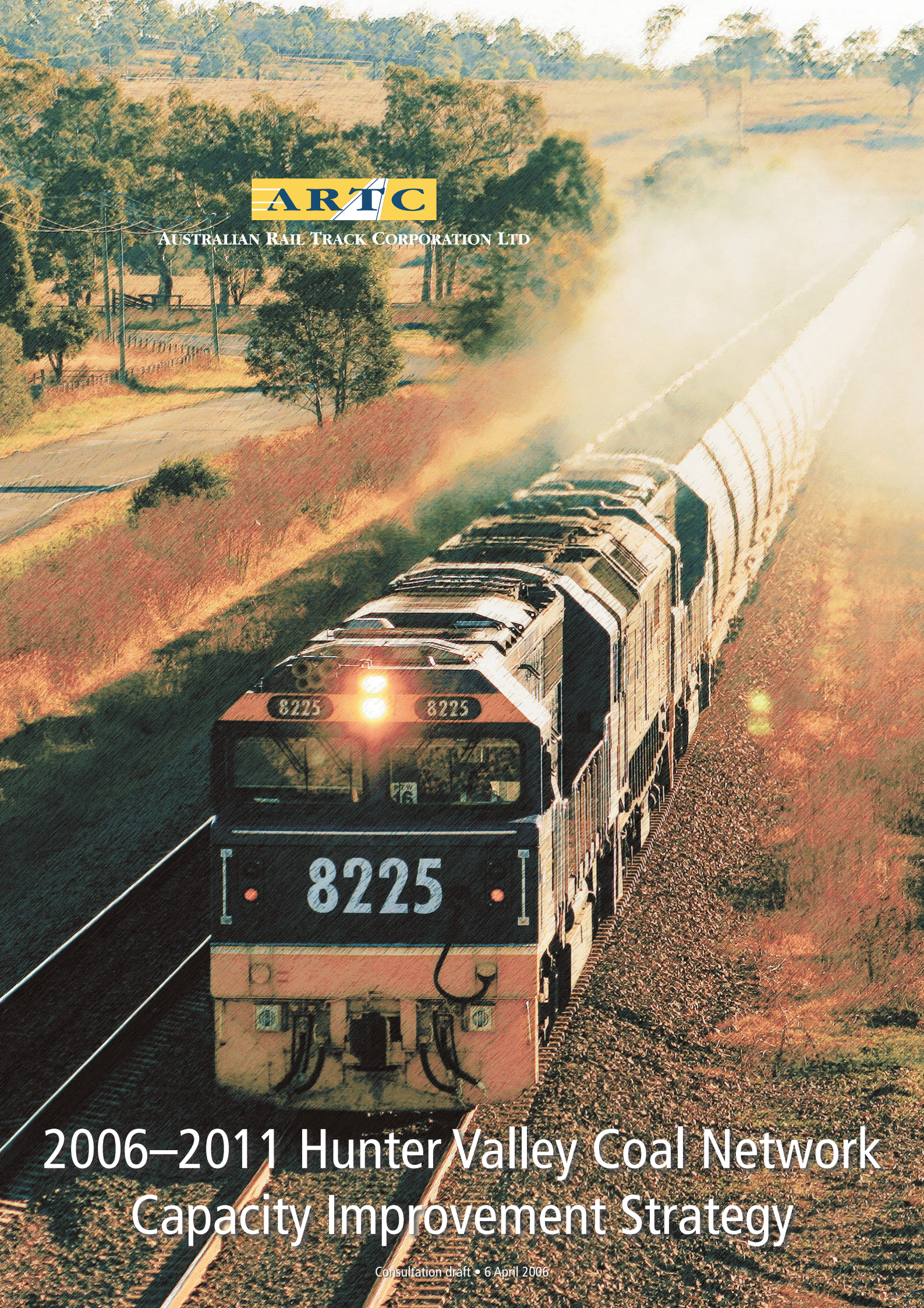
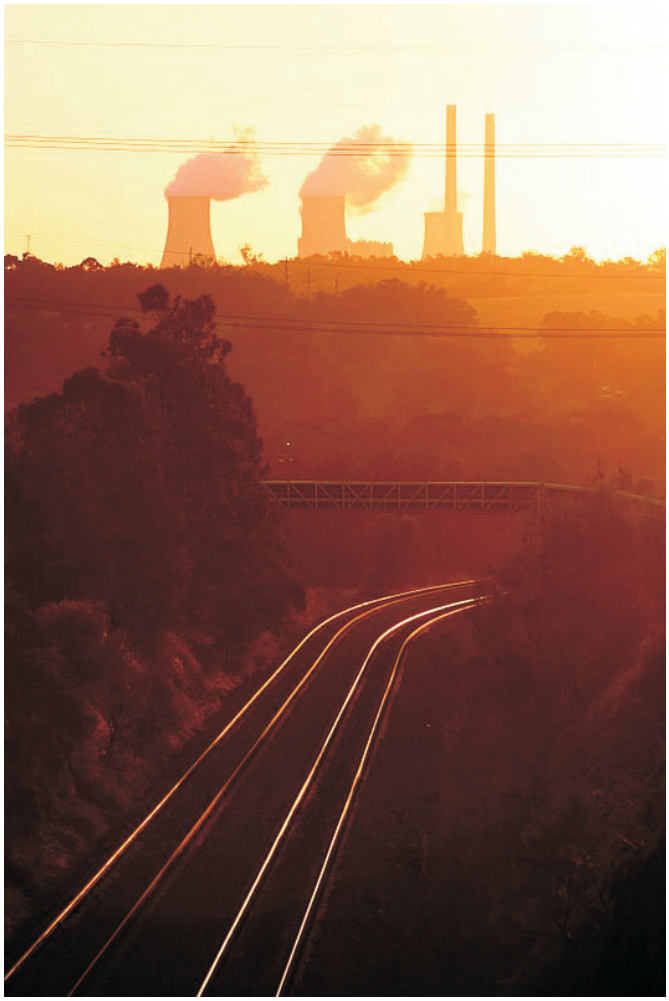


AUSTRALIAN RAIL TRACK CORPORATION LTD

2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy

Consultation draft • 6 April 2006

AUSTRALIAN RAIL TRACK CORPORATION LTD



2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy

Consultation draft • April 2006

Contents

2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy

Consultation draft • 6 April 2006

Executive summary

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

In late 2004 and early 2005 the Hunter Valley network aspects of the ARTC's investment program were reviewed and updated in the light of the rapid growth in coal demand over the last few years. A first draft of the resultant *Hunter Valley Corridor Capacity Improvement Strategy* was released in February 2005, and following extensive consultations an updated 'Version 4' was released in May 2005.

This *2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy* is a further development and updating of the 'Version 4' strategy of May 2005, using revised forecasts of coal demand and the results of further analyses during 2005 and early 2006.

In common with the earlier strategies, it identifies the 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 the ARTC in developing this *Strategy* has been to **increase capacity (with a reserve surge capability) to levels sufficient to meet anticipated demands for export and domestic coal transport**, while at the same time achieving greater operational harmony between the various sections of the Hunter Valley network.

The Hunter Valley coal network and the growth in coal demand

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

Most of this coal comes from a series of mines and coal loaders strung out along the Hunter Valley, conveyed to the ports on the railway that runs between Muswellbrook and Newcastle. Coal also feeds onto this line from Ulan and Gunnedah, west and northwest of Muswellbrook, and, much closer to the port, from Stratford, Pelton and the southern suburbs of Newcastle (*Figure A).*

At present the export coal capacity of the Hunter Valley rail network averages around 106 million tonnes per annum (mtpa).

Industry forecasts indicate that in the absence of capacity constraints at the Newcastle ports total coal demand on the Hunter Valley network could be about 104 mtpa in 2006, increasing to around 109 mtpa in 2007, 116 mtpa in 2008, 133 mtpa in 2009, 143 mtpa in 2010, 145 mtpa in 2011 and, more speculatively, 157 mtpa in 2015 (*Figure A*).

While the heaviest coal volumes are forecast to continue to be at the lower end of the Hunter Valley, a rapid growth in coal mining along the Ulan line and in the Gunnedah basin is expected to produce significant changes in coal demand in the

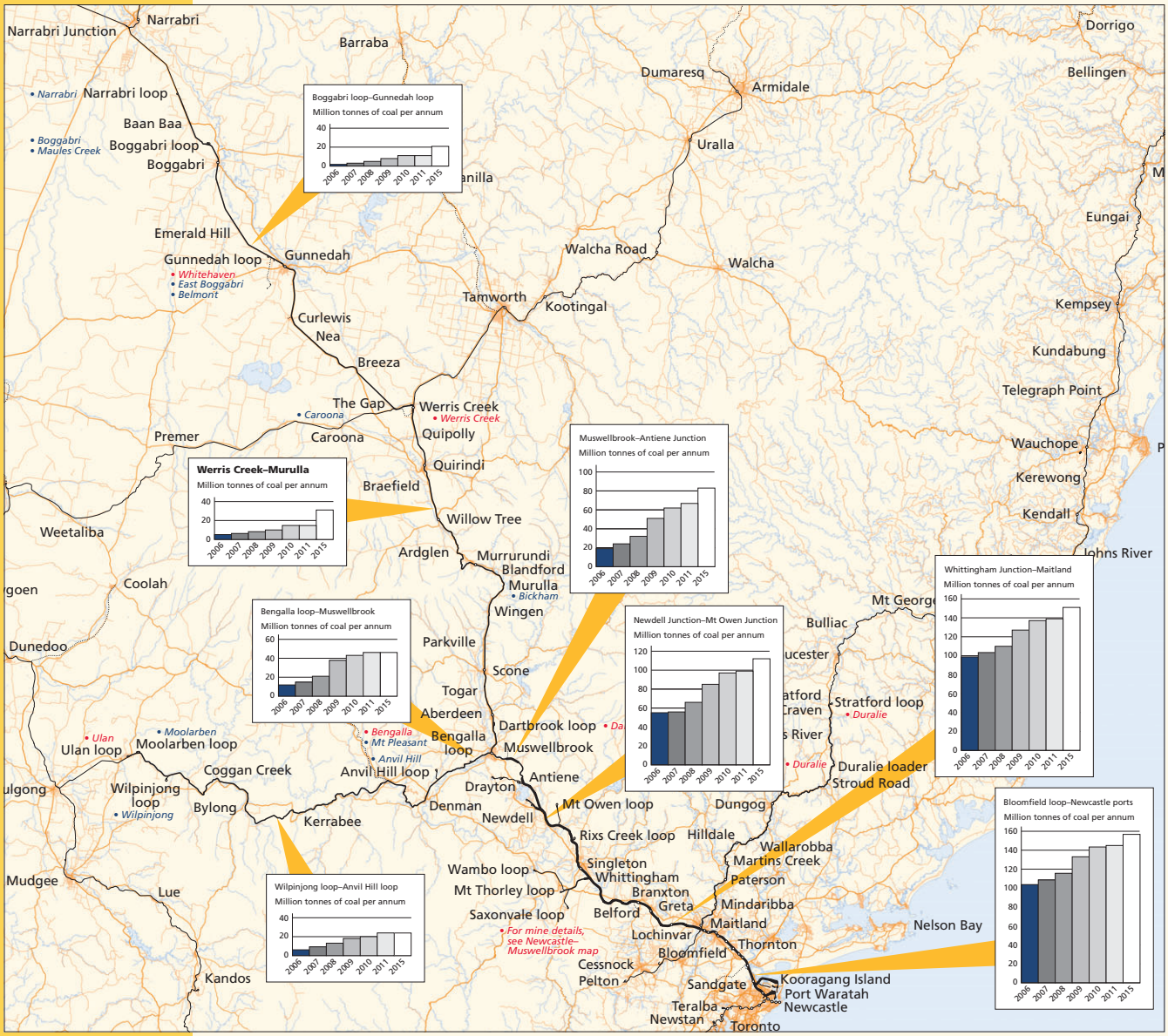


Figure A. The Hunter Valley coal network and forecasts of future coal transport demand on different sections of this network.

Upper Hunter and along these lines over the next few years (*Figures A and B*), necessitating a stronger focus than in the past on the single track sections of the network north of Antiene.

These demand forecasts, based on ARTC consultations with the coal mining industry, are towards the high end of expectations, and in the short term significantly exceed the combined capacity of the Newcastle export ports.

Even if export and domestic coal markets expand at the rates assumed in the coal industry's forecasts, there will have to be significant improvements in mining, loader and port capacities, as well as rail capacity, if the forecast tonnages are to be able to be achieved.

The ARTC will continue to closely monitor coal demand and port capacity expectations. The various capacity enhancement projects identified in this *Strategy* can then be implemented more quickly or more slowly as demand growth requires.

The ARTC will also continue to analyse and review the options available for responding to this growth in demand, right up to the commencement of construction, in order to ensure its projects deliver the greatest possible value for money.

This *Strategy* should therefore be regarded simply as presenting a 'snapshot' of the ARTC's thinking, and will be regularly reviewed and updated to reflect the bast available information and analysis.

How this *Strategy* has been developed

The starting point in the development of this *2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy* has been to identify the numbers of coal trains able to run through each 'track section' (either plain track or a junction) in the network.

The second step has been to harmonise capacity along the length of the line between Newcastle and Muswellbrook, so that headways on this line are either the same as those on adjacent track sections or a multiple of the adjacent achievable headways. This process tends to provide more capacity than is required as the distance from the port increases, but it allows trains to be timetabled straight through, with no delays caused by mismatches of headways or capacity.

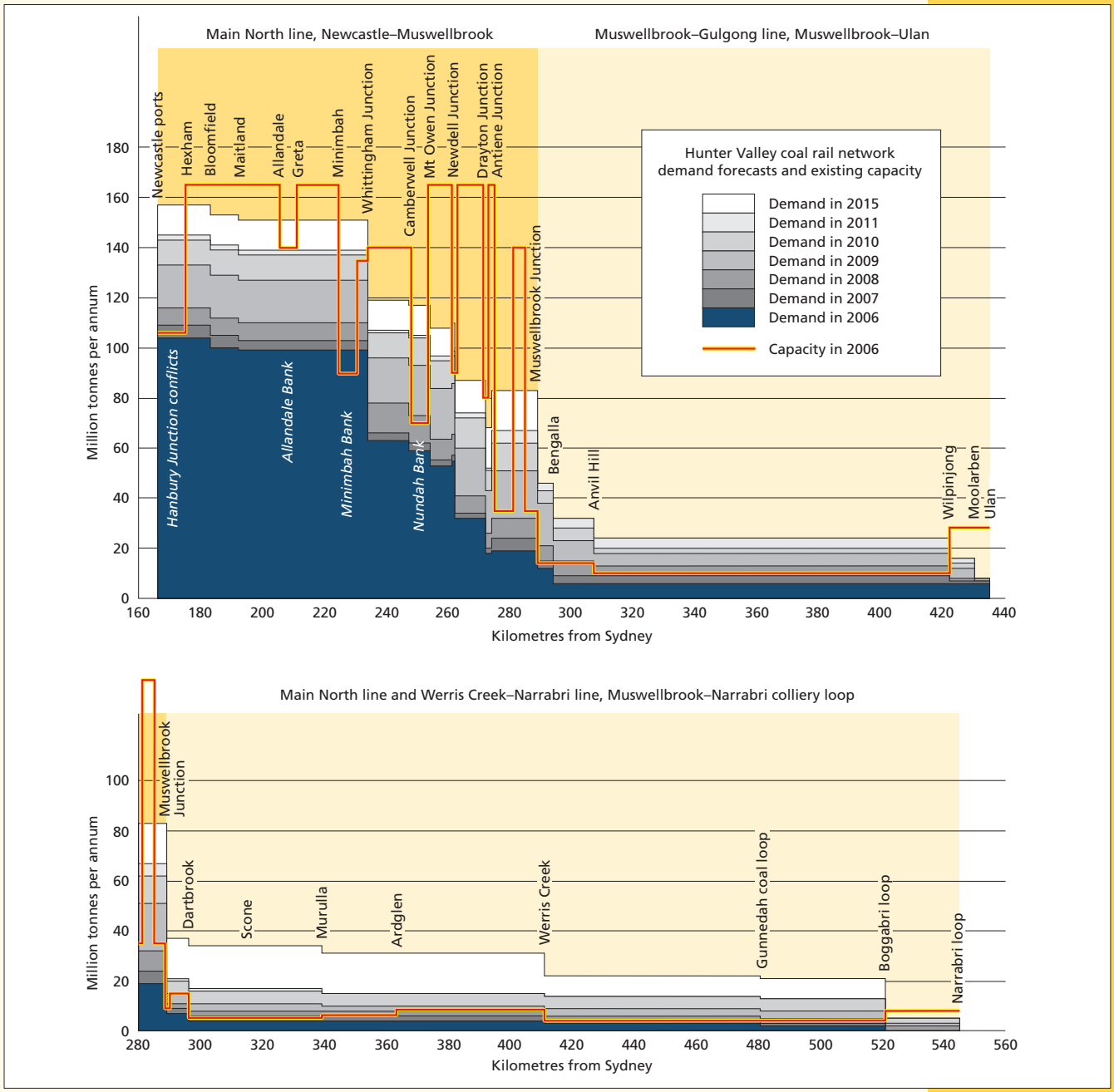


Figure B. *Forecast demand and current rail capacity (millions of tonnes per annum).*

For the period to 2010 or 2011 a standard minimum headway between coal trains of ten minutes will be adequate to cater for the forecast coal demand, but in subsequent years a minimum headway of eight minutes is likely to be required south of Whittingham Junction, making harmonisation a more challenging task.

The third step has been to relate the network's existing and potential capacities to likely future demands, in order to identify current and likely capacity constraints.

Previously identified options for addressing each of these constraints have then been reviewed and, where necessary, additional or refined options have also been developed, so that a preferred option could be identified, either for implementation or for more detailed investigation.

On the single track sections west and north of Muswellbrook, the focus has been on developing optimal combinations of passing loops to cater for medium-term demand while allowing individual projects for extended and 'infill' loops to proceed in a staged manner as demand increases over the next five years, along with signalling improvements on both of these lines.

