominal section time plus 50%. That is, 80% of trains should have a section time of less than 41 minutes. Performance to NCIG is being similarly monitored, against a section time of 21 minutes. Year to date performance has easily exceeded the KCT target. Performance to NCIG has been mixed, primarily due to temporary speed restrictions at North Fork.

ARTC will continue to actively work with other service providers to consistently achieve the target for variability in performance between Hexham and the terminals.

6

Maintenance strategy

Context

With coal producers seeking to actively control operating costs, ARTC aims to provide insight on its commitment to improve the customer value proposition by providing transparency as to process and expected costs for maintenance in the Hunter Valley.

This section summarises the methodology and key drivers behind the future maintenance plans and outlines the expected maintenance spend profile of the Hunter Valley.

Changes from Previous Year

There are no significant changes between the 2015 Strategy and this Strategy in terms of the published spend profiles for the maintenance program . This is expected given the sustaining maintenance strategy approach of ARTC. The approach of a sustaining strategy is primarily due to the absence of any major infrastructure commissioning until such time as prospective volumes trigger their construction.

Maintenance Planning Process

The development of the Hunter Valley Corridor Maintenance program is an iterative process using various data inputs and analysis methods to arrive at a program of works that is considered to deliver ARTC's customer requirements in the most efficient manner.

Figure 16 outlines the basics of the process.

ARTC has recently made some adjustments to the process used to develop the annual maintenance program with a view to providing better value for money. Most notably these changes have involved:

- Challenging the underlying risk to safety, environment and operations using detailed condition assessments and asset degradation forecasts
- Risk assessment of proposed corridor capital to determine if projects can be deferred.

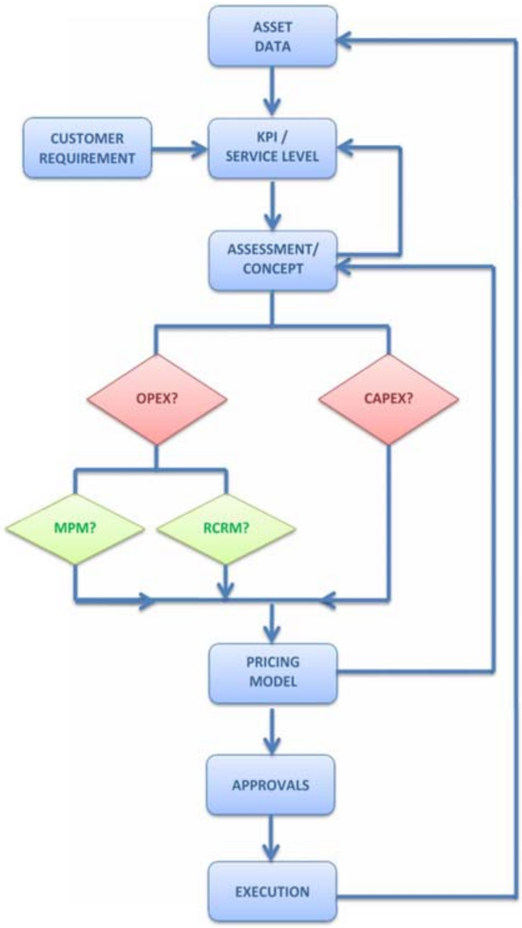

Figure 16 - Maintenance Development Process

- Increased ARTC project manager involvement in scope development and deliverability assessment.

Works Summary

The annual maintenance program is divided into three main areas of expenditure; Routine Corrective and Reactive Maintenance (RCRM), Major Periodic Maintenance (MPM) and Corridor Capital (capital). The RCRM and MPM programs are considered an operating