The ARTC has commissioned a separate investigation into a possible realignment of the line through the Liverpool Range between Murrurundi and Willow Tree, but this *Strategy* identifies projects to increase capacity on the existing line in this area should it be concluded that a new alignment is not warranted in the short or medium term.

The recommended projects

The projects recommended in this *Strategy*, their timings (assuming demand patterns reflect the coal producers' forecasts) and their associated increases in the rail network's coal transport capacity are summarised in *Tables A to C* and *Figure C*.

***Table A*. Newcastle–Muswellbrook capacity enhancement projects.**

Line section	Existing capacity (mtpa)	Projects required by first half of 2007		Projects required by second half of 2007		Projects required by 2008		Projects required by 2009		Projects required by 2010		Projects required by 2011		Capacity available in 2011	Capacity forecast to be required in 2011 (mtpa)[1]	Capacity forecast to be required in 2015 (mtpa)[1]
		Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)			
Sandgate	106	Grade separation	165											165	146	159
Sandgate–Bloomfield	>165													165	146	159
Bloomfield–Maitland	>165													165	143	155
Maitland–Allandale[3]	165													165	141	153
Allandale–Branxton[3, 4]	140									Resignalling of Up track for 8-minute headways	165			165	141	153
Branxton–Whittingham	90	Resignalling for 80 km/h approaches	102	Resignalling for 10-minute headways	135					Third track for 8-minute headways	165			165	141	153
Whittingham Junction	135									Third track at and south of junction	155 Down, 165 Up			155 Down, 165 Up	141	153
Whittingham–Camberwell Junction[3, 4]	140									Resignalling of Down track, Singleton–Camberwell Jn, for 8-minute headways	165			165	109	121
Camberwell Junction–Glennies Creek[3]	70	Resignalling for 80 km/h approaches	86	Resignalling for 10-minute headways	140							Third track, to harmonise with 8-min headways further south	165	165	107	120
Glennies Creek– Newdell Junction[2, 3]	165													165	95–97	108–110
Newdell Junction[3]	90							Junction renewal	120					120	97	110
Newdell Junction–Drayton Junction[3]	165													165	74	87
Drayton Junction[3, 4]	80											Junction renewal	120	120	74	87
Drayton Junction–Antiene[3, 4]	165													165	52	68
Antiene–Grasstree[4]	35					Duplication	165							165	67	83
Grasstree–St Heliers[4]	140							Resignalling (with adjacent duplications)	165					165	67	83
St Heliers–Muswellbrook[4]	35			Muswellbrook Yard and loop extension	65			Completion of duplication	165					165	67	83

Notes: **1.** The forecast capacity requirements are the highest annualised values forecast for any quarter in the relevant calendar year. 2. Ashton coal is loaded onto northbound trains which reverse direction at the Newdell balloon loops. **3.** It is assumed that bi-directional signalling will be installed between Maitland and Branxton and between Whittingham and Antiene, accounting for 7.5 mtpa of the capacities shown for these sections. **4.** It is assumed that bi-directional signalling for 8-minute headways will be installed with the duplication works between Antiene and Muswellbrook. **5.** It is assumed resignalling for 8-minute headways between Allandale and Branxton, Singleton and Camberwell Junction and Drayton Junction and Muswellbrook will be carried out in conjunction with bi-directional signalling work. **6.** The infrastructure proposed for 2011 would have an additional capacity of 35 mtpa if trains were lengthened to close to their maximum permissible length (1,550 m). This is a matter for rail operators and loaders.

Table B. Muswellbrook–Ulan capacity enhancement projects.

Line section	Existing capacity (mtpa)	Projects required by second half of 2007		Projects required by 2008		Projects required by 2009		Projects required by 2010		Projects required by 2011		Capacity forecast to be required in 2011 (mtpa)	Capacity forecast to be required in 2015 (mtpa)
		Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)		
Ulan line through Muswellbrook	14	Muswellbrook Junction and loop extension (*Table 1*)	46									46	46
Muswellbrook–Bengalla	14	Muswellbrook Junction and loop extension, Centralised Train Control	46									46	46
Bengalla–Anvil Hill	14	Centralised Train Control		New passing loop at around 304 km	33							32	32
Anvil Hill–Wilpinjong	10	Centralised Train Control		New passing loop at around 381 km	18	New passing loop at around 410 km	20	New passing loops at around 348 and 370 km	28			24	24
Wilpinjong–Ulan	28	Centralised Train Control										16	16

Table C. Muswellbrook–Narrabri capacity enhancement projects.

Line section	Existing capacity (mtpa)	Projects required by second half of 2007		Projects required by 2008		Projects required by 2009		Projects required by 2010		Projects required by 2011		Capacity forecast to be required in 2011 (mtpa)	Capacity forecast to be required in 2015 (mtpa)
		Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)		
Werris Creek line through Muswellbrook	9	Muswellbrook Junction and loop extension (*Table 1*)	21									21	37
Muswellbrook–Dartbrook	15							New Koolbury passing loop	34			21	37
Dartbrook–Murulla	5	Togar passing loop extension	9			Parkville passing loop extension	15	(With new Koolbury passing loop)	17			17	34
Murulla–Werris Creek	6	Murulla passing loop extension	7	Ardglen, Willow Tree (or Chilcotts Creek) and Werris Creek Yard passing loop extensions	9	Ardglen–Kankool duplication (unless a realignment option is adopted) and Quirindi passing loop extension	10	Murrurundi passing loop extension	15			15	31
Werris Creek–Gunnedah coal loading loop	4	New Gunnedah passing loop and motorised turnouts at all passing loops	7			Curlewis passing loop extension and Centralised Train Control or ATMS train order working	12	New Burilda passing loop	15			14	22
Gunnedah coal loading loop–Boggabri coal loading loop	4	New Gunnedah passing loop and motorised turnouts at all passing loops	10					Emerald Hill passing loop extension and Centralised Train Control or ATMS	14			13	21
Boggabri coal loading loop–Narrabri colliery	8											5	5

Note: The coal capacity estimates in this table assume average coal train loads on this route will increase from 3,150 to 4,950 tonnes—an increase of 57%—from 2008.

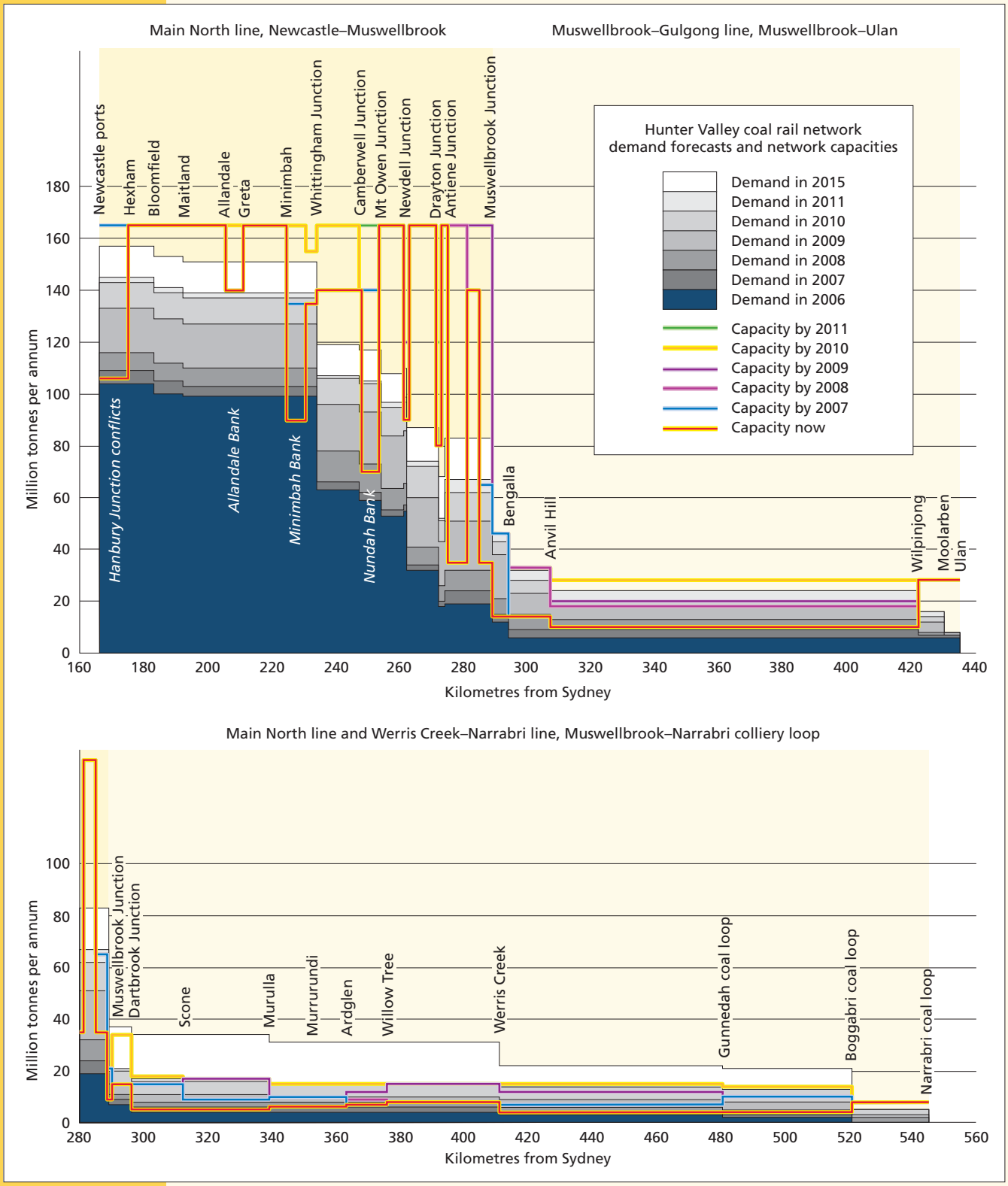


Figure C. Forecast coal demand and the rail network's coal transport capacities, with the projects recommended in this Strategy, at present and in 2007, 2008, 2009, 2010, 2011 and 2015 (millions of tonnes per annum).

***Table D.* Indicative project cost estimates.**

Required by	Project	Estimated cost (2006 $)
First half of 2007	Sandgate grade separation	$66.7 m
	Resignalling for 80 km/h approaching Minimbah Bank	$0.5 m
	Resignalling for 80 km/h approaching Nundah Bank	$0.5 m
Second half of 2007	Resignalling for 10-minute headways on Minimbah Bank	$1.0 m
	Resignalling for 10-minute headways on Nundah Bank	$1.0 m
	Muswellbrook Junction and passing loop extension	$10.2 m
	Ulan line Centralised Train Control	$15.5 m
	Togar passing loop extension	$3.5 m
	Murulla passing loop extension	$3.5 m
	Gunnedah passing loop (NSW Rail Infrastructure Corporation (RIC area)	$3.5 m
	Power operation of passing loop turnouts, Werris Creek–Narrabri (RIC area)	$8.0 m
January 2008	Bi-directional signalling, Whittingham–Newdell Junction	$11.5 m
	Antiene–Grasstree duplication (including bi-directional signalling)	$21.0 m
	304 km passing loop on Ulan line	$8.2 m
	381 km passing loop on Ulan line	$8.2 m
	Ardglen passing loop extension	$3.5 m
	Willow Tree passing loop extension (or new Chilcotts Creek loop)	$3.5 m
	Werris Creek Yard passing loop extension	$3.5 m
January 2009	Bi-directional resignalling, Maitland–Branxton	$13.4 m
	Newdell Junction upgrading	$6.9 m
	Bi-directional resignalling, Grasstree–St Heliers	$7.0 m
	St Heliers–Muswellbrook duplication (including bi-directional signalling)	$21.9 m
	410 km passing loop on Ulan line	$8.2 m
	Parkville passing loop extension	$3.5 m
	Ardglen–Kankool duplication	$12.0 m
	Quirindi passing loop extension	$3.5 m
	Curlewis passing loop extension (RIC area)	$3.5 m
	Centralised Train Control, Werris Creek to Narrabri (RIC area)	$10.4 m
January 2010	Resignalling on Allandale Bank for 8-minute headways	$1.0 m
	Third track on Minimbah Bank for 8-minute headways	$40.2 m
	Bi-directional resignalling, Newdell Junction to Drayton Junction	$7.2 m
	348 km passing loop on Ulan line	$8.2 m
	370 km passing loop on Ulan line	$8.2 m
	Koolbury passing loop	$5.0 m
	Murrurundi passing loop extension	$3.5 m
	Burilda passing loop (RIC area)	$3.5 m
	Emerald Hill passing loop extension (RIC area)	$3.5 m
January 2011	Third track on Nundah Bank for 8-minute headways	$27.6 m
	Drayton Junction upgrading	$4.2 m

Indicative budget estimates for all the projects are summarised in *Table D*.

When it commencement its NSW lease, the ARTC indicated that it would spend at least $153 million on investments in the Hunter Valley over the first five years of the lease. In combination with on-going infrastructure renewal investments and the Sandgate grade separation project, the projects set out in this *Strategy* now lift the ARTC's expected expenditure on major capital enhancements to the Hunter Valley network to $375 million over the next five years. (In comparison, in the May 2005 'Version 4' of this *Strategy* the forecast expenditure was $270 million, an estimate that included not only the major projects but also minor upgrades, the consolidation of train control and major periodic maintenance/renewals.)

Although the capital commitments to be made by the ARTC are large and have increased significantly, these commitments would be made in the context of—and within timeframes that match—an even greater growth in the volumes of coal to be transported over longer distances.

As a result, there would be a significant reduction in Hunter Valley coal haulage costs per tonne kilometre (*Figure D*), making Hunter Valley coal significantly more competitive.

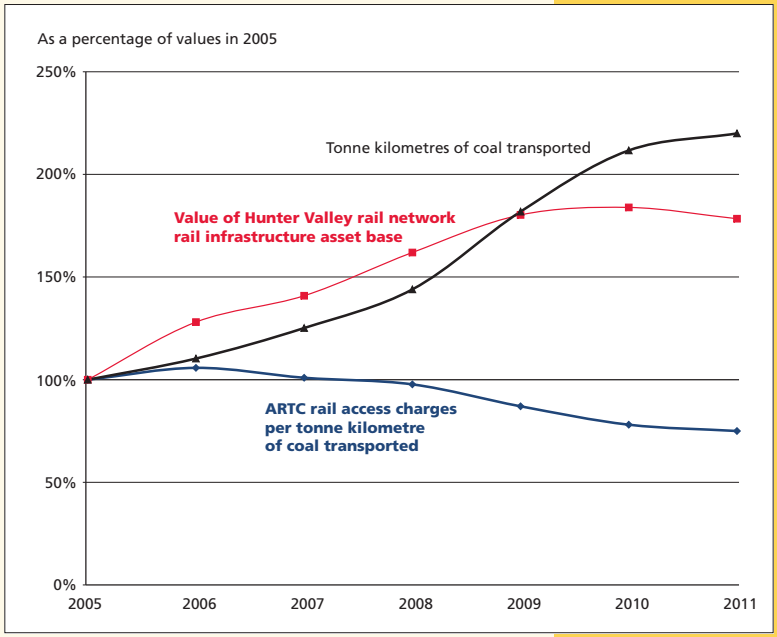


Figure D. *Despite their high capital cost, the projects recommended in this Strategy will significantly reduce coal haulage costs per tonne kilometre on the Hunter Valley coal rail network.*

1 Introduction

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

The 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 the ARTC.

As part of its proposal for this lease, in 2002 the ARTC developed a detailed, $872 million infrastructure investment program for the NSW rail network and the Melbourne–Albury corridor.

In late 2004 and early 2005 the Hunter Valley network aspects of this investment program were reviewed and updated by the ARTC in the light of the rapid growth in coal demand over the last few years. A first draft of the resultant *Hunter Valley Corridor Capacity Improvement Strategy* was released in February 2005, and following extensive consultations an updated 'Version 4' was released in May 2005.

This *2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy* is a further development and updating of the 'Version 4' strategy of May 2005, using revised forecasts of coal demand and the results of further analyses during 2005 and early 2006.

In common with the earlier strategies, it identifies the 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 the ARTC in developing this *Strategy* has been to increase capacity (with a reserve surge capability) to levels sufficient to meet anticipated demands for export and domestic coal transport, while at the same time achieving greater operational harmony between the various sections of the Hunter Valley network.

The Hunter Valley coal network

At present the export coal capacity of the Hunter Valley rail network averages around 106 million tonnes per annum (mtpa).

This estimate is higher than the equivalent estimate in earlier versions of this *Strategy* (85 mtpa), as ARTC analyses have now established that the existing infrastructure can be 'pushed' to the higher level, but it should be noted that the revised estimate assumes a favourable pattern of coal demand origins, and may not be able to be realised in practice.

Industry forecasts indicate that in the absence of capacity constraints at the Newcastle ports total coal demand on the Hunter Valley network could be about 104 mtpa in 2006, increasing to around 109 mtpa in 2007, 116 mtpa in 2008, 133 mtpa in 2009, 143 mtpa in 2010, 145 mtpa in 2011 and, more speculatively, 157 mtpa in 2015.

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

Most of this coal comes from a series of mines and coal loaders strung out along the Hunter Valley, conveyed to the ports on the railway that runs between Muswellbrook and Newcastle. Coal also feeds onto this line from Ulan and Gunnedah, west and northwest of Muswellbrook, and, much closer to the ports, from Stratford, Pelton and

A loaded coal train climbing the 'Minimbah Bank' south of Whittingham Junction, on the way to Newcastle.

Figure 1. The general location of the Hunter Valley coal rail network on the eastern coast of New South Wales.

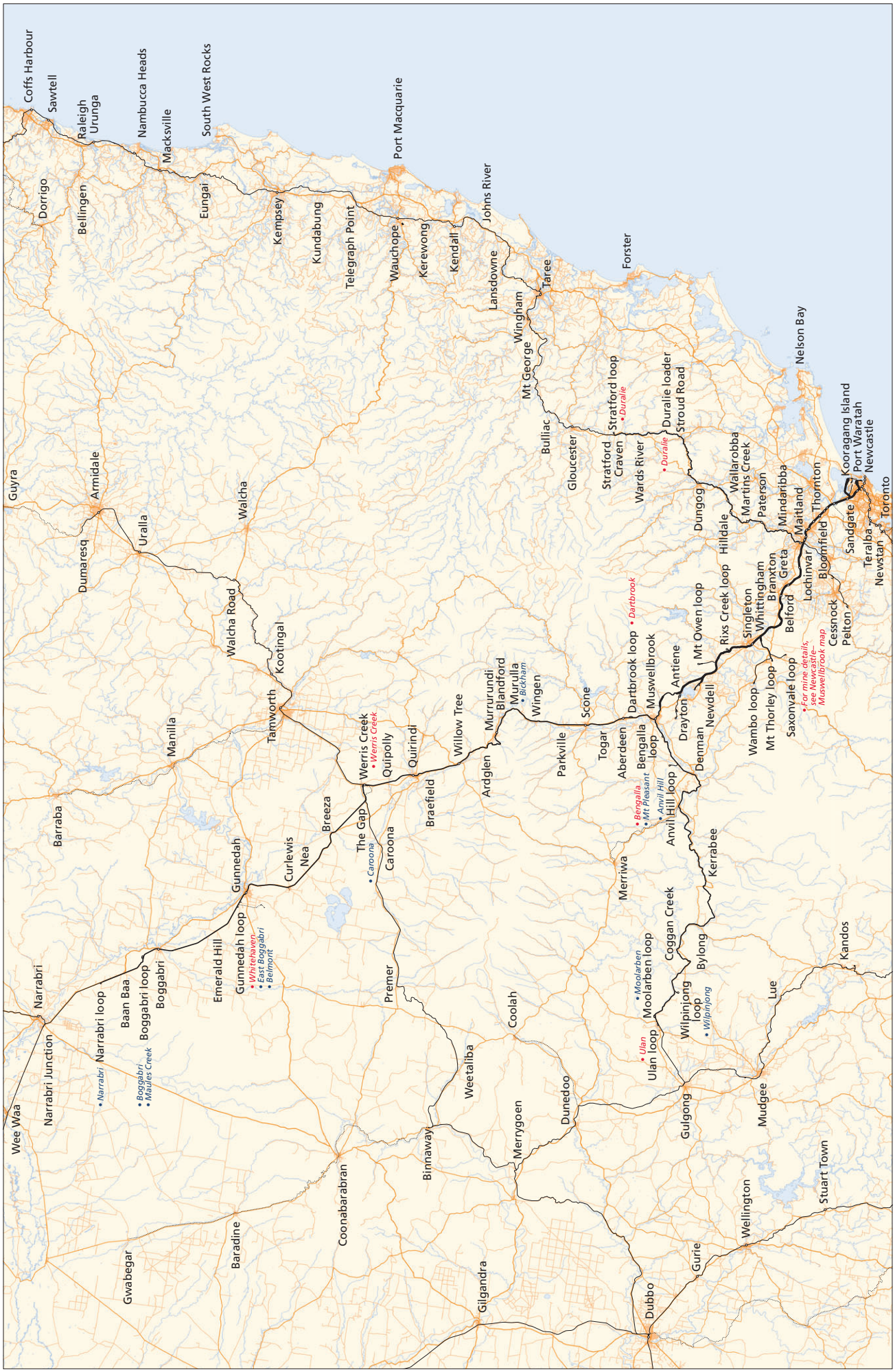


Figure 2. The Hunter Valley coal rail network (Newcastle to Narrabri and Ulan) and other railways in the area. Existing coal mines serviced by rail loops and sidings along this network are shown in red and proposed mines are shown in blue.

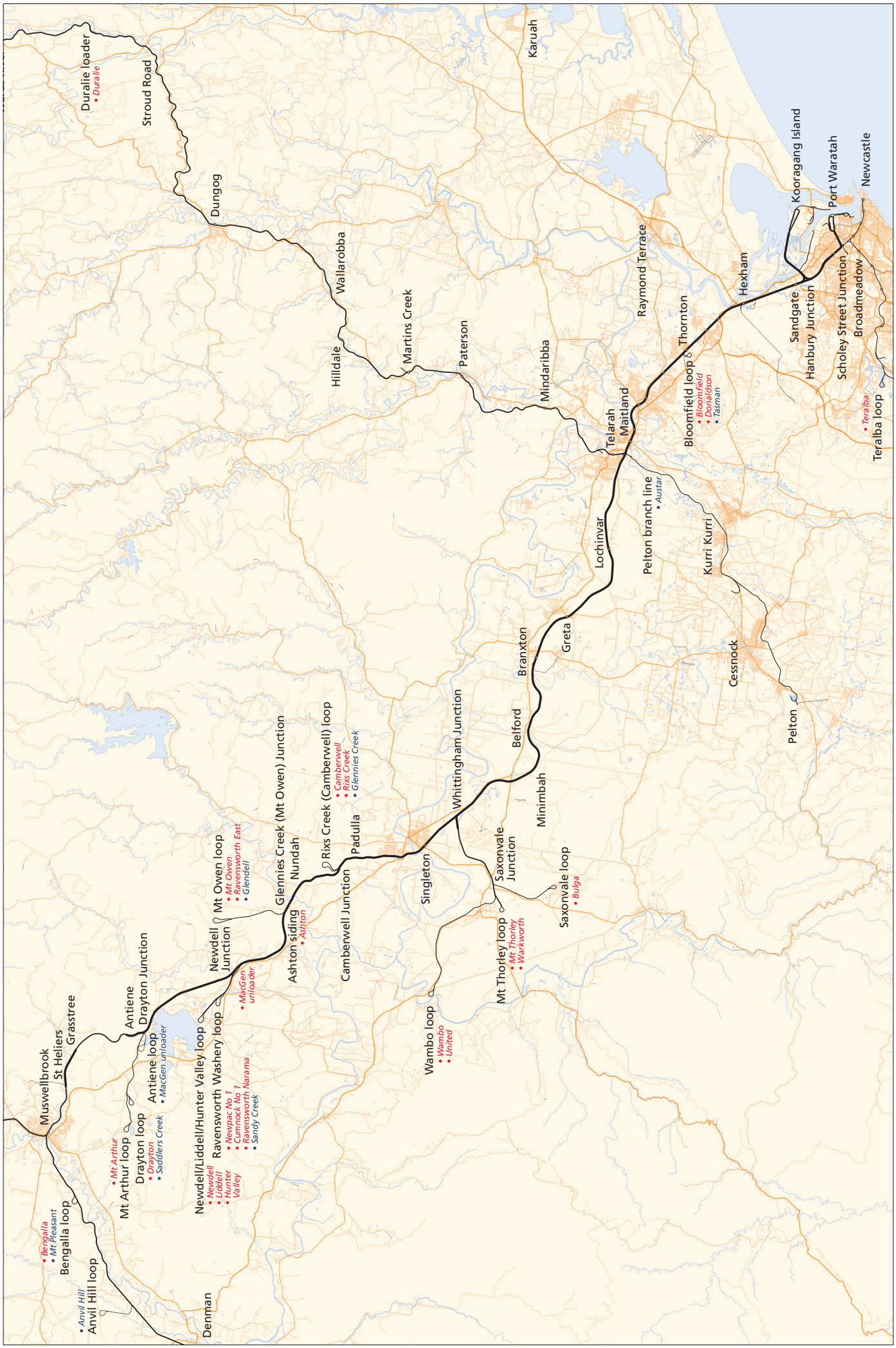


Figure 3. The Newcastle ports to Muswellbrook sections of the Hunter Valley coal rail network. Existing coal mines and power station coal unloaders serviced by rail loops and sidings along this network are shown in red and proposed mines etc are shown in blue.

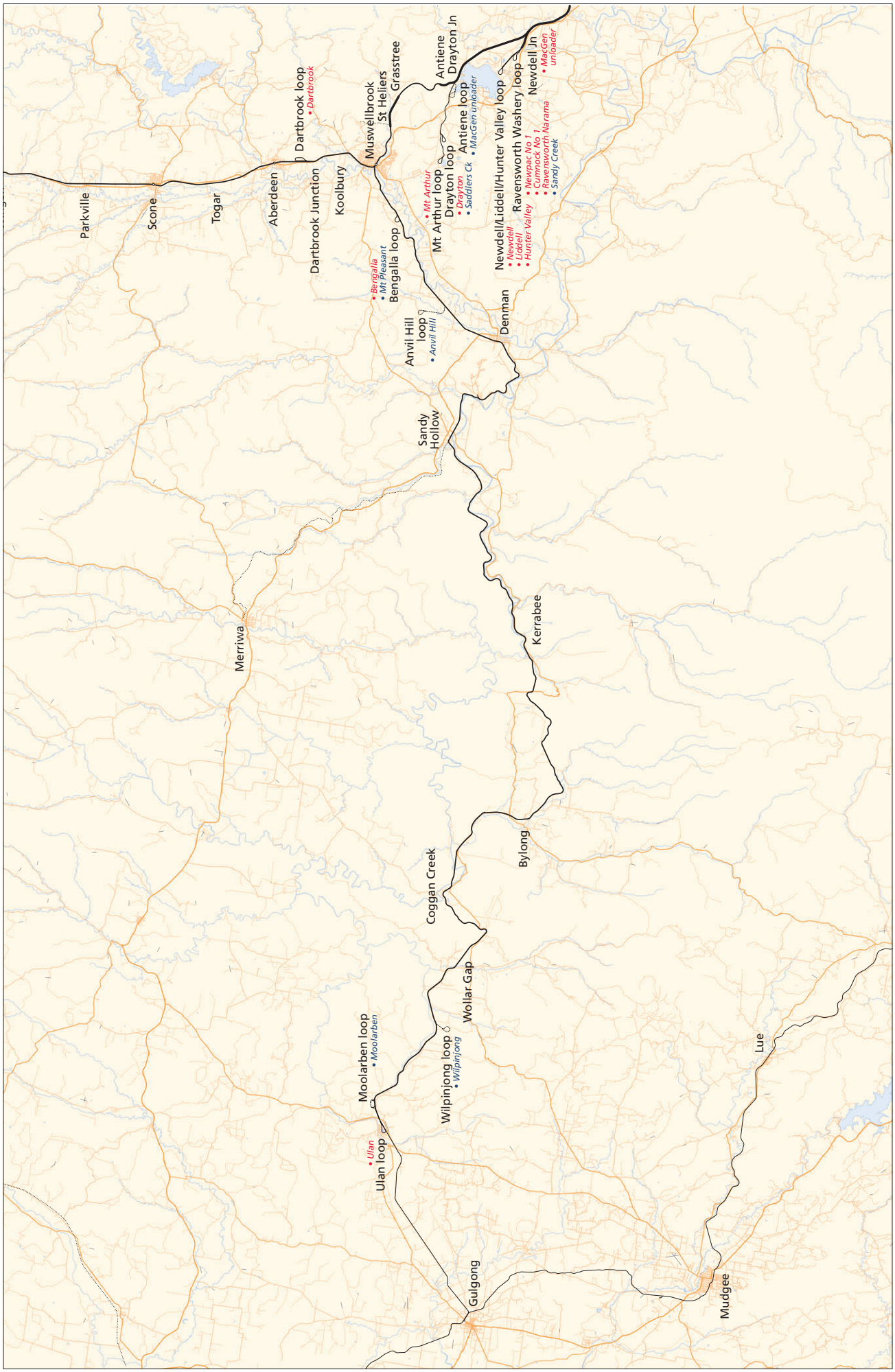


Figure 4. The Muswellbrook to Ulan sections of the Hunter Valley coal rail network. Existing coal mines and power station coal unloaders serviced by rail loops and sidings along this network are shown in red and proposed mines etc are shown in blue.

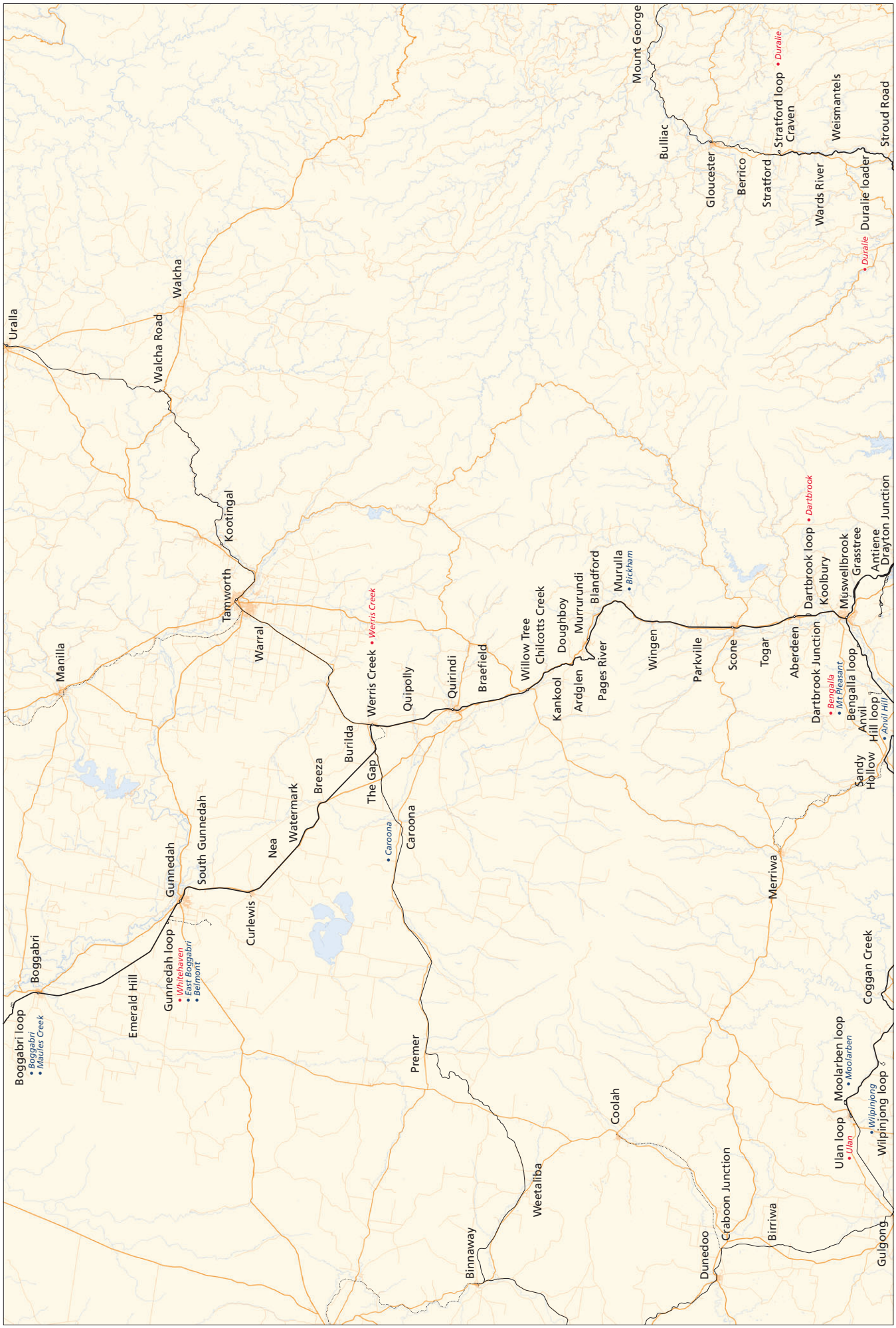


Figure 5. The Muswellbrook to Boggabri sections of the Hunter Valley coal rail network. Existing coal mines serviced by rail loops and sidings along this network are shown in red and proposed mines are shown in blue.

Coal train entering the line to the port facilities on Kooragang Island from the 'coal line' tracks at Hanbury Junction, across the 'main line' tracks. The Sandgate grade separation project, now under construction, will eliminate these flat junction conflicts.

Bloomfield and from the Newstan and Teralba mines south of Newcastle* (*Figures 1 to 5*).

Domestic coal is also transported over the same network. This sector is comparatively small, but demand is anticipated to grow substantially over the next five years, especially on the Ulan and Upper Hunter lines.

The Hunter Valley coal network consists of a dedicated double track 'coal line' between Port Waratah and Maitland, a shared double track line from Maitland to Antiene and a shared single track with passing loops and some short sections of double track from that point north and west (*Figures 2 to 5).*

The heaviest coal volumes are at the lower end of the Hunter Valley, but the expected growth in coal mining along the Ulan line and in the Gunnedah basin is likely to produce significant changes in coal demand and traffic patterns over the next few years (*Figure 6*), necessitating a stronger focus in this *Strategy* on the single track sections of the network north of Antiene.

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 outlying track sections, north of Dartbrook Junction near Muswellbrook, are rated only for 25 tonne axle loads (100 tonne wagons).

There are currently 23 export coal trains made up of '120 tonne' wagons and eight made up of '100 tonne' wagons.

Across the whole fleet, the average coal capacity is around 5,600 tonnes per train load. At the existing coal volumes, an average of around 50 loaded trains need to be run each day, or one every 29 minutes.

Train lengths vary from around 1,000 metres to 1,550 metres, apart from a small group of 'short' trains of 760 metres dedicated to Gunnedah and Stratford services.

Trains made up of '120 tonne' wagons are restricted to 60 km/h, while '100 tonne wagon' coal trains are allowed to travel at 80 km/h on the core coal network and 65 km/h on the line to Narrabri north of Muswellbrook. Because most of the coal trains are '120 tonne wagon' trains, the coal network tends to move at 60 km/h.

The whole Hunter Valley coal supply chain is interrelated. The stockpiling and loading capability of the mines affect the trains required, the trains affect the rail infrastructure and so on.

How this *Strategy* has been developed

The development of this *2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy* has involved:

- Assessments of the capacity of the existing Hunter Valley rail network for transporting export coal to the Newcastle ports and domestic coal to Hunter Valley power stations
- Comparisons of this capacity with anticipated demand, to identify existing and future likely constraints
- Reviews of the options previously proposed to address these constraints

120-tonne wagons with 30 tonne axle loads (left) and 100-tonne wagons with 25-tonne axle loads (right).

* Because this traffic from the south operates on the RailCorp rail network as far as Broadmeadow, and faces no capacity problems on the short section of the ARTC network over which it travels, this *Strategy* does not specifically discuss these movements.