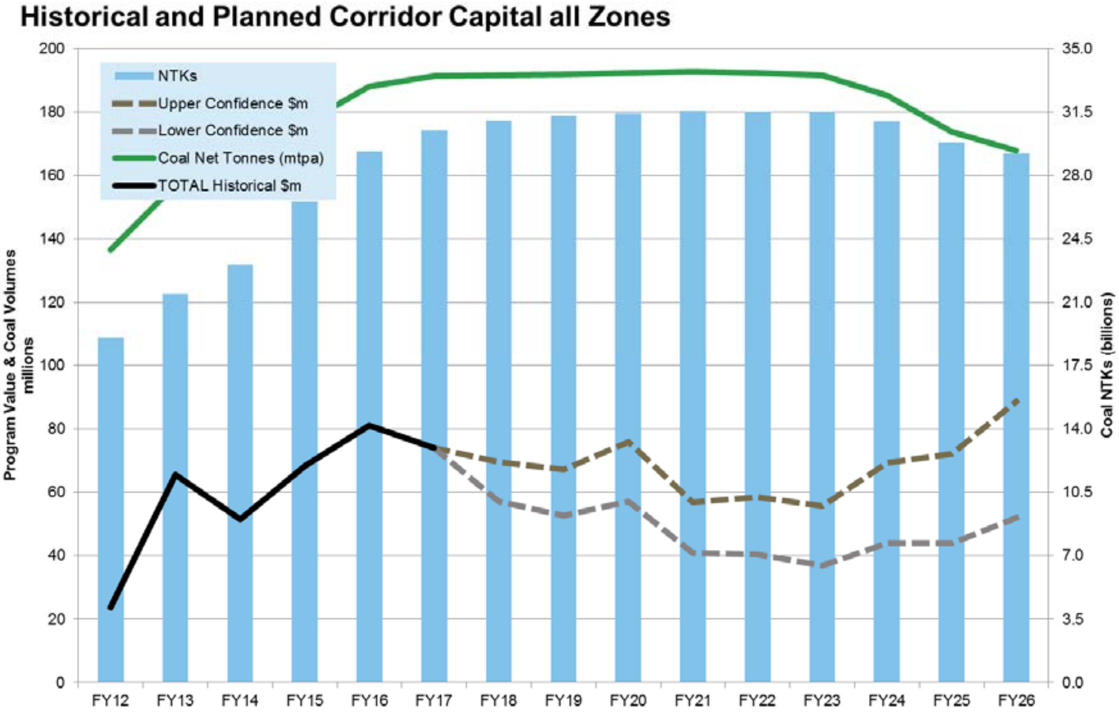

Figure 17 - Historical and Planned Corridor Capital

expense and as such these programs are not subject to the Regulated Asset Base (RAB) treatment, whereas the capital program of works is subject to this treatment in accordance with the Hunter Valley Access Undertaking (HVAU).

The current forecast program of works for both MPM and capital is presented in the following sections. The graphs highlight an upper and lower confidence limit in terms of the forecast expenditure. This limit diverges over time in line with confidence around the requirement for the works and the cost estimate associated with the works. The graphs include the total Net Tonne Kilometres (NTK's) and the total coal volumes. The trend in maintenance expenditure can be compared to the trend of both historic and future NTK's and coal tonnes.

To provide further context to this forward maintenance spending profile, the previous five years of maintenance expenditure is also shown.

Corridor Capital

The current forecast of the ten-year corridor capital program for all zones is shown in Figure 17.

This spend profile includes the 30 tonne axle load program of works being delivered in Zone 3 which concludes at the end of 2017. At the conclusion of this program the corridor capital spending profile shows a modest sustaining program across all zones with a few of the departures to this trend being significant asset replacements (e.g. bridges).

The significant activities under the corridor capital program of works and a brief description of the development and asset risk are provided below. These activities typically represent over 50% of the annual corridor capital spend in any given year.

Rerailing

The rerailing program is calculated using a model which uses the historical observed rail wear rates for each section of track. By correlating the actual tonnage history over these sections, the model then estimates the amount of rerailing required on the network through the use of forecast volumes to predict future life of the rail.

Rerailing is essential both to ensure that the rail has adequate structural capacity to carry the specified axle loads and to reduce the risk of rail breaks as defects in the rail propagate over time.

Track Strengthening

The track strengthening program generally consists of track reconditioning (removal of all ballast and subgrade) where the work extends over a distance of greater than 200m. The identification and development of the scope utilises various sources of information including temporary speed restrictions, amount of tamping effort, geotechnical investigations and local team knowledge.

The majority of the Hunter Valley rail network is built on an earthworks formation which was constructed during the early 1900's. The running of 30 tonne axle load rolling stock would not have been envisaged by design work done during this period. Due to the age and engineering design of these earthworks, some sections do progressively fail and the replacement is performed with a contemporary formation design.

Turnout Renewal

The turnout renewal program is derived through an assessment of turnout performance, age, location risk and current maintenance effort. The scope of works under this activity generally delivers an upgrading of the existing turnout and underlying formation with any design optimisation performed in the investigation phase of the project.

Turnouts constructed with timber bearers and older style steel work are considered an operational risk to the coal network as this style of turnout is prone to failure and a high maintenance effort. The majority of turnout replacements performed in the Hunter Valley are replacing turnouts of this design with turnouts designed to withstand the demands required of the asset in moving the volumes forecast.

Major Periodic Maintenance

The forecast spend profile of the MPM program for all zones is shown in Figure 18.

The significant activities under the MPM program of works and a brief description of the development and asset risk are provided below. These activities typically represent over 50% of the annual MPM spend in any given year.

Ballast Cleaning

The ballast underneath the sleepers must be free draining for the track asset to function properly. Over time the free draining nature of ballast reduces through the degradation of the ballast and the development of fines throughout the track profile. This degradation is due to many factors including tonnage, the amount of tamping effort, coal debris and formation failures.

Ballast cleaning is performed to remove these fines that build up over time. This process involves major track plant which screens the in-situ ballast and returns good ballast to the track, with fines removed to spoil. As ballast degradation is highly correlated to tonnage, the ballast cleaning program is cyclic in nature and sensitive to future coal volumes, noting that in the next few years there is a legacy that ARTC is continuing to work on rectifying.

Rail Grinding

The rail grinding programme is a cyclic program based on tonnage, track curvature and rail performance (internal/external defects). The process of rail grinding involves grinding the surface of the rail to reinstate the rail shape to a profile which best suits the rollingstock wheel profiles. If there is a mismatch in these profiles, excess stresses are transferred into the rail section, creating defects which may lead to TSRs or broken rails.

It is an essential part of any rail operation to maintain the rails through rail grinding. This program of works is correlated to tonnage and track curvature (with the shaper curves getting ground more often than straight track).

Resurfacing (Tamping)

Resurfacing (or tamping) is a process where the track geometry is reinstated to a standard at which trains can travel through a track section at full design track speed. Over time track geometry deteriorates

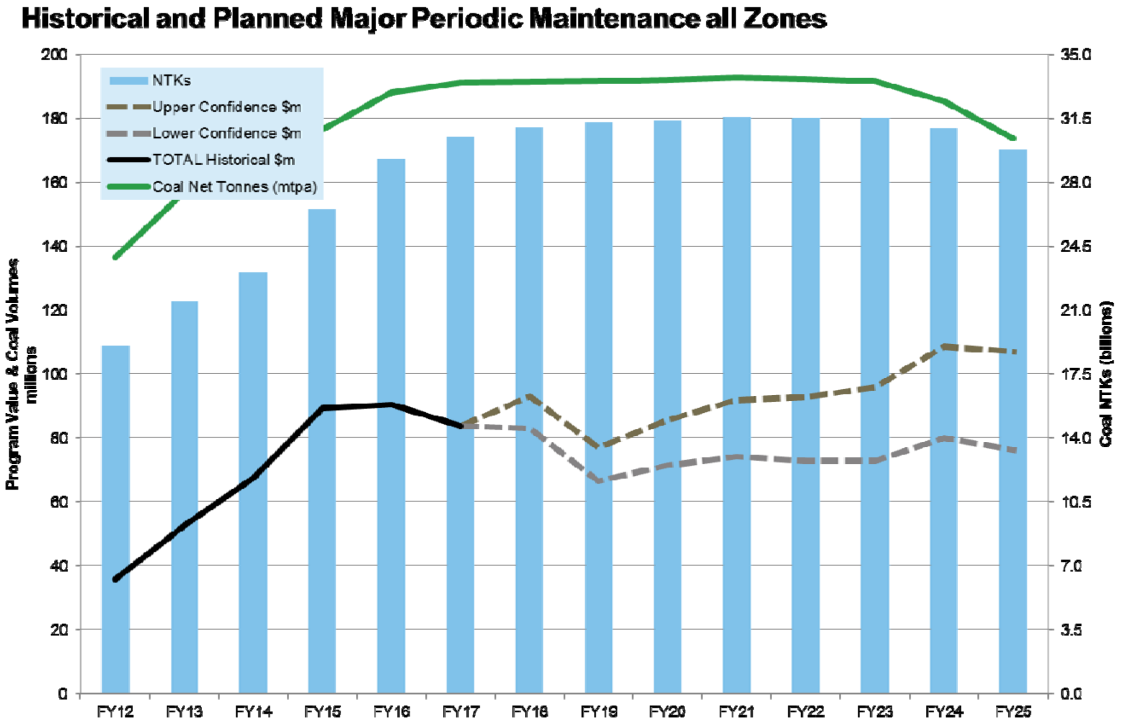

Figure 18 - Historical and Planned Major Periodic Maintenance

mainly due to tonnage across the line, weather conditions and the underlying track formation.

The resurfacing programme is a cyclic program based on tonnage and track performance.

Drainage and Mudhole Rectification

The Drainage and Mudhole rectification activity is considered to be an essential part of the maintenance program. This scope of works is variable from site to site (mud hole dig outs, surface drain cleaning, subsurface drain installation etc) however the maintenance of an effective drainage system is critical to ensuring that track geometry faults and the development of TSRs are kept to an acceptable level.

Future Work

Work is currently underway to further test the prudence and efficiency of the maintenance spend, which ultimately is driven at demonstrating a positive value proposition to ARTC's customers. This work involves improvements to the asset management systems used by ARTC. These improvements will be centred on improving the understanding of the asset condition and behaviour of the asset in response to the current maintenance work being performed.

Some of the future improvements to the current process used by ARTC are likely to be in the central storage and interpretation of condition based data, use of tools that assist in the accurate forecasting of asset degradation, and linkages of maintenance standards to the risk associated with the condition of the asset.

Storage of Data and Prediction Tools

Central storage of asset data is an essential improvement to the asset management process. ARTC currently uses a variety of tools to predict asset behaviour with a reasonable amount of success. However the linkages of these tools to a master set of data is seen as an improvement to the current process. With one single master set of condition data, linkages of various elements of asset behaviour can be tested with a greater level of confidence and accuracy.

For example, points failures may be linked to the degradation of the condition of the track geometry at certain locations. Currently the data required to investigate this issue is located in two separate and non-linked systems. While this analysis can still be undertaken, it is a labour intensive process which is prone to error with the combination of two different data sets on the same asset. The centralisation of condition data will assist asset engineers in determining if there are correlations such as this on the network in a more efficient manner and with greater confidence of outcome. This outcome will allow engineers to make better maintenance decisions on the asset which will benefit the customer through better value definition in the maintenance spend.

Maintenance Standards

The majority of the maintenance standards used to manage the asset have been derived using a tonnage or time basis. This time/tonnes basis has historically managed the safety risk across many rail operations worldwide. For example a turnout will be inspected at a certain interval regardless of other mitigating factors such as age, condition or recent performance.