Southbound coal train on the twin-track section between St Heliers and Grasstree, southeast of Muswellbrook.

A loaded coal train on the Mt Thorley branch line south of Singleton.

- Where necessary, the development of additional or refined options, and
- The selection of preferred actions to address each of the identified constraints.

The capacity of any rail system fundamentally depends on two factors:

- The number of trains able to be run over a track section in a given period of time (or, viewed another way, the minimum time separation or 'headway' between these trains), and
- The carrying capacity of the trains.

Partly because of its short-term focus, this *2006–2011 Strategy* focuses primarily on the *number* of trains able to use the Hunter Valley's rail infrastructure. However, it recognises that track-related issues will also have an impact on the carrying capacity of these trains, and *vice versa*, so train carrying capacity issues, including the use of longer and heavier trains, have also been considered.

The starting point has been to identify the numbers of coal trains able to run through each 'track section' (either plain track or a junction) in the network. This has been done by calculating the underlying headways that can be achieved, and then making allowances for the effects of conflicts at junctions, the use of the lines by non-coal trains and maintenance of the tracks and other rail infrastructure.

The second step has been to harmonise capacity along the length of the line between Newcastle and Muswell-

Several coal loaders and private coal loading loops, branch lines and sidings will also need to be upgraded as coal throughput increases.

An empty northbound coal train passing a loaded southbound grain train at the Ardglen passing loop in the Liverpool Range, on the Main North line between Muswellbrook and Werris Creek.

brook, so that headways on this line are either the same as those on adjacent track sections or a multiple of the adjacent achievable headways.

This process tends to provide more capacity than is required as the distance from the ports increases, but it allows trains to be timetabled straight through, with no delays caused by mismatches of headways or capacity.

For the period to 2010 or 2011 a standard minimum headway between coal trains of ten minutes will be adequate to cater for the forecast coal demand, but in subsequent years a minimum headway of eight minutes is likely to be required south of Whittingham Junction, making harmonisation a more challenging task.

The third step has been to relate the network's existing and potential capacities—the latter depending on the options available—to likely future demands, in order to identify current and likely capacity constraints.

Previously identified options for addressing each of these constraints have then been reviewed and, where necessary, additional or refined options have also been developed, so that a preferred option could be identified, either for implementation or for more detailed investigation.

Frequently the capacity increments resulting from rail infrastructure improvements are large, so that significant spare local capacity will become available when a project is

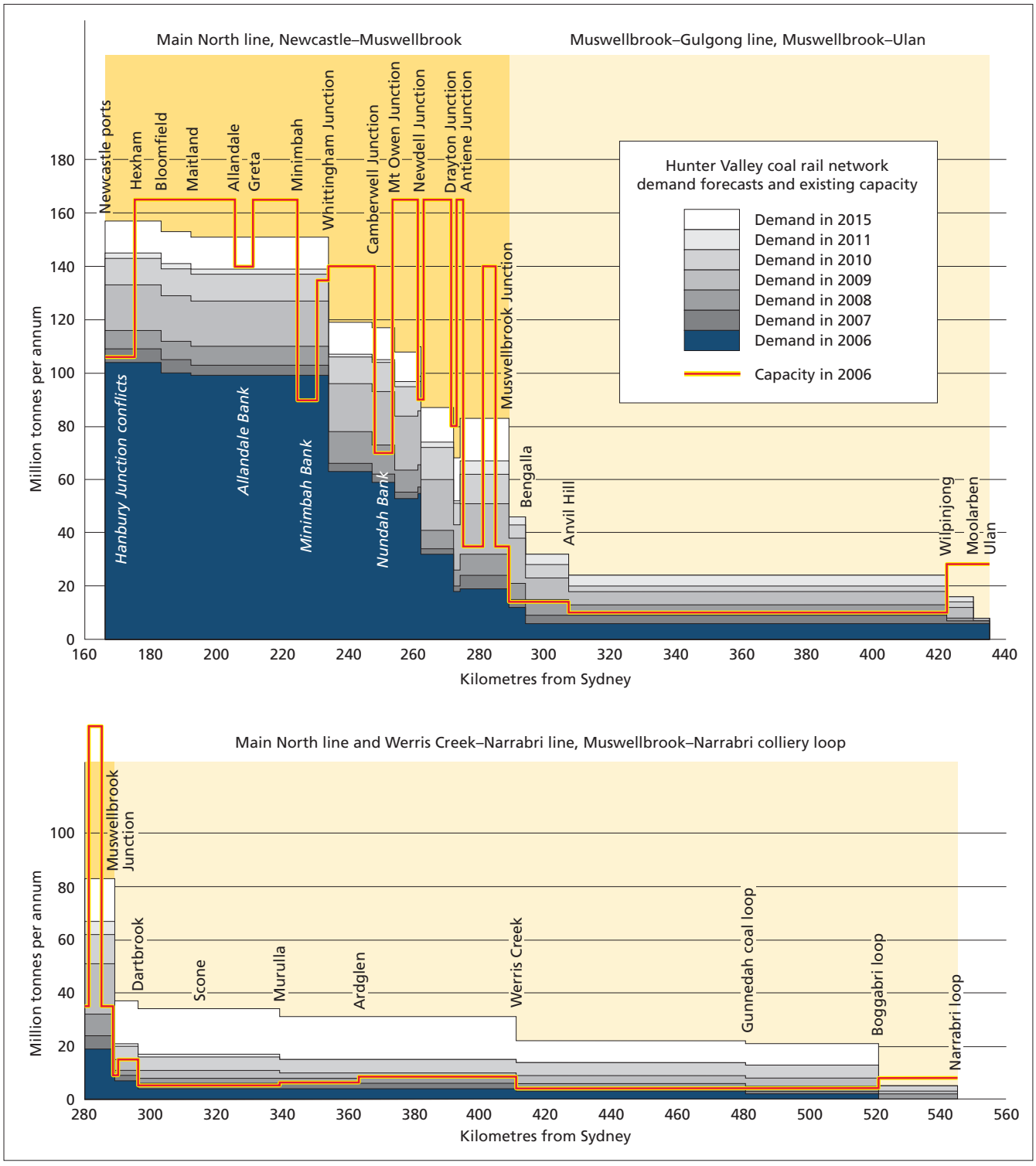


Figure 6. *Forecast demand and current rail capacity (millions of tonnes per annum).*

completed. Usually this means a capacity constraint elsewhere in the network will then become the critical constraint for the line.

In this way various projects have been identified for increasing rail capacity, reducing the track closures required for maintenance and/or building greater reliability into the Hunter Valley coal network.

Assumptions and qualifications

As already indicated, this *Strategy* assumes that the forecast coal demand of 104 mtpa for 2006 will increase to around 116 mtpa in 2008, 145 mtpa in 2011 and 157 mtpa in 2015.

Figure 6 compares these projected coal tonnage demands in 2006, 2007, 2008, 2009, 2010, 2011 and 2015 with current modelled rail capacity, and *Figure 7* makes the equivalent comparisons in terms of the numbers of coal train paths required per day.

The demand forecasts are based on ARTC consultations with the coal mining industry. They are towards the high end of expectations, and in the case of the 2015 estimates—beyond the immediate five-year timeframe that is the primary focus of this *Strategy*—they assume there will be substantial post-2011 increases in the outputs of Gunnedah Basin mines, especially at Maules Creek, north-

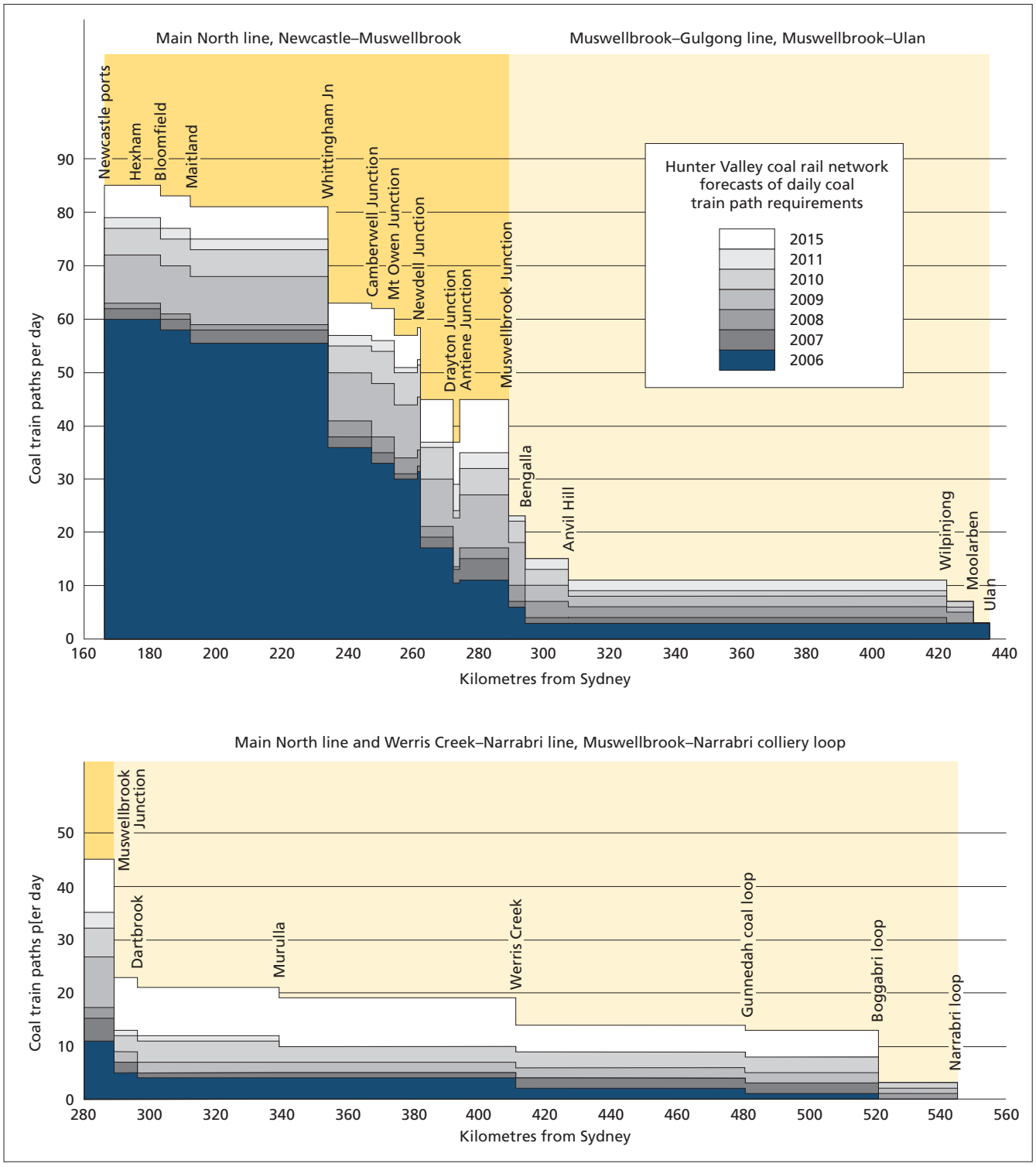


Figure 7. Forecast demand and rail capacity (round-trip coal train paths per day).

east of Boggabri, and a proposed new mine at Caroona, west of Werris Creek.

In addition, even if export and domestic coal markets expand at the rates assumed in the coal industry's forecasts, there will have to be significant improvements in mining, loader and port capacities, as well as rail capacity, if the forecast tonnages are to be able to be achieved.

As *Figure 8* illustrates, the demand forecasts for the next three years significantly exceed the forecast combined capacity of the Newcastle ports. Because the ARTC does not know which producers will fail to obtain the full port access assumed in the demand forecasts, it is not possible to adjust the demand forecasts for individual sections of the rail network so that they more closely reflect realistically achievable volumes. However, ARTC analyses have determined that the constraints imposed by limited port capacity will *not*, in any event, affect the dates by which rail projects are required or the sequencing of these projects in this *Strategy*.

The ARTC will continue to closely monitor coal demand and port capacity expectations. The various capacity enhancement projects identified in this *Strategy* can then be implemented more quickly or more slowly as demand growth requires.

The ARTC will also continue to analyse and review the options available for responding to this growth in demand, right up to the commencement of construction, in order to

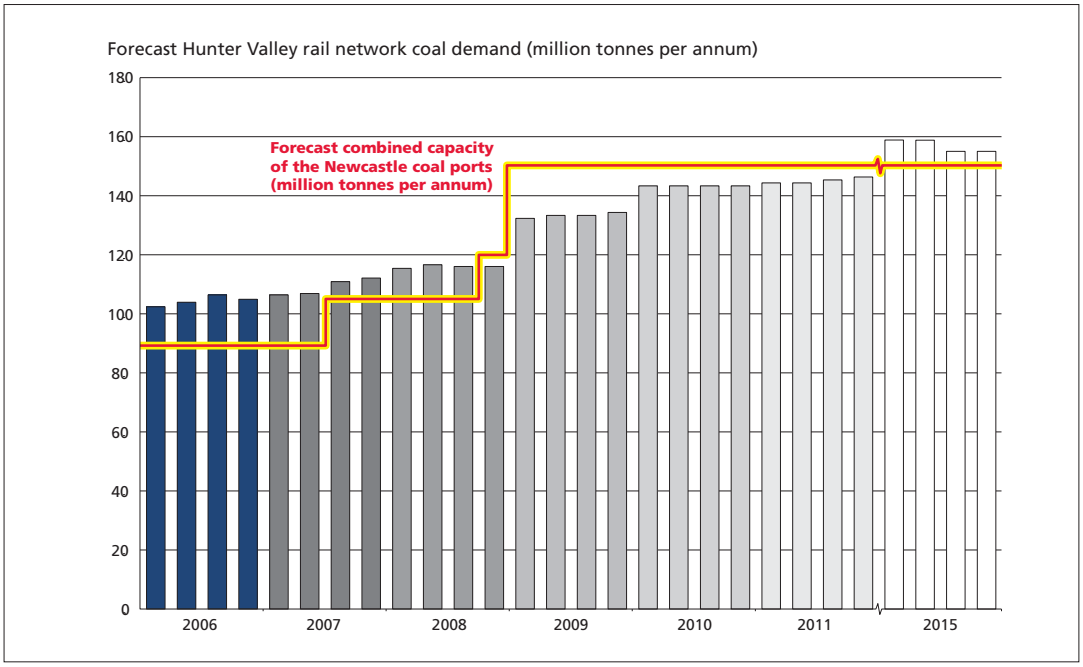


Figure 8. A comparison of the coal industry's demand forecasts assumed in this Strategy and the forecast combined Newcastle export ports' capacity. ARTC analyses have shown, however, that the forecast shortfall in port capacity will not affect the required timing or sequencing of the Hunter Valley rail network projects described in this Capacity Improvements Strategy.

ensure its projects deliver the greatest possible value for money.

This *Strategy* should therefore be regarded simply as presenting a 'snapshot' of the ARTC's thinking, and will be regularly reviewed and updated to reflect the bast available information and analysis.

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

- No recommendations have been made in relation to Kooragang Yard. This interface between the rail network and the ports needs to be examined separately, in the light of recent decisions to develop a third Newcastle export coal loader, on Kooragang Island.
- It is assumed that the Sandgate grade separation, currently under construction, will be completed.

  The resultant removal of the existing flat crossing conflicts at Hanbury Junction (*Figure 3*), where coal trains cross over the two 'main line' tracks when moving between the 'coal line' tracks and the line to Kooragang Island, will make at least 50 additional freight train paths per day available on the 'main line' at Sandgate. These paths will be useful both for through freight trains and for coal trains travelling on to Port Waratah via the 'main line' and then the Warabrook or Waratah crossovers to the 'coal line' north of the Scholey Street Junction.

  This additional capacity, in combination with the minimum eight-minute headways already provided by the dedicated 'coal line', means there is no apparent impediment to carrying the forecast coal tonnages between Maitland and Sandgate, and this section will not hinder the achievement of capacities planned for the sections northwest of Maitland.
- The full capacity gain achieved by each project will apply only in the area directly affected by the project, and may not be able to be realised in practice because of constraints in other areas. In general, however, the line sections between any given project and the ports will have sufficient spare capacity to allow a reasonable proportion of the project's gain to be immediately achieved.
- The capacity gains referred to in this *Strategy* take no account of the capabilities of loading and unloading interfaces, including the capabilities of private rail sidings and loops. In other words, at the conclusion of each project the identified rail capacity will be available, but this does not necessarily mean the coal supply chain will be able to make use of this capacity at that stage.
- The capacity gains associated with several of the projects depend on the implementation of other projects. The timeframes for capacity gains reported in this *Strategy* are therefore based on the project priority order identified in the *Strategy*, and would almost certainly change if the sequence were altered.
- Estimates of the numbers of trains required to carry the forecast coal tonnages are based on the average train coal-carrying capacities applying in 2006, including QRNational's 74-wagon Mount Arthur mine trains (7,500 tonnes), apart from:
  - The reintroduction of longer Pacific National '120 tonne wagon' trains on the 30-tonne axle loading sections of the network once the initial Minimbah Bank and Nundah Bank signalling enhancement projects described in section 2 of this *Strategy* are completed, with the currently dominant use of 53-wagon trains (5,000 tonnes), with some 80-wagon trains (7,600 tonnes), being replaced by 60-wagon trains (5,700 tonnes) and 91-wagon trains (8,650 tonnes) respectively, and
  - The introduction of longer '100 tonne wagon' trains on the 25-tonne axle loading sections of the network north of Dartbrook Junction, up from 42 wagons (3,150 tonnes) to 66 wagons (4,950 tonnes), from 2008.
- It is assumed that 50% of the train paths on double track sections created by the projects will be available

An eastbound coal train on the Main North line at Branxton, headed to Newcastle.

A loaded train on the twin-track section between St Heliers and Grasstree, east of Muswellbrook.

for coal, with the balance being consumed by passenger services, other freight services, maintenance requirements and unscheduled delays.

Although the number of paths will progressively increase as the works are completed, so too will the impact of non-coal activities.

In particular, passenger services, which operate at faster speeds than coal trains and thereby cause a "shadow" effect by running down trains in front and outrunning trains behind, will have a correspondingly greater impact as train headways are reduced.

Similarly, if maintenance occupies the same amount of track time, maintenance will affect more paths as the frequency of paths increases.*

Accordingly, the 50% loss of paths currently prevailing on the network has been assumed to continue.

* In practice, there will be pressure for greater amounts of track time to be available for maintenance, because the greater tonnages will increase track maintenance requirements. This means it will be necessary to develop ways of increasing the amount of maintenance work able to be carried out in any given track closure time and/or to provide a further small increase in track capacity, as discussed in section 7.

2 Reducing headways on the Nundah, Minimbah and Allandale Banks

The constraints

Between the ports and Muswellbrook there are only three 'plain track' sections of the coal rail network—as distinct from the junctions, considered in section 3 of this *Strategy*—for which the minimum headway between loaded coal trains is more than ten minutes:

- The 'Minimbah Bank', which climbs from just south of Muddies Creek to a crest just south of Minimbah (*Figure 9*)
- The 'Nundah Bank', another climb from Glennies Creek to a crest on the line just south of Camberwell Junction (*Figure 9*), and
- The section between Muswellbrook and Antiene, most of which is a single shared track (see section 4 of this *Strategy*).

The minimum headways for loaded coal trains on the Minimbah and Nundah Banks are currently around 17 and 20 minutes, respectively.

If these headways were reduced to ten minutes these sections would be harmonised with the rest of the double track rail system, with the whole line from Antiene/Drayton Junction to Sandgate being able to provide coal train paths at ten-minute intervals, sufficient for the forecast coal demand until 2010 or 2011.

Although only 50% of Hunter Valley coal trains negotiate the Nundah Bank, compared to 95% at Minimbah (*Figures 6 and 7*), in order for train pathing to be harmonised over the length of the main double track coal network minimum coal train headways will need to be reduced to ten minutes over both of these grades.

After 2010 or 2011 minimum headways south of Whittingham Junction will need to be reduced to eight minutes to accommodate the forecast coal demand, potentially necessitating works on the Allandale Bank (*Figure 9*) as well as more extensive works on the Minimbah Bank and (for harmonisation purposes) the Nundah Bank.

The options

Four options have been identified to remove the headway constraints on the Minimbah, Nundah and Allandale Banks:

- Track deviations with reduced grades
- Additional tracks on the current routes
- Resignalling on the approaches to the banks to permit increased speeds for loaded '120 tonne wagon' coal trains approaching the grades, and

A southbound coal train climbing the Minimbah Bank.

- Re-signalling on the current banks to allow ten-minute headways for loaded coal trains.

Track deviations would have high capital costs and take several years to complete. They would not be able to be staged, so in each case no benefits would be realised until the deviation was completed. Carefully designed signalling to resolve the headway issue would still be required. For these reasons, deviations are not an attractive solution to these capacity constraints.

A third track on the existing routes would not only facilitate robust short headways but would allow overtaking and parallel running over the slow speed sections, further enhancing capacity and flexibility. More specifically, this option would:

- Allow two trains to be on the grade without the risk of the second train's needing to come to a stop
- Provide greater recovery flexibility if a train stalls on the grade
- Reduce the impact of the capacity "shadow" caused by passenger trains, by allowing passenger services to overtake coal trains on the grade, where the speed. differential is greatest
- Permit re-sequencing of coal trains if this is required, and
- In the case of the Minimbah Bank, reduce the capacity impacts of coal trains entering at Whittingham Junction. (Because these trains cannot reach 80 km/h before they arrive at the Minimbah Bank, they have a slower journey up the grade.)

While the third track option has a high cost and long lead times, re-signalling solutions alone can only reduce the practical minimum headway to about ten minutes. When eight-minute headways are required, a third track is likely to become essential.

The two re-signalling options have much lower costs and would be relatively quick to implement.

It is therefore proposed initially to institute limited signalling enhancements to allow '120 tonne wagon' coal trains to run at 80 km/h on the approaches to the Nundah and Minimbah Banks, reducing the minimum headways by

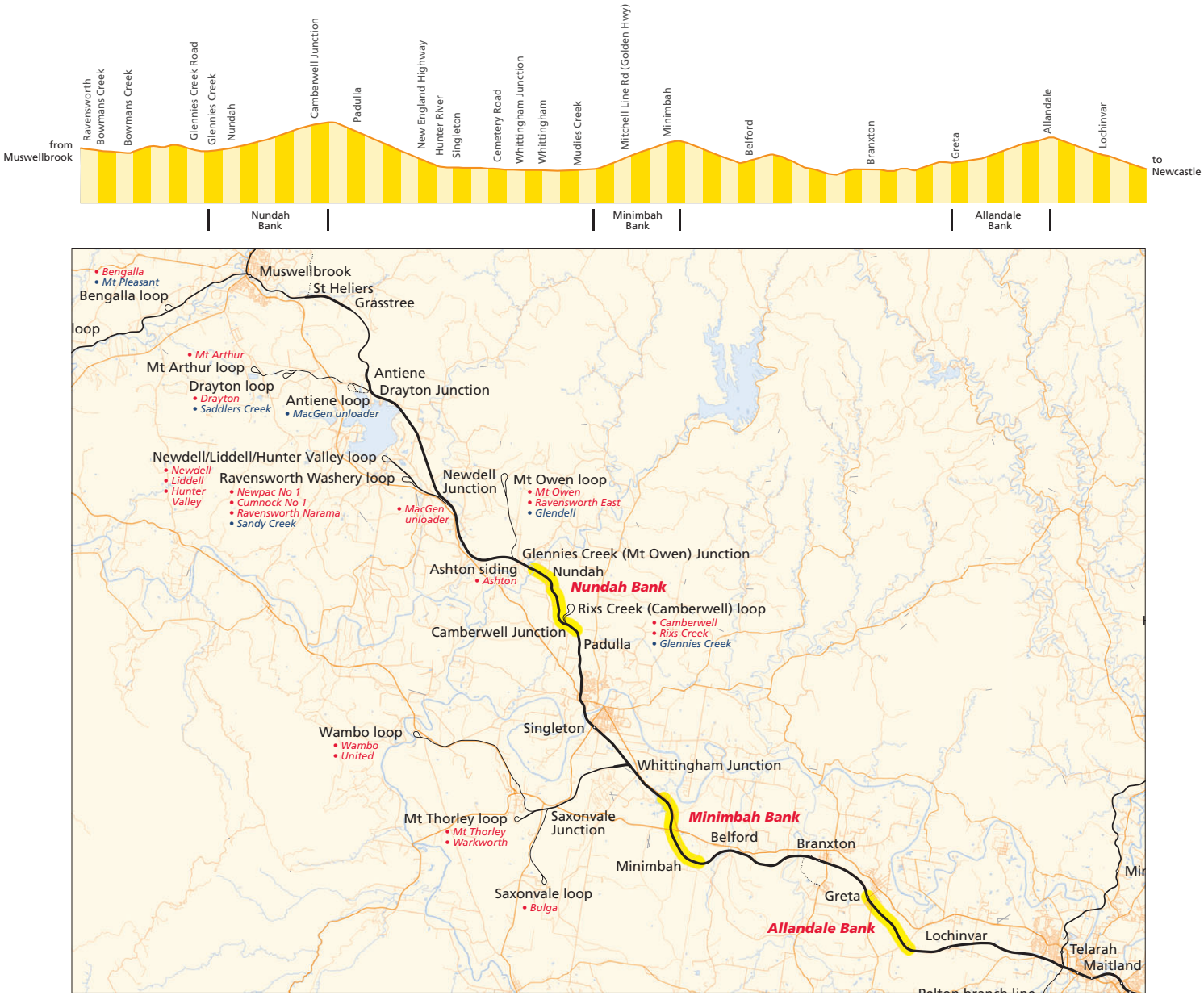


Figure 9. The Nundah, Minimbah and Allandale Banks.

2½ minutes and permitting trains to return to their former 60 or 91 wagon sizes.

These initial signalling enhancements are necessary to ensure there are adequate braking distances between signals on the approach to the banks.

Because the constraint imposed by the Allandale Bank has become relevant only as a result of the new coal demand forecasts upon which this *Strategy* is based, the options to address this constraint are still being evaluated. However, a similar re-signalling strategy on the approaches to the Allandale Bank may be the preferred option for reducing the minimum headways on this grade to eight minutes after 2010–11.

Design work for signalling enhancements on the Nundah and Minimbah Bank approaches is now underway, and these projects will be completed by the opening of the Sandgate grade separation project.

Trials conducted in conjunction with Pacific National have confirmed that the expected benefits will be achieved or exceeded at these locations.

As a second stage, it is proposed to reduce the minimum headways on the Nundah and Minimbah Banks to ten minutes by reducing the distance between signals and providing additional signal indications on the banks, while ensuring that fast passenger trains and other freight trains will continue to have adequate braking distances.

The reduced signal spacing will allow two coal trains to be on each bank at the same time, thereby increasing the capacities of the banks.

If the leading train were to fail, the second train might not be able to resume its climb from a standing start, marginally increasing the impact of the failure. It is generally believed, however, that all the train types using the banks are capable of restarting on the banks, and in ARTC's view the benefits of closer spacing on the banks outweigh any potential disadvantages.

The speed-restricted Bowmans Creek bridge north of the Nundah Bank will need to be rebuilt for this headway harmonisation project to succeed. This project is currently part of ARTC's minor capital works program, and is scheduled to be completed by September 2006.

In order to achieve eight-minute headways south of Whittingham Junction from 2010–2011 it will be necessary to:

- Construct a third track on the Minimbah Bank, and
- Construct a third track on the Nundah Bank as well, for the purpose of harmonisation of headways even though coal demand on this grade will not exceed the capacity of the existing twin tracks.

Depending on the findings of investigations into the effects of signalling changes on the approaches to the Allandale Bank and along this grade, it might also be necessary to construct a third track along this section of the line.

The results

The combination of the higher approach speeds and reconfigured signalling would lift the line capacity from around 70 mtpa to 140 mtpa at Nundah and 90 mtpa to 135 mtpa at Minimbah. Subsequent construction of a third track at these locations would lift their capacity to about 165 mtpa, the same as the capacity to be achieved by 2010–11 on the Allandale Bank, where the capacity is currently 140 mtpa.

These estimates assume:

- 50% of the available paths at ten-minute headways would be allocated for coal working
- Pacific National would restore its '120 tonne wagon' trains to their former lengths
- The inability of trains that have stopped at Whittingham Junction (mainly trains from the Mt Thorley branch line) to reach the higher 80 km/h approach speed before they arrive at the Minimbah Bank would reduce the capacity of this bank by around 5 mtpa until a third track is constructed, and
- Trains that have stopped at Newdell Junction would be able to achieve the higher 80 km/h approach speed before they reach the Nundah Bank, and there are relatively few trains stopping at Mt Owen Junction, so there would be no equivalent reduction in the capacity of this bank.

An empty northbound train descending the Minimbah Bank, headed to Whittingham Junction.

3 Reducing junction conflicts

The constraints

There are numerous junctions on the Hunter Valley rail network where trains travelling from coal-loading branch lines potentially conflict with empty trains travelling in the opposite direction on the main line (*Figures 3, 4 and 5*).

The effects of these conflicts on rail capacity are particular acute at three junctions which have slow junction speeds and/or high frequencies of train movements: Whittingham, Newdell and Drayton (*Figure 10*).

Newdell and Drayton Junctions also have high maintenance turnouts, necessitating excessive track maintenance and producing additional train delays.

The options

The options identified to address these constraints are:

- Relay junctions with new high-speed, low-maintenance turnouts
- Separate entry and exit tracks
- A three-track mainline configuration
- A reduction in headways for empty trains travelling in the 'down' direction (away from Newcastle), and
- Grade separation of the junctions.

Relaying with high speed turnouts is an obvious and simple option. It would reduce junction occupancy times and ongoing maintenance costs, and in some circumstances the faster speeds through the junctions can also allow a simplification of the junction arrangements, further reducing the up-front cost, installation time and ongoing maintenance.

The separation of entry and exit tracks may be justified if it is desirable to be able to hold an arriving empty train clear of the main line, although the need for this may be partly offset by higher junction speeds. This option would generally have higher costs and in some cases it might be complicated by track ownership issues.

A three-track mainline configuration would allow 'up' direction and 'down' direction conflicts to be separately managed. At present, a loaded train leaving any of the branch lines at Whittingham, Newdell and Drayton has to cross over the main line's 'down' track and slot in between other 'up' direction trains, so there is a high probability there will be a conflict in at least one of these directions. A third track at the junction would permit a departing 'up' train to proceed across the 'down' track while there is a

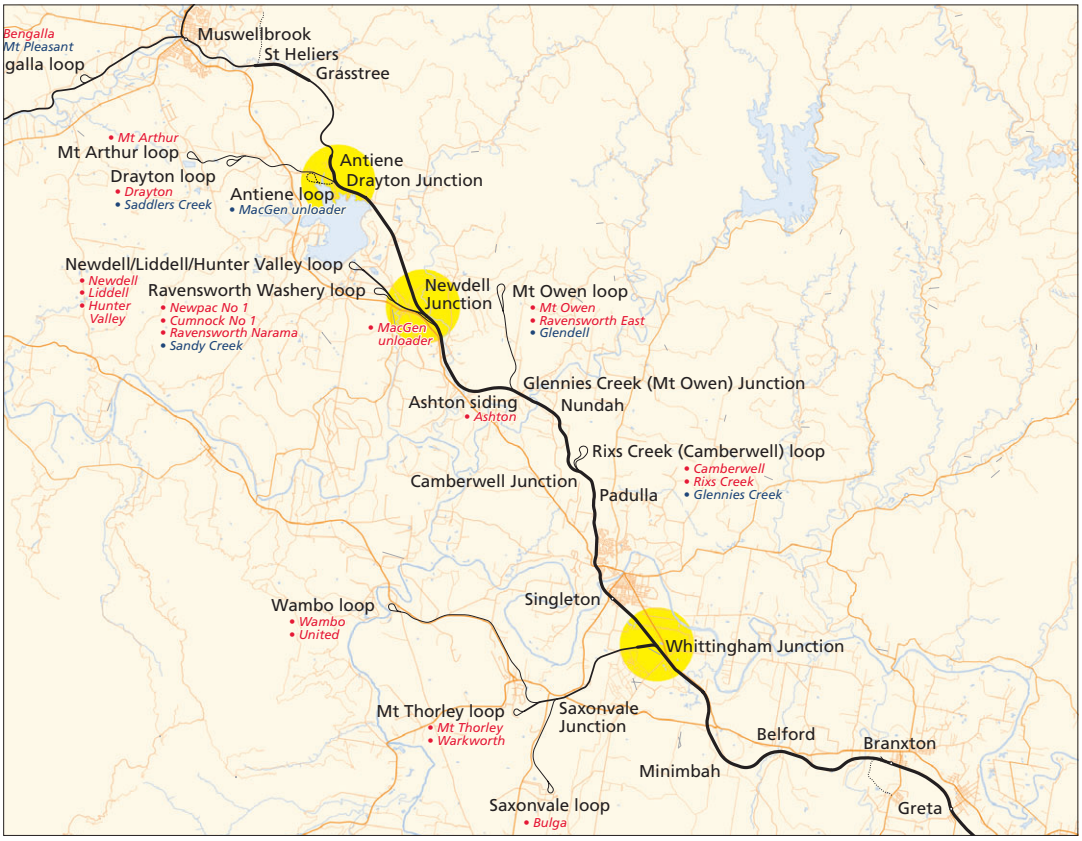


Figure 10. The Drayton, Newdell and Whittingham Junctions.

The existing low-speed and maintenance-intensive Drayton Junction, looking north.

The Drayton branch line, with the short crossing loop now proposed for extension, on the left, with the Main North line to Antiene on the right. The proposed branch line from Antiene to a new Antiene coal loop, for the unloading of coal for Macquarie Generation's power stations in this area, will pass under the section of the Drayton branch line shown in this photograph.

gap between 'down' services and then to be held on the centre track until a suitable gap in the 'up' direction becomes available.

A move to eight-minute headways on the main line in the 'down' direction would compensate for the fact that, at present, the conflict between 'up' trains exiting the branch lines and 'down' through services reduces the main line's capacity in the 'down' direction even though it does not produce a corresponding reduction in 'up' direction capacity.

Grade separation is a high cost option, but if train frequencies are high it may be the best way to reduce conflicting train movements and reduce the wear from loaded coal trains on main line turnouts and crossovers.