ARTC is currently undertaking work which will challenge these maintenance standards, ultimately bringing about greater efficiencies in operating costs. The aim of this work is to intervene and maintain the asset only after a safety, reliability or condition trigger.

The changes to standards will be implemented in stages over a medium to longer term time horizon. ARTC plans to work with the industry safety regulator and other subject matter experts as required to ensure that any changes to inspection intervals are done in a proper risk controlled manner that does not comprise the safety of the asset.

7

Recommended Projects and Network Capacity

A summary of the recommended projects for contracted volumes comparing previous and new proposed delivery timeframes, together with estimated costs at a P75[2] level, is shown in Table 4.

Table 5 shows the same detail as Table 4, for the scope of work required for prospective volumes. In Table 6, costs are shown as both un-escalated and escalated based on the 'proposed by' delivery dates. 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 RCG in accordance with the HVAU.

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 19, 20 and 21. 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 7 and 8 respectively. Tables 9 and 10 show the equivalent information for prospective volumes, for train numbers and tonnage respectively.

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

Contracted Volume	2015 Strategy – Proposed by	2016 Strategy – Required by	2016 Strategy – Proposed by	Change 2015 to 2016	Estimated Cost ($m, escalated P75)
Port—Muswellbrook					
Nil					
Ulan Line					
Nil					
Gunnedah Line					
Nil					
Congestion Projects					
Kooragang Arrival Roads Stage 2	Q2 2016	see note 1	Q4 2016	+ 6 months	$36
Productivity Projects					
ARTC Network Control Optimisation (ANCO)	Q4 2016	n/a	n/a	see note 2	$30
Advanced Train Management System (ATMS)	Q1 2020	n/a	Q1 2020	see note 3	$260

Table 4 - 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.

Note 1—Whilst KCT Stage 2 is not strictly required for ARTC contracted capacity, the RCG has endorsed the project proceeding on the basis of advice from HVCCC that it provides broader system benefits.

Note 2 - ANCO will be a phased roll out starting in Q4 2016.

Note 3—The cost estimate for ATMS includes the roll out for the whole of the Hunter Valley. There are options to implement the project partially and incrementally over a longer period of time reducing this estimate significantly.

Contracted plus Prospective Volume	2015 Strategy – Required by	2016 Strategy - Required by	Estimated Cost ($m) un-escalated 2016, order-of-magnitude	Estimated Cost ($m) escalated, order-of-magnitude
Port—Maitland				
Nil				
Maitland - Muswellbrook				
Nil				
Ulan Line				
Mt Pleasant	Q1 2022	Q1 2024	$25	$29
Widden Creek	Q1 2023	-		
Gunnedah Basin Line				
Aberdeen	Q3 2017	Q1 2019	$18	$19
Togar North Loop	Q2 2016	Q1 2017	$21	$21
316 km loop (Parkville South)	-	Q1 2022	$42	$47
Wingen loop	Q3 2016	Q1 2017	$21	$21
Blandford loop	Q3 2017	Q1 2019	$35	$36
Pages River North extension	-	Q1 2022	$90	$126
Kankool—Ardglen	Q3 2017	Q1 2019	$85	$88
Braefield north extension	-	Q1 2022	$51	$82
Bells Gate south extension	Q3 2017	Q1 2017	$42	$42
407 km loop (Werris Creek South)	-	Q1 2022	$30	$48
414 km loop (Werris Creek North)	Q1 2022	Q1 2020	$27	$29
Breeza north extension	-	Q1 2023	$40	$45
South Gunnedah loop	Q3 2016	Q1 2017	$23	$23
Collygra	-	Q1 2017	$23	$23
Congestion Projects				
Train Parkup	See Note 1	TBD		

Table 5 - Recommended Projects, Delivery Schedule and Costs for Prospective 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.

Note 1: ARTC continue to work with HVCCC to identify the requirements for this project

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 19, 20 and 21.

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, breaching ARTC's confidentiality obligations To give an indication of net capacity table 6 provides net capacity for 3 key line sections for contracted volumes and is intended to complement figures 19, 20 and 21.

Chapter 2 includes a discussion around the development of the ANCO and ATMS projects and notes the potential for these projects to deliver a higher rate of single track utilisation than the 65% adopted for the purposes of determining capacity in this Strategy. Purely for illustrative purposes, table 11 shows the effect on the scope of prospective volume if it were possible to increase the utilisation rate to 75%.

Net Capacity (paths)	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Pricing Zone 3 (at Werris Creek)	1.1	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pricing Zone 2 (at Bylong)	4.3	3.6	2.8	2.8	2.5	2.5	2.5	2.5	2.5	2.7
Pricing Zone 1 (at Whittingham)	37.7	36.6	35.9	35.9	35.6	35.6	35.8	35.3	37.8	41.2

Table 6 - Surplus coal path availability (total capacity less contracted volume) for indicative line sectors for each zone.