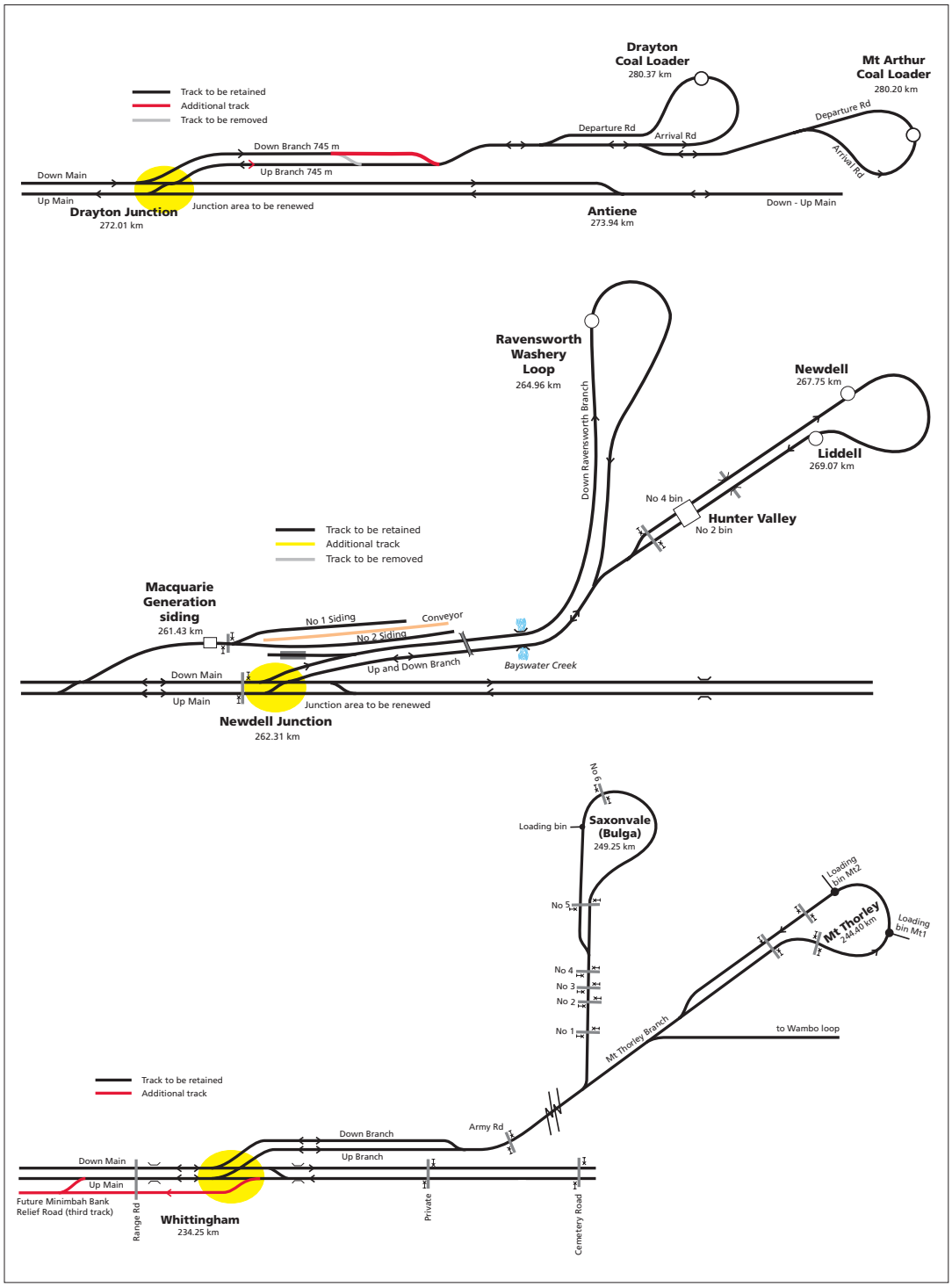
ARTC investigations suggest the first option would be the best for Newdell and Drayton Junctions, both of which have slow-speed, high-maintenance turnouts.

It is therefore proposed that **Drayton Junction** should be renewed with 1:18 turnouts, raising the junction speeds for trains moving onto and off the branch line from 25 km/h to 75 km/h.

This would reduce the junction time for a loaded coal train leaving the branch line from around six minutes to around three minutes, thereby effectively doubling the number of branch line trains able to be handled or permitting an extra 20 northbound main line coal trains per day.

Upgrading of this junction would also produce significant maintenance benefits, so it may be desirable to carry out the upgrading earlier than would be required for capacity reasons.

Early ARTC investigations, reported in 'Version 4' of this *Strategy* in May 2005, suggested that only the main line crossover and junction turnout would need to be renewed, because the faster junction times would mean the branch



Indicative track diagrams for the Drayton and Newdell Junction renewal projects and the concept for grade-separation of Whittingham Junction, alternatives for which are now being investigated.

line's existing crossing loop would no longer be required, saving two turnouts in the new arrangement.

More recently, however, new forecasts of substantially increased coal traffic on this branch line have led to a reassessment, and the retention and extension of the branch line's crossing loop, which is currently too short for any standard coal trains, is now being considered.

The Drayton branch line is currently subject to a 20 km/h speed restriction. If this line were not upgraded, it would limit the ability of the junction upgrading to realise its potential speed and capacity increases.

The ARTC has commenced discussions with the owners of the branch line concerning an extension of its crossing loop and an upgrading of the track.

It is proposed that **Newdell Junction** should also be renewed with 1:18 turnouts, again raising the junction speeds for trains moving onto and off the branch line to the Ravensworth and Newdell/Liddell/Hunter Valley loops from 25 km/h to 75 km/h.

This would reduce the junction time for a loaded train leaving the branch line from around 4½ minutes to around 2¼ minutes, thereby effectively doubling the number of branch line trains able to be handled or permitting an extra 15 northbound main line coal trains per day.

Although the existing junction has adequate capacity for the immediate future, renewal of the junction is also highly desirable as a way of minimising recurrent maintenance costs. Accordingly, the ARTC has now commenced

Whittingham Junction, looking north.

A loaded train moving from the Mt Thorley branch line to the Up (southbound) main line, blocking northbound trains on the main line.

Trains moving onto and off the Mt Thorley branch line, in the latter case waiting for a southbound train on the main line.

design work on this renewal, and may proceed to construction earlier than would be required for capacity reasons.

For **Whittingham Junction**, serving the busy Mt Thorley branch line, the initial ARTC investigations reported in 'Version 4' of this *Strategy* suggested a more substantive upgrading would be required, with a flyover from the Mt Thorley line to join the Up (southbound) main line.

The Mt Thorley branch line currently consists of about 8 km of single track between a crossing loop immediately west of Whittingham Junction and the junction of two (and soon three) balloon loops near Mt Thorley (see *Figure 3*). The main line turnouts at Whittingham Junction are

Loaded coal train waiting to move from the Mt Thorley branch line onto the main line at Whittingham Junction, with an empty train moving onto the branch line at right.

swing-nose, high-speed units, but the speed limit in the Up (southbound) direction is only 55 km/h, because of the geometry of the tracks leading into these turnouts.

The single line section will be adequate for predicted train numbers to 2011, but conflicts at Whittingham Junction are likely to become a constraint around 2008. With increasing demand associated with the Upper Hunter, Ulan line and Gunnedah Basin coalfields, coal train movements on the main line at Whittingham being forecast to grow from 51 to 75 trains each way per day over the next five years, while coal train movements on the Mt Thorley line are expected to decrease only marginally, from 20 to 18 trains each way per day.

A flyover would remove conflicts with northbound main line trains, reduce the number of turnouts being used by loaded (high wear) trains and give loaded trains from Mt Thorley a small downgrade speed benefit approaching the Minimbah Bank.

It would, however, be very expensive, with a capital cost considerably higher than the ARTC's initial investigations suggested, and its usefulness would progressively decline as coal production from the mines served by the Mt Thorley line reduces over the longer term.

Accordingly, the ARTC is now investigating a number of alternatives.

Increasing junction speeds to the turnouts' 75 km/h capabilities would be consistent with the upgrading of speeds on the approach to the Minimbah Bank to 80 km/h, but would only be a partial solution.

Similarly, while a three-track configuration would be consistent with the future construction of a third track along the entire length of the Minimbah Bank, and could be developed as the first stage of that project, it would provide only a partial solution, as and loaded 'up' train which had to come to a stop on the centre track would have to proceed relatively slowly across the 'down' track and would also be attacking the grade from a standing start, increasing the time required to climb the Minimbah Bank and reducing its 'up' direction capacity.

The optimal solution is likely to be the full construction of a third mainline track from just north of Whittingham Junction to a point past the top of the Minimbah Bank, a project that will be required by around 2011.

Bringing forward the planned eight-minute headway in the 'down' direction would provide sufficient additional capacity to cope in the meantime.

The results

The Drayton Junction renewal project would increase loaded train capacity through this junction, on either the branch line or the main line, by the equivalent of 20 coal trains per day, or by around 40 mtpa, from 80 to 120 mtpa.

Similarly, the Newdell Junction renewal project would increase loaded train capacity through this junction, on either the branch line or the main line, by the equivalent of 15 coal trains per day or an estimated 30 mtpa, from 90 to 120 mtpa.

Eight-minute 'down' direction headways at Whittingham Junction would increase the capacity of the double track sections to the number of trains required for a coal demand of 165 mtpa and allow the impact of the junction to be managed so as to provide a nominal two-way capacity of 140 mtpa. Once eight-minute headways are achieved for both directions on the Minimbah Bank, through the construction of a third track, the additional flexibility will increase the junction's capacity to 155 mtpa.

4 Increasing capacity between Antiene and Muswellbrook

The constraints

There are two single track sections of the Main North line between Antiene and Muswellbrook, the first of them a 7 km section between Antiene and Grasstree Summit and the second a 4 km section between St Heliers and Muswellbrook Yard (*Figure 11*).

The capacity of these single track sections is significantly lower than the capacity of the rest of the Newcastle–Muswellbrook line, and well below the demands forecast within the next five years as a result of new mine developments along the Ulan line (see section 5) and the Muswellbrook–Werris Creek–Narrabri lines (see section 6) (*Figures 6 and 7*).

Train numbers between Antiene and Muswellbrook are currently restricted to around 70 trains per day in total.

The options

The options identified to remove these constraints are:

- A deviation of the Ulan line to connect with the main line at Antiene rather than Muswellbrook
- Fewer, longer trains
- Full duplication of the existing single track sections between Antiene and Muswellbrook, and
- Staged duplication of these sections, coupled with the works to remove Muswellbrook Yard constraints described in section 5 below.

Deviation of the Ulan line west of the town of Muswellbrook would run into significant problems with mine subsidence areas, mining leases and environmental and planning processes. It would also only partly solve the immediate capacity problems, because the main line would still need to be retained and enhanced to cater for the forecast growth in services to and from Werris Creek, Gunnedah, Boggabri and Narrabri (see section 6).

The use of longer trains would assist only to a limited degree. The longest '120 tonne wagon' trains on the network already run to Ulan, Bengalla and Dartbrook as a matter of course. Lengthening of the Gunnedah line trains, which are currently short 42-wagon '100 tonne wagon' trains, would help (see section 6), but not to the extent that work on the single track sections could be avoided.

The **full duplication** option would technically provide a jump in capacity from the current nominal 35 mtpa to about 120 mtpa, making the limiting constraints the limited capacities of the Ulan and Werris Creek/Gunnedah lines.

Duplication work on the two single track sections between Antiene and Muswellbrook was partly completed when work stopped in the 1950s. Most of the earthworks were constructed, but rock excavation at the southern end near Antiene and the three Muscle Creek bridges between St Heliers and Muswellbrook remained to be done.

While it is likely that substantial remediation work would be required to bring the old formations up to contemporary standards, there would be time and cost savings in not having to carry out significant cut and fill operations next to an operating track.

Staged duplication, initially with a new long loop at the south end of Muswellbrook (see section 5), would

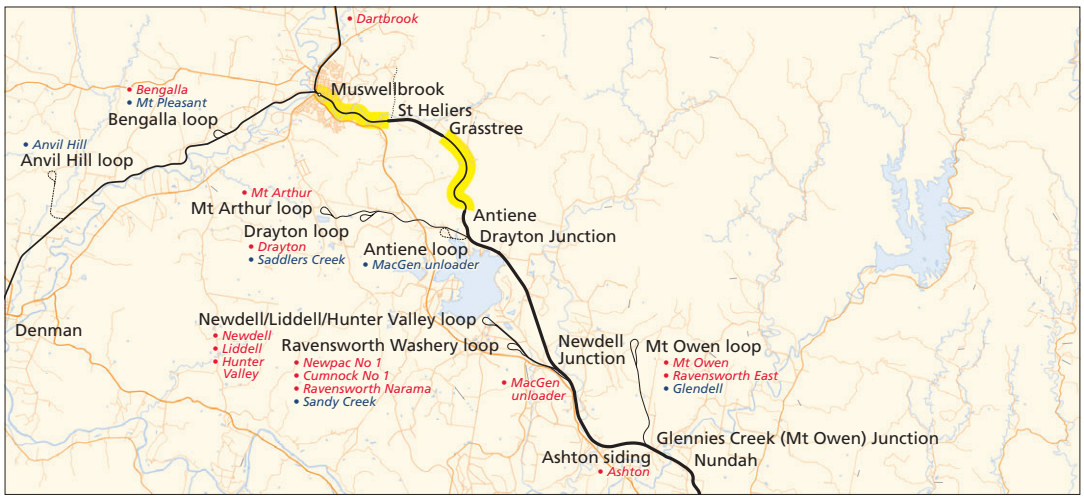


Figure 11. The two single-track sections of the Main North line south of Muswellbrook (Antiene–Grasstree and St Heliers–Muswellbrook).

An empty northbound train approaching Muswellbrook, on the single track section between St Heliers and Muswellbrook.

reduce the single track section between St Heliers and Muswellbrook to only 2 km, leaving the other single track section between Antiene and Grasstree Summit as the capacity-limiting section.

Duplication of the 2.5 km section between Grasstree and Grasstree Summit, on the largely cleared formation from the 1950s, would then leave two nominally five-minute single track sections. Construction work on these sections would be considerably more complicated and expensive, with rock work required at the Antiene end and three bridges at the St Heliers end.

The choice between a staged approach and full duplication as a single project essentially depends on their costs, with the savings achieved by delaying expenditure being offset by the additional construction costs of fragmented projects with greater mobilisation costs and fewer economies of scale.

'Version 4' of this *Strategy* (May 2005) indicated a preference for staged duplication of the line. Under the later coal demand forecasts summarised in *Figures 6 and 7*, however, it is likely there will be only a three-year gap between the time staged duplication will need to be completed (2008, to permit the carriage of more than 36 mtpa) and the time full duplication will be required (2011, to permit the carriage of more than 65 mtpa).

In combination with further ARTC analyses of the construction costs, this means full duplication as a single project is now more likely to be the preferred approach.

The ARTC has therefore commenced design work for the full duplication project. It will, however, continue to monitor the timing gap and relative costs of the two approaches, to ensure the lowest cost solution is ultimately adopted.

The new Muswellbrook loop is an important project in its own right (see section 5), and warrants early completion, so regardless of the duplication approach adopted for the rest of the route this project will be completed before the rest of the duplication works.

One of the three Muscle Creek bridges.

The results

The staged partial duplication configuration would be capable of handling about 65 mtpa, although with little margin, while full duplication would give an ultimate capacity of around 120 million tonnes per annum.

5 Increasing capacity between Muswellbrook and Ulan

The constraints

The Ulan line extends approximately 170 km between Muswellbrook, in the upper Hunter Valley, and Gulgong, west of the Dividing Range.

It is a single track line, with passing loops at Sandy Hollow, Kerrabee, Coggan Creek and Ulan (*Figures 4 and 11*), and most of the line, from a point 7 km west of Muswellbrook, is operated under electric staff working.

Although the line is used mainly by coal trains—currently to and from the Bengalla and Ulan loops, and in the near future to and from the Anvil Hill, Wilpinjong and Moolarben loops as well (*Figure 4 and 12*)—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.

Coal demand on the line is forecast to increase rapidly (*Figures 6 and 7*), with trains carrying export coal to the ports at Newcastle and increasing volumes of domestic coal to Hunter Valley power stations, and in particular the proposed Antiene unloading loop (*Figure 3*).

Electric staff working adds at least 60 minutes of avoidable delay to coal trains travelling to and from Ulan (40 minutes of dwell times and an estimated 25 minutes through slowing and restarting), reducing the line capacity.

The limiting capacity constraint on the Ulan line at present is the capacity of the long single track section, on this line and the Main North line, between St Heliers and Sandy Hollow, the crossing loop at Muswellbrook being too short for coal trains. This section includes Muswellbrook station, which has a 50 km/h turnout at its south-eastern end and a 25 km/h turnout at its northwestern end, and takes 61 minutes to traverse, including the intermediate stop to operate the electric staff system. Daily activity on this section is currently limited to 12 train paths per day.

The crossing facility at Muswellbrook needs to be a full length crossing loop to avoid the capacity constraint arising when Werris Creek and Ulan line trains need access to the Muswellbrook–St Heliers section of the Main North line at the same time. Such a loop would also act as partial duplication of the section to St Heliers (see section 4).

The options

The options identified to remove these constraints are:

- A bypass to the west of Muswellbrook, with a deviation of the Ulan line to connect with the main line at Antiene rather than Muswellbrook
- Increased train speeds
- A Centralised Train Control (CTC) signalling and train control system, and
- Additional passing loops.

Muswellbrook Yard, looking west to the junction of the Ulan and Werris Creek lines. The current loops at this location are too short for coal trains.

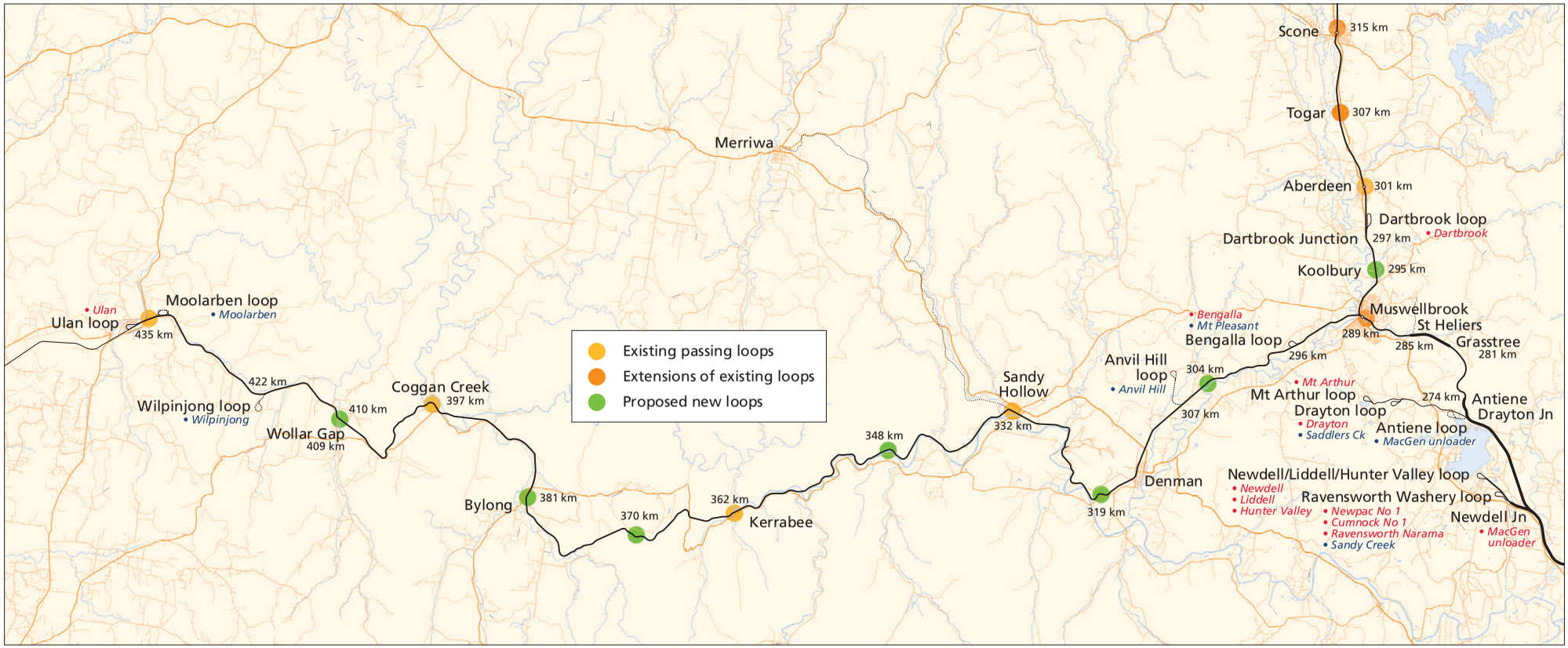
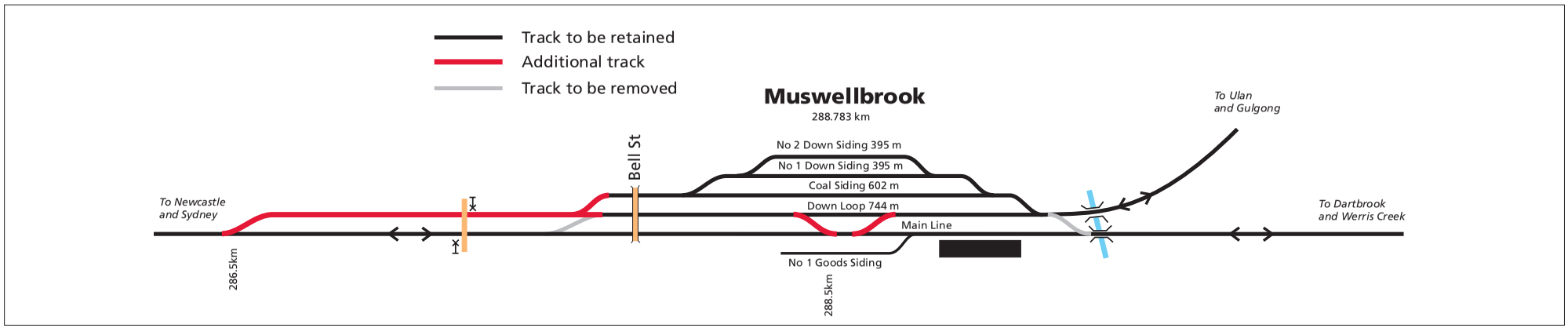


Figure 12. Proposed locations of new passing loops on the Ulan line.



he proposed loop extension southeast of Muswellbrook Yard and reconfiguration of the junction of the Ulan and Werris Creek lines at the northwestern end of this yard.

Electric staff operation at Denman on the Ulan line.

As discussed in section 4, a deviation of the Ulan line west of Muswellbrook would run into significant problems with mine subsidence areas, mining leases and environmental and planning processes and would only partly solve the immediate capacity problems, as it would not address the forecast growth in demand to and from Werris Creek, Gunnedah, Boggabri and Narrabri (see section 6).

An increase in coal train speeds on the Ulan line would generally not have a great effect on travel times or the line's capacity, as there are tight curves and significant gradients on much of the line. However, an increase in track speeds through Muswellbrook *would* have a significant effect on the long single track section between St Heliers and Sandy Hollow.

This project would involve a rationalisation of the Muswellbrook Yard, with the current 25 km/h junction at the northwestern end being removed, permitting train to run at 50 km/h instead, and with a long crossing loop with normal 1:18 turnouts being established further to the southeast. This would improve train speeds and capacity not only on the Ulan line but also on the Werris Creek/Gunnedah line (see section 6).

The installation of CTC would also have a significant positive impact. It would eliminate the delays associated with electric staff working, reducing the cycle times for coal trains by up to two hours, and significantly improving both capacity and reliability.

The provision of intermediate follow-on signals, which are not possible with the existing system, would provide additional capacity by allowing the 'flighting' of trains in one direction at a time.

Additional passing loops will also be required, however, as the combination of faster travel times through Muswellbrook and CTC signalling will not, by themselves, be able to increase the Ulan line's capacity sufficiently to meet the forecast coal demand beyond 2009.

There are relatively few locations that are suitable for new passing loops on the Ulan line, because of the difficult terrain. The ARTC has devoted considerable attention to identifying the most suitable and effective loop locations, so that the CTC project can be designed in a way that will minimise future loop construction costs.

The currently preferred locations are shown in *Figure 11*.

The results

The project to rationalise Muswellbrook Yard and extend the Muswellbrook passing loop would increase the capacity of the Ulan line from eight to 12 coal trains per day, sufficient for the demand forecast for 2007 and 2008, by reducing running times on the longest single track section from 61 to 53 minutes.

It would also increase the capacity of the Werris Creek line in this area by about four coal trains per day.

The installation of CTC will lift the capacity of the Ulan line to 15 coal trains per day, just adequate for the forecast 2009 demand.

The currently preferred (but not yet finalised) program for the provision of additional passing loops to accommodate forecast demand on the Ulan line past that date, in addition to the de facto passing loops provided by the coal loading loops at Bengalla and Wilpinjong, is for new loops at locations 304 km and 381 km from Sydney by 2008, new loops at 348 km, 370 km and 410 km by 2010 and a new loop at 319 km in the longer term, after 2015.

These estimates assume grain, ore, general freight and inter-modal traffic on the Ulan line will remain constant over the next five years at six train paths per day. Because these trains are generally well below the maximum permitted train length on the corridor, any growth in demand can readily be accommodated by increasing train lengths.

6 Increasing capacity between Muswellbrook and Narrabri

The constraints

The single-track Muswellbrook–Werris Creek–Narrabri line is highly complex.

In addition to its coal traffic, it carries passenger trains (CityRail services to and from Scone and CountryLink services to and from Moree and Armidale) and a proportionately high level of grain, fuel, cotton and flour freight train activity. This 'background' traffic is up to 12 trains each way per day as far as Scone, then up to nine each way to Werris Creek, seven each way to Gunnedah and six each way to Narrabri.

Coal demand on the line is forecast to increase very rapidly (*Figures 6 and 7*), and considerable increases in capacity will be needed to accommodate this growth.

There are currently three coal train origins and destinations along the route, at Dartbrook, Werris Creek and the coal loader west of Gunnedah, but in the next few years these are expected to be joined by new coal loader loops at Murulla, Caroona (on the line between Werris Creek and Merrygoen/Dubbo), Boggabri and the proposed Narrabri colliery (*Figures 2 and 5*).

The Ardglen Bank, crossing the Liverpool Range, is a particular impediment. The severe grades on the short section between Willow Tree and Murrurundi dictate limits for train operations on the whole Werris Creek to Newcastle route, and coal trains crossing the Liverpool Range are currently limited to only 42 '100 tonne' wagons. The need to use 'banker' locomotives for loaded coal and grain trains using this section means it will reach its capacity limits earlier than the rest of the line, because the return of the 'banker' locomotives adds a northbound train path for each southbound coal or grain train.

The existing passing loops on the Muswellbrook–Narrabri route (*Figure 13*) are relatively short, typically 650–750 m, and some loops are even shorter, although there are several longer loops of 950–1,200 m north of Werris Creek. The turnouts for the loops north of Werris Creek are mechanically operated rather than motorised.

The track north of Dartbrook is rated only for 25 tonne axle loads (i.e. '100 tonne' wagons).

Train control north of Werris Creek is by electric staff working. This section of the route is managed by the ARTC on behalf of the NSW Rail Infrastructure Corporation (RIC), and decisions on investments in this section are a matter for the RIC. The ARTC is working closely with RIC to facilitate an integrated approach to investments in the entire corridor.

An empty northbound coal train emerging from Ardglen Tunnel.

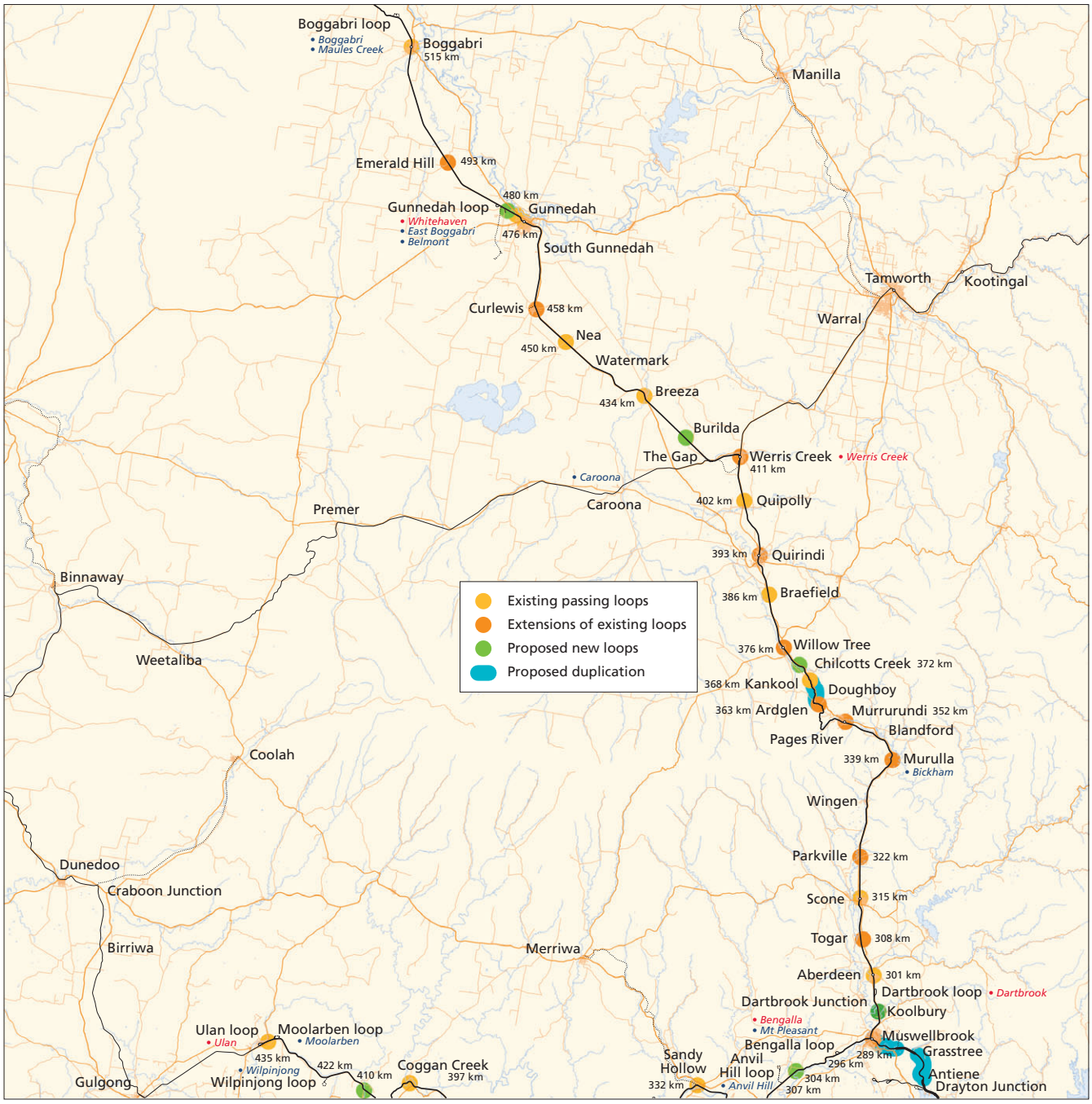
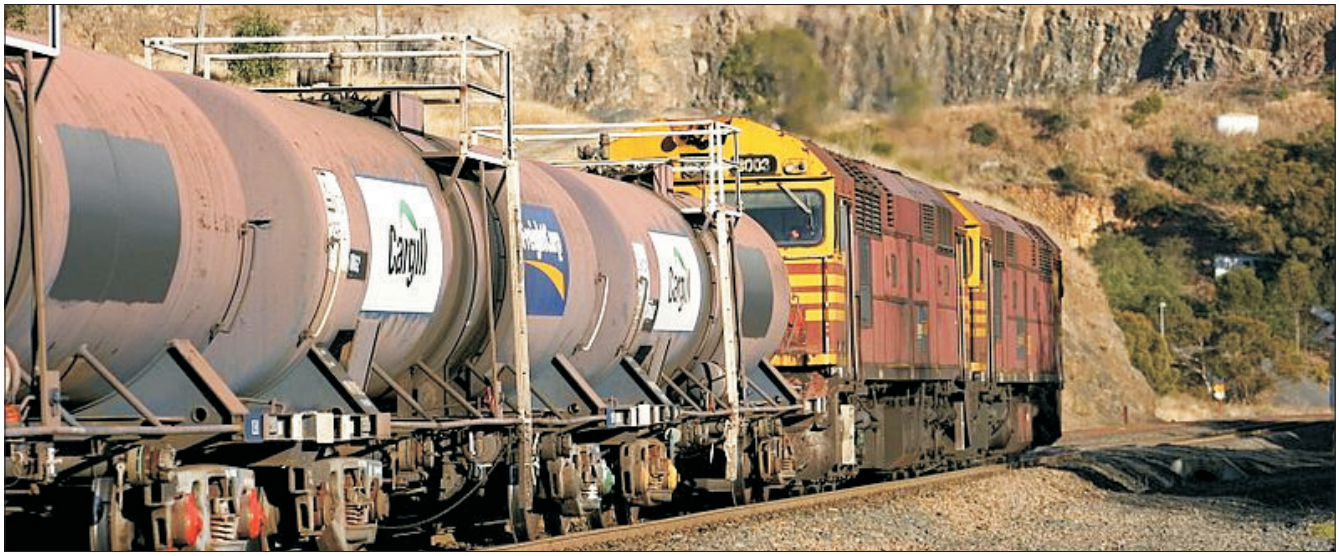
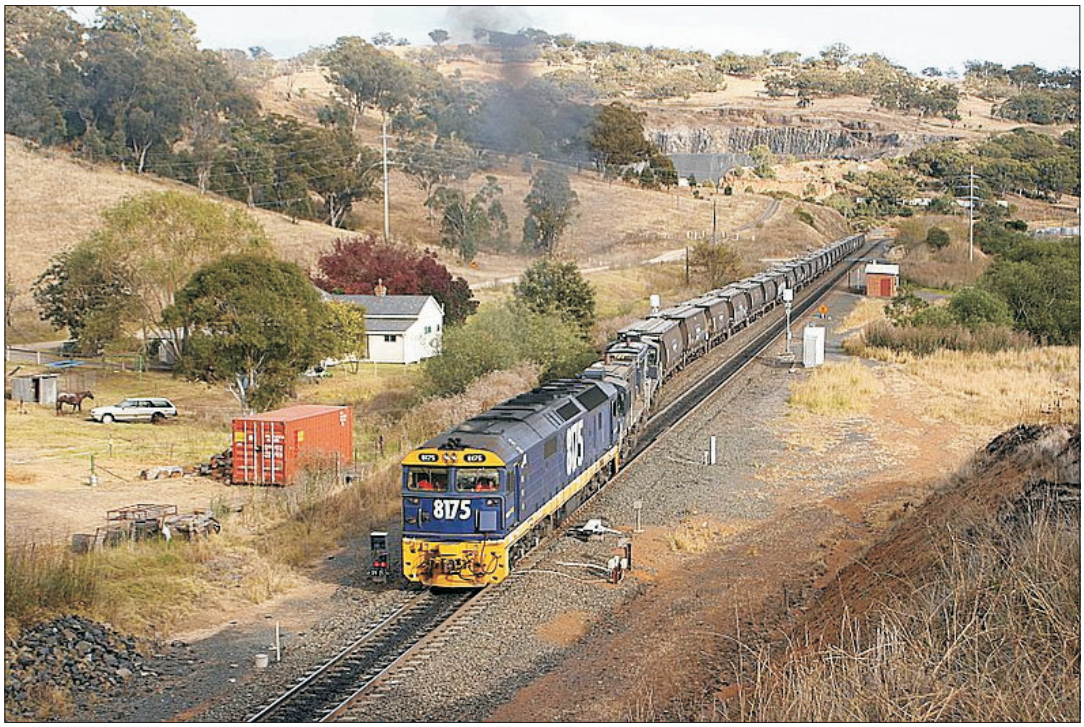


Figure 13. Passing loops on the Muswellbrook–Werris Creek–Boggabri lines.



'Banker' locomotives at the rear of a southbound freight train at the Ardglen passing loop.



The Ardglen passing loop, at the top of the steep Ardglen Bank climb from Willow Tree.

The options

The options identified to address capacity constraints between Muswellbrook and Narrabri are:

- Longer trains
- A re-alignment over the Liverpool Range
- Track duplication on the north face of the Liverpool Range
- The lengthening of selected passing loops and construction of additional loops to allow the consolidation of coal and grain freight services into longer but fewer trains
- The upgrading of structures and track to accommodate trains with 30-tonne axle loads, and
- Upgrading of the train control and safeworking system between Werris Creek and Narrabri.

Regardless of the infrastructure options adopted, coal **trains significantly longer than the current 42-wagon trains will be essential**, although the maximum length of trains on the line is likely to be limited to about 1,300 m, because of in-train forces on grades, until a new alignment across the Liverpool Range is constructed. The use of 'distributed' power to permit even longer trains on the existing grades, with one or more locomotives in the middle of each train rather than at the front, would present technical complexities and is regarded by the ARTC as improbable.

Regardless of the type of train employed, there will also be a need to enhance infrastructure if the coal demand forecasts for the line are to be able to be realised.