Projects required for Prospective Volume	Current systems (65% utilisation)	ATMS / ANCO (75% utilisation)
Ulan Line		
Mt Pleasant	Q1 2024	-
Gunnedah Basin Line		
Aberdeen	Q1 2019	Q1 2022
Togar North Loop	Q1 2017	Q1 2021
316 km loop (Parkville South)	Q1 2022	-
Wingen loop	Q1 2017	Q1 2021
Blandford loop	Q1 2019	Q1 2022
Pages River North extension	Q1 2022	Q1 2023
Kankool—Ardglen	Q1 2019	Q1 2022
Braefield north extension	Q1 2022	-
Bells Gate south extension	Q1 2017	Q1 2020
407 km loop (Werris Creek South)	Q1 2022	Q1 2023
414 km loop (Werris Creek North)	Q1 2020	Q1 2022
Breeza north extension	Q1 2023	-
South Gunnedah loop	Q1 2017	Q1 2022
Collygra	Q1 2017	-

Table 11—Scope for prospective volumes under current and potential future single track utilisation rates.

	2016				2017				2018	2019	2020	2021	2022	2023	2024	2025
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1
Narrabri - Boggabri	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Boggabri - Gunnedah	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Gunnedah - Watermark Jct	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Watermark Jct - Werris Creek	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
Werris Creek - Scone	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Scone - Muswellbrook	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Ulan - Moolarben	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
Moolarben - Wilpingjong	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
Wilpingjong - Bylong	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
Bylong - Ferndale	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
Ferndale - Spur Hill	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9
Spur Hill - Mangoola	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Mangoola - Mt Pleasant	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
Mt Pleasant - Bengalla	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1
Bengalla - Muswellbrook	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
Muswellbrook - Drayton	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3
Drayton - Newdell	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
Newdell - Mt Owen	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3
Mt Owen - Camberwell	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
Camberwell - Whittingham	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
Whittingham - Maitland	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6
Maitland - Bloomfield	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0
Bloomfield - Sandgate	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0

Table 7 - Saleable capacity in coal train numbers (round-trips per day) for contracted volume

	2016				2017				2018	2019	2020	2021	2022	2023	2024	2025
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1
Narrabri - Boggabri	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Boggabri - Gunnedah	25.8	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	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1	27.1
Watermark Jct - Werris Creek	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9	33.9
Werris Creek - Scone	29.6	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7
Scone - Muswellbrook	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3	31.3
Ulan - Moolarben	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3
Moolarben - Wilpingjong	60.6	60.6	60.6	60.6	60.5	60.5	60.5	60.5	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4
Wilpingjong - Bylong	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.0	55.0	55.0	55.0	55.0	55.1
Bylong - Ferndale	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1
Ferndale - Spur Hill	52.3	52.3	52.3	52.3	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2
Spur Hill - Mangoola	69.4	69.4	69.4	69.4	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.3
Mangoola - Mt Pleasant	62.0	62.0	62.0	62.0	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.9	61.8
Mt Pleasant - Bengalla	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.8	65.8	65.8	65.8	65.8	65.7
Bengalla - Muswellbrook	196.0	196.0	196.0	196.0	195.8	195.8	195.8	195.8	195.8	195.8	195.7	195.7	195.7	195.7	195.7	195.5
Muswellbrook - Drayton	146.4	146.3	146.3	146.3	146.4	146.4	146.4	146.4	146.4	146.4	146.5	146.5	146.5	146.5	146.5	146.2
Drayton - Newdell	254.1	253.8	253.8	253.8	253.8	253.8	253.8	253.8	253.7	253.7	253.7	253.7	253.7	253.7	253.7	253.5
Newdell - Mt Owen	356.8	356.6	356.6	356.6	356.6	356.6	356.6	356.6	356.6	356.6	356.6	356.6	356.6	356.5	356.6	356.2
Mt Owen - Camberwell	274.6	274.4	274.4	274.4	274.4	274.4	274.4	274.4	274.4	274.4	274.4	274.4	274.3	274.3	274.1	273.0
Camberwell - Whittingham	276.7	276.5	276.5	276.5	276.4	276.4	276.4	276.4	276.4	276.4	276.4	276.4	276.4	276.5	276.4	275.5
Whittingham - Maitland	292.4	292.2	292.2	292.2	292.1	292.1	292.1	292.1	292.1	292.1	292.0	292.0	292.0	292.2	292.0	291.1
Maitland - Bloomfield	458.7	458.5	458.5	458.5	465.5	465.5	465.5	465.5	465.5	465.5	465.5	465.5	465.4	465.7	470.9	469.4
Bloomfield - Sandgate	458.7	458.5	458.5	458.5	465.5	465.5	465.5	465.5	465.4	465.4	465.4	465.4	465.4	465.7	470.9	469.4

Table 8 - Saleable capacity in tonnes for contracted volume

	2016				2017				2018	2019	2020	2021	2022	2023	2024	2025
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1
Narrabri - Boggabri	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9	4.9
Boggabri - Gunnedah	9.2	9.2	9.2	9.2	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Gunnedah - Watermark Jct	9.6	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2
Watermark Jct - Werris Creek	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	15.6	15.6	15.6	17.0	17.0	17.0
Werris Creek - Scone	10.5	10.9	10.9	10.9	12.1	12.1	12.1	12.1	12.1	14.4	14.4	14.4	20.8	20.8	20.8	20.8
Scone - Muswellbrook	11.1	11.1	11.1	11.1	12.5	12.5	12.5	12.5	12.5	15.5	15.5	15.5	19.7	19.7	19.7	19.7
Ulan - Moolarben	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
Moolarben - Wilpingjong	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
Wilpingjong - Bylong	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8	17.8
Bylong - Ferndale	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
Ferndale - Spur Hill	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9	16.9
Spur Hill - Mangoola	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
Mangoola - Mt Pleasant	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8	35.7	35.7
Mt Pleasant - Bengalla	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	21.1	35.7	35.7
Bengalla - Muswellbrook	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4
Muswellbrook - Drayton	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3	48.3
Drayton - Newdell	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0	82.0
Newdell - Mt Owen	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3	116.3
Mt Owen - Camberwell	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
Camberwell - Whittingham	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
Whittingham - Maitland	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6	93.6
Maitland - Bloomfield	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0
Bloomfield - Sandgate	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0	151.0

Table 9 - Saleable capacity in coal train numbers (round-trips per day) for prospective volume

	2016				2017				2018	2019	2020	2021	2022	2023	2024	2025
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q1	Q1	Q1	Q1	Q1	Q1	Q1
Narrabri - Boggabri	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2
Boggabri - Gunnedah	25.9	25.9	25.9	25.9	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7
Gunnedah - Watermark Jct	27.1	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.6	48.6	48.6	48.6	48.7	48.7	48.7	48.7
Watermark Jct - Werris Creek	33.9	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.1	44.0	44.0	44.1	48.0	48.0	48.0
Werris Creek - Scone	29.7	30.8	30.8	30.8	34.2	34.2	34.2	34.2	34.2	40.6	40.6	40.7	59.1	59.1	59.1	59.1
Scone - Muswellbrook	31.3	31.3	31.3	31.3	35.3	35.3	35.3	35.3	35.3	43.9	43.9	44.0	55.8	55.8	55.8	55.8
Ulan - Moolarben	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3
Moolarben - Wilpingjong	60.6	60.6	60.6	60.6	60.5	60.5	60.5	60.5	60.4	60.4	60.4	60.3	60.3	60.3	60.3	60.3
Wilpingjong - Bylong	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.1	55.0	55.0	55.0	55.0	55.0	55.0
Bylong - Ferndale	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1	46.1
Ferndale - Spur Hill	52.3	52.3	52.3	52.3	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.2	52.1
Spur Hill - Mangoola	69.4	69.4	69.4	69.4	69.3	69.3	69.3	69.3	69.3	69.3	69.3	69.2	69.2	69.2	69.2	69.2
Mangoola - Mt Pleasant	62.0	62.0	62.0	62.0	61.9	61.9	61.9	61.9	61.9	61.9	61.8	61.8	61.8	61.8	111.3	111.1
Mt Pleasant - Bengalla	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.9	65.8	65.8	65.7	65.7	65.7	111.5	111.3
Bengalla - Muswellbrook	196.0	196.0	196.0	196.0	195.8	195.8	195.8	195.8	195.8	195.7	195.6	195.5	195.5	195.5	195.3	195.1
Muswellbrook - Drayton	146.2	146.1	146.1	146.1	146.0	146.8	146.8	147.6	147.4	148.7	148.7	148.4	147.8	147.6	147.8	147.8
Drayton - Newdell	253.6	253.4	253.4	253.4	253.0	254.2	254.2	255.3	254.9	256.7	256.7	256.0	254.7	254.1	254.1	254.0
Newdell - Mt Owen	356.4	356.2	356.2	356.2	355.8	357.1	357.1	358.4	358.1	360.1	360.2	359.6	358.4	357.9	358.3	358.2
Mt Owen - Camberwell	274.3	274.1	274.1	274.1	273.8	274.7	274.7	275.7	275.4	276.9	276.9	276.4	275.5	275.1	275.1	274.5
Camberwell - Whittingham	276.4	276.2	276.2	276.2	275.8	276.7	276.7	277.6	277.3	278.7	278.7	278.2	277.2	276.8	276.7	276.1
Whittingham - Maitland	292.1	291.9	291.9	291.9	291.5	292.3	292.3	293.2	292.8	294.0	294.0	293.4	292.5	292.0	291.9	291.1
Maitland - Bloomfield	458.4	458.2	458.2	458.2	464.7	466.0	466.0	467.2	466.8	468.9	461.1	460.8	460.0	460.1	464.0	463.0
Bloomfield - Sandgate	458.4	458.2	458.2	458.2	464.7	465.9	465.9	467.2	466.8	468.8	461.1	460.8	460.0	460.1	464.0	462.9

Table 10 - Saleable capacity in tonnes for prospective volume

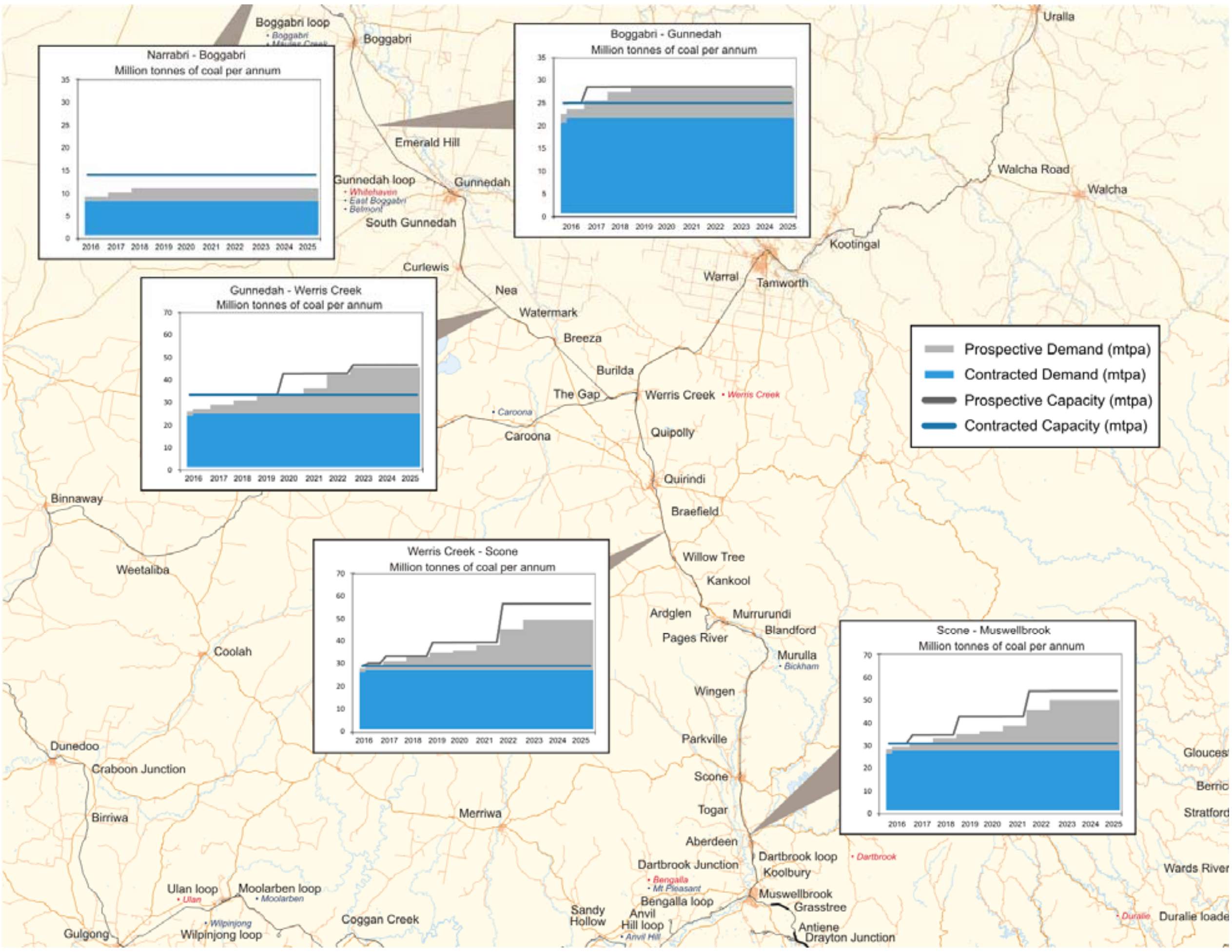

Figure 19 - Volume and capacity on the Gunnedah basin line.

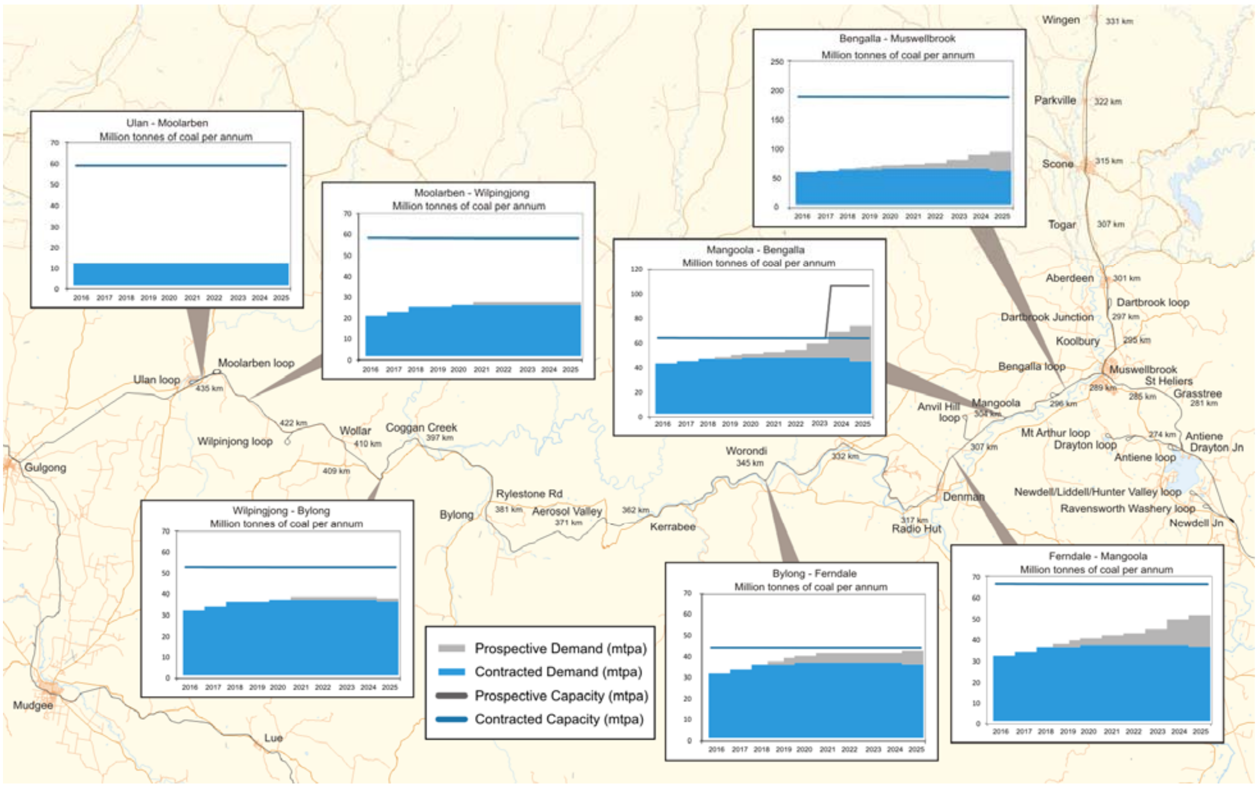

Figure 20 - Volume and capacity on the Ulan line

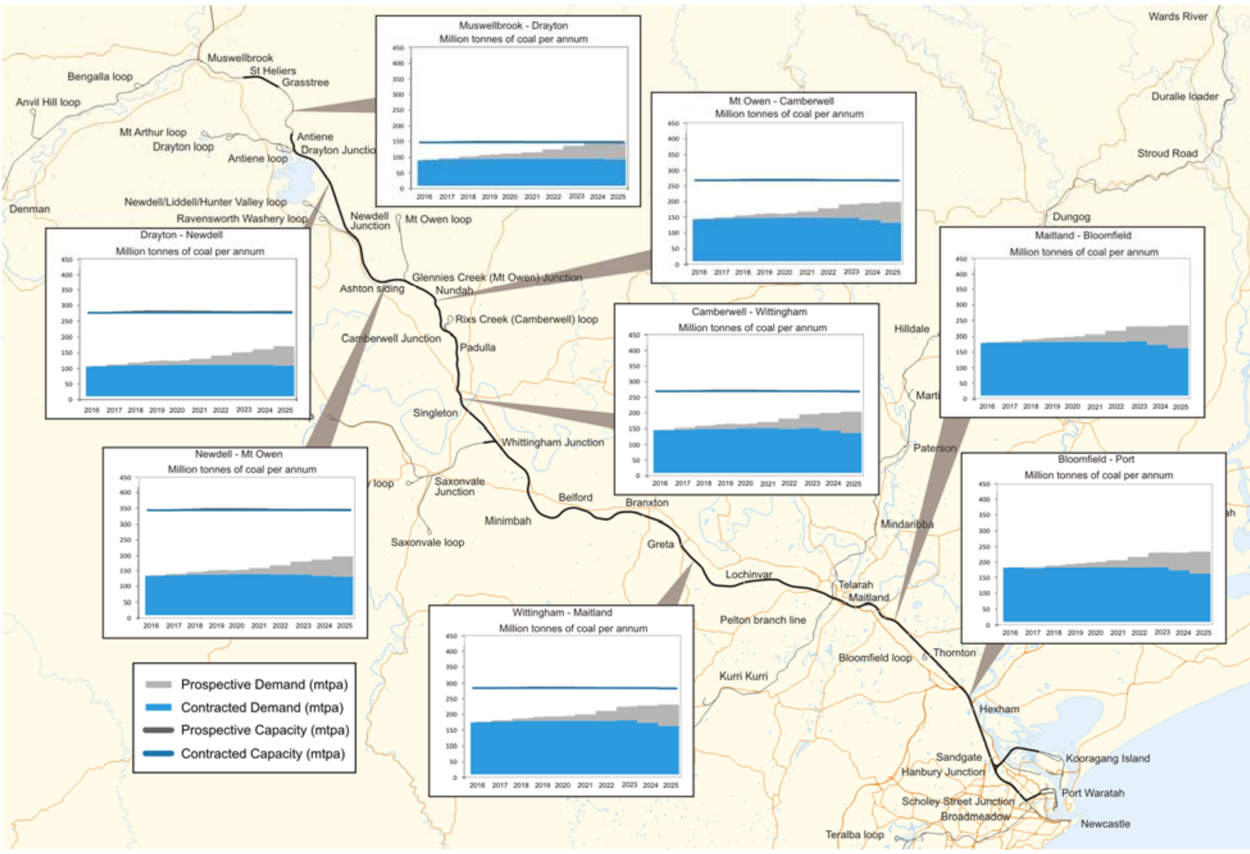

Figure 21—Volume and capacity Muswellbrook—Newcastle

Refer to ARTC's website for more information on ARTC.

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