Re-alignment on a new route over the Liverpool Range is likely to be the most expensive option, but would have the advantage of removing the steep grades which represent the major constraint on the corridor.

An initial assessment has indicated that a new alignment may be desirable in the longer term. Accordingly, the ARTC has engaged consultants to undertake a major study to identify a preferred alignment and the conditions under which construction might be justified.

If it were concluded that a new alignment is not warranted in the short or medium term, it would become necessary to carry out a number of capacity enhancement projects on the existing alignment across the Liverpool Range, essentially involving a progressive extension of the existing Ardglen passing loop to form **a double-track section down the western side of the range**.

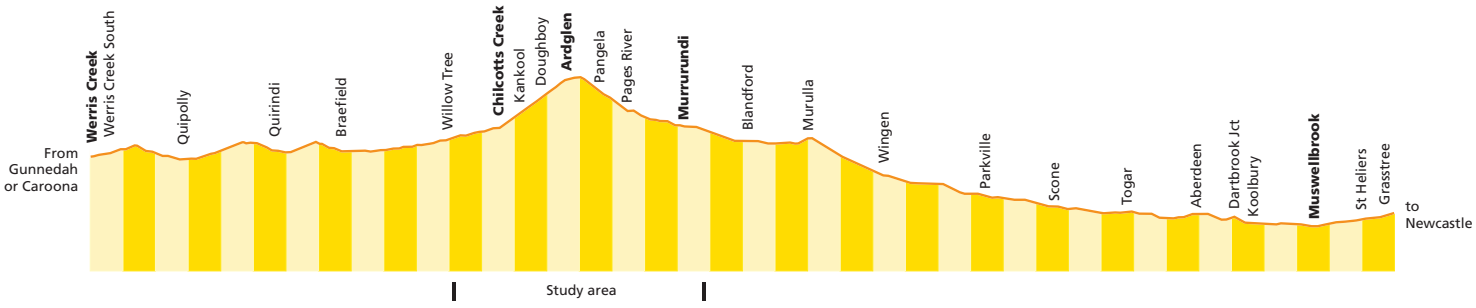
The first stage would be downhill duplication of a 3 km section to a point 366 km from Sydney (*Figure 12*). This would be required by 2009. In later years the duplication would be progressively extended as far as Chilcotts Creek at the foot of the grade, 372 km from Sydney.

The **lengthening of selected existing passing loops and construction of additional passing loops** will also be essential. This can be implemented progressively, provided future train lengths and eventual train frequencies are established with reasonable certainty at an early stage.

The ARTC has already started works to extend the Togar and Murulla loops to 1,350 m, and it is proposed that this will become the new standard length for passing loops in the corridor.

The proposed sequence of loop extensions and new loops is then for:

- A new passing loop near the Gunnedah coal loop by 2007
- Loop extensions by 2008 at Ardglen (prior to further downhill extensions by 2009), Willow Tree and the Werris Creek Yard (depending on the findings of the Liverpool Range study and comparative cost investigations, an alternative to the Willow Tree loop extension might be the construction of a new loop at the foot of the steepest grade at Chilcotts Creek, about 372 km from Sydney)
- Loop extensions at Parkville and Quirindi and full duplication between Ardglen and Kankool by 2009, and



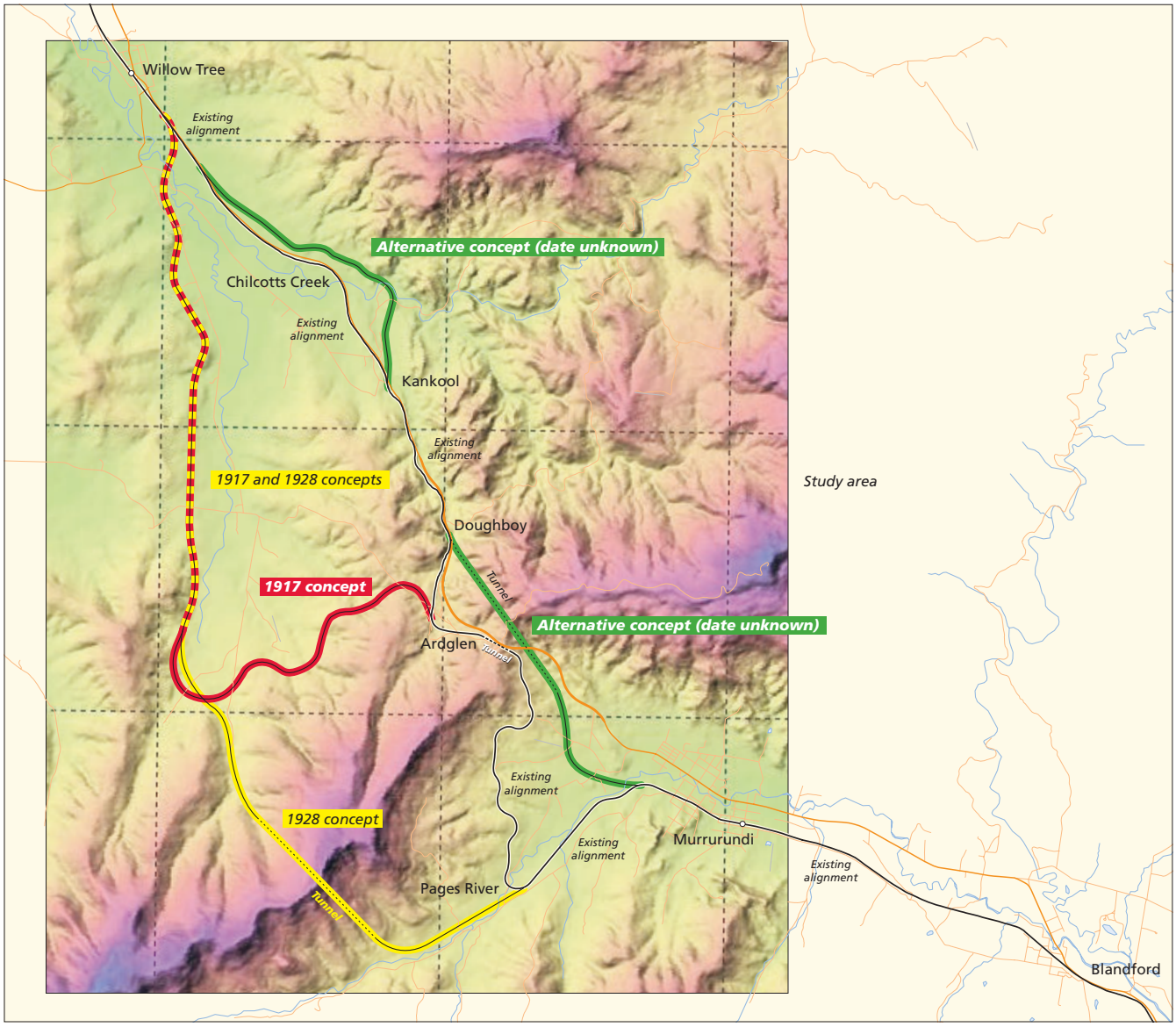


Figure 14. The ARTC has recently commissioned a new study to identify the most suitable route for a new railway alignment across the Liverpool Range, particularly for the steep sections between Murrurundi and Chilcotts Creek. This map shows three options for a new alignment identified in earlier investigations, two of them with long tunnels.

- Extensions of the loops at Murrurundi, Curlewis and Emerald Hill and construction of new loops at Koolbury and Burilda by 2010 (*Figure 13*).

This sequence assumes maximum axle loads on the route will remain at 25 tonnes. **If axle loads were increased to 30 tonnes**, permitting the use of 120 tonne wagons and thus increasing the carrying capacity of each train, some of the later loop extensions could be deferred, but the extensions scheduled for 2006, 2007 and 2008 would still be required, as these are prerequisites for a switch to longer trains.

Initial analyses suggest it could well be cost-effective to move to 30 tonne axle loads sooner rather than later, provided this can be done in a progressive way.

In the short term, this would involve upgrading only of the structures and track that are structurally unable to accommodate 30 tonne axle loads. The rest of the track would be upgraded to a stronger structure, with concrete sleepers and 60 kg/m rails, only as renewals were required.

This approach would minimise the up-front capital costs but would increase short and medium-term maintenance and renewal costs.

Murrurundi, looking west.

Wingen.

Up-front upgrading of all the track to a stronger structure would not be financially justifiable, even with the increased coal tonnages that are now being forecast.

The ARTC is now carrying out further investigations to confirm the scope of up-front upgrading required and the maintenance and renewal cost differentials, and also to see whether it is possible to move to the higher axle loading for all coal mines along the route.

The best strategy for **upgrading the train control and safeworking system and mechanically operated points** on passing loops on the RIC line between Werris Creek and Narrabri is still to be determined.

However, an ARTC study of the time savings that could be achieved with different combinations of safeworking and loop operating systems suggests that:

- It will be necessary to undertake some form of upgrading over the next one to two years, and
- A full centralised train control (CTC) system will be required, as a replacement for the existing electric staff system, within four to five years.

As an initial step, the loop turnouts should be motorised, with driver push-button releases or, preferably, the ARTC's *In-Cab Activation Points System* (ICAPS), which would allow drivers to activate the turnouts without stopping their trains. The motorised points would be 'self-restoring',

Ardglen 'banker' locomotives.

so a train leaving a loop would not have to stop for the points to be reset.

The option of adopting train order working (TOW) has been examined but is not preferred, because:

- CTC is likely to be required in 2009
- All investments in TOW would become redundant once CTC was introduced, whereas virtually all the investments in motorised points would be compatible with, and required for, CTC, and
- Points motors would produce better time savings, and hence greater capacity increases, than TOW.

However, if the growth in coal demand were significantly slower than is currently forecast, the TOW option would need to be reassessed.

The results

The loop extension program outlined above would permit the use of longer trains between Muswellbrook and Boggabri from late 2008, potentially reducing the number of coal train paths required on the Muswellbrook–Boggabri route by about 50% and providing a small but material increase in capacity on the line south of Muswellbrook as well. The reductions achieved in practice would depend on the rail operators' preferred train configurations, and would therefore be likely to vary from operator to operator.

The consolidation of grain trains should also enable the saving of an additional train path.

Other issues

Three secondary issues that need to be addressed on the Muswellbrook–Narrabri route are:

- The restriction of loaded '100 tonne wagon' coal trains on the line to 65 km/h. This restriction adds to the section times and makes train handling over the undulating sections of track harder than would be the case with the 80 km/h speed limit that applies elsewhere on the coal network.
- The speed-restricting asymmetric configuration of the Scone passing loop, a short loop that is of real use only for passenger working.
- The speed-restricting configuration of the tracks at Gunnedah, with the main (platform) track running through the diverging legs of turnouts at both ends of the station.

These issues are discussed in sections 9.10 to 9.12 below.

7 Reducing maintenance impacts and increasing operational flexibility

The constraints

The need for on-track maintenance inevitably results in some loss of capacity for coal trains.

This loss will become more significant as coal tonnages increase, because maintenance requirements will increase and there will be a greater loss of coal capacity for any given duration of maintenance activity.

For the purpose of modelling rail network capacity, track closures for maintenance have been assumed to require the same amount of time as at present. In practice, however, there will be pressure for greater amounts of track time to be available for maintenance, because of the increased track maintenance requirements. This means it will be necessary to develop ways of increasing the amount of maintenance work able to be carried out in any given track closure time and/or to provide a further small increase in track capacity to cater for essential maintenance activities.

The options

The infrastructure options identified to reduce these constraints are:

- Additional tracks to allow more on-track time while retaining train running capacity, and
- Bi-directional signalling, allowing some train running while maintenance is being carried out.

For both of these options a secondary benefit would be the ability generally to recover from train or track failures more quickly than with a single track or uni-directional tracks.

The provision of additional tracks is a high-cost option with long lead times, and is justified only where capacity enhancements are approaching their limits with the existing number of tracks (see section 2).

While bi-directional signalling is not cheap, it provides a significant degree of operational flexibility without the cost of extra tracks, and allows the postponement of track enhancement in some cases.

These infrastructure options need to be supported by investments in higher production rate track maintenance equipment, so maintenance tasks can be completed more quickly. The ARTC is assessing the benefits of this against the costs of the infrastructure solutions.

At present bi-directional signalling is the preferred infrastructure solution, in some cases in combination with track amplifications to address more general capacity constraints.

Bi-directional signalling has already been installed between Branxton and Whittingham Junction.

It is proposed to implement further bi-directional signalling, on other busy sections of the coal network, in three stages:

- Maitland to Branxton
- Whittingham to Newdell Junction
- Newdell Junction to Antiene

The results

These three projects would release track capacity equivalent to around 3 mtpa associated with planned maintenance work, and each of them would 'save' a further 1.5 mtpa associated with failures and short-notice maintenance. The total benefit of the combined projects is therefore estimated to be of the order of 7.5 mtpa at the ports.

The Whittingham to Newdell Junction and Newdell Junction to Antiene stages would also facilitate efficient operation of the Camberwell, Mt Owen, Newdell, Drayton and Antiene branch line junctions by allowing standing empty trains to be passed by following trains if there were a suitable gap between trains in the opposite direction.

Bi-directional signalling on the Minimbah Bank.

8 Wagon capacity limitations

The constraints

The core Hunter coal network is now operating to a 30 tonne axle load standard, and coal wagons making use of this limit are built to the full width and height allowable for standard rollingstock outlines.

If the maximum axle load were increased, and/or the width and/or height of the wagons were increased, more coal could be hauled for any given number of trains.

(The benefits of increasing maximum axle loadings on the Muswellbrook–Narrabri line from 25 to 30 tonnes have already been discussed in section 6.)

The options

The options considered are:

- An increase in the maximum axle loading to the American standard of '286,000 lb' (32.5 tonnes)
- An increase in the axle loading to more than 32.5 tonnes, and
- Enlargement of the coal route rolling stock outline to the AAR plate E outline (15 ft 9 in by 10 ft 8 in).

To achieve additional axle loadings without increasing wagon lengths it would be necessary to permit wider and higher rollingstock dimensions than are now able to be run.

A second issue would be whether it would be possible to acquire and run standard design heavy haul locomotives and wagons 'off the shelf'. If it were not, there would be long acquisition lead times and additional acquisition costs.

If axle loadings were increased to the American standard in conjunction with an enlarged rolling stock outline, 'off the shelf' trains could carry up to 12 tonnes of additional coal per wagon (e.g. 60-wagon trains would go from 5,700 to 6,420 tonnes of coal).

An increase to axle loads of more than 32.5 tonnes would probably necessitate purpose-built rolling stock, with similar lead times and costs as now.

Any moves to higher axle loads and larger rolling stock outlines would necessarily be long-term projects. Their benefits would only come when the existing infrastructure is reaching its technical capacity and track amplifications or other high-cost responses are the only other options.

However, both projects, which should ideally be implemented in tandem, would need to be established as goals early on and then progressively implemented with every project that involves track or structures.

For instance, the provision of newly duplicated track, new main line crossovers and rebuilt bridges would all need to involve adjustments to meet the new dimension and strength standards.

120-tonne wagons.

9 Miscellaneous other issues

There are a number of additional issues that are either of a minor nature or have only minor impacts on the enhancement of capacity on the Hunter Valley corridor.

These issues, discussed in turn below, are:

- Signalling and remote control of the 'XYZ' crossovers between the main line and the coal line at the entry to the Port Waratah complex
- Improvements to the 123/124 crossovers at Waratah
- Shunting procedures at the Steggles siding (181 km from Sydney, between Beresfield and Thornton)
- The 65 km/h line speed on the coal line through Thornton (182 km)
- The 50 km/h line speed on the coal line through Maitland (193 km)
- The need for a high-speed crossover between the coal and main lines at Maitland
- The single passenger platform on the Up (southbound) side at Singleton
- The upgrading of Camberwell and Mt Owen Junctions
- The public level crossing on the Drayton branch line approximately 800 m from Drayton Junction
- The asymmetric track arrangement and associated speed restrictions at Scone
- Track arrangements through Gunnedah
- The 65 km/h speed limit for loaded '100 tonne wagon' trains north of Muswellbrook
- Low speed limits on coal loader branch lines, and
- The provision of adequate maintenance sidings for the Hunter Valley network.

In most cases it is proposed that these issues should be dealt with in conjunction with major adjacent projects. In some cases, however, the issues require separate treatment, and in others they are more appropriately handled as part of maintenance of the network.

9.1 The Waratah 'XYZ' crossovers

This set of three crossovers, immediately northeast of the entry to the Port Waratah complex, is currently a manually worked emergency facility.

The proposal is to equip the turnouts with point motors and control them from the Broadmeadow Control Centre as a normal running route.

This would allow Up freight trains that require access to Port Waratah to run on the Up main line to Waratah and then cross over to the coal line at the entry to Port Waratah, without obstructing the opposing main line as happens if the move to the coal line is made using the '135' crossover at Warabrook.

Trains from Port Waratah which need to be routed from the Down coal line to the Down main line would have the choice of crossing at the XYZ crossover or at the '134' crossover at Warabrook.

The additional flexibility gained would facilitate the sequencing of trains into and out of Port Waratah, particularly for trains of different types (coal, grain, steel, etc), and would maximise the ability to use the additional main line capacity created by the Sandgate grade separation project (see section 1).

The ability to use spare main line capacity to manage the Hunter Valley coal task, either by parallel routing (e.g. Stratford trains on the main line, Mt Thorley trains on the coal line) or as a way of gaining maintenance access to the coal lines, is an important 'given' in this *Strategy*, as is the ability to use the main line as a way of easing coal line conflicts at the Sandgate coal line junction.

This project will be part of the current Lower Hunter Valley resignalling scheme, which is primarily aimed at eliminating the last manual signal boxes in the Hunter region.

9.2 The '123' and '124' crossovers at Waratah

These parallel crossovers at the Down end of Waratah station allow Down trains to cross from the main line to the coal line and Up trains to cross from the coal line to the main line.

Their usefulness is reduced by limited clearances which have forced the signalling to be set up so as to prevent clearing for parallel cross moves. In addition, the crossovers are high maintenance items.

In 'Version 4' of this *Strategy* (May 2005) it was proposed that the track arrangements should be altered to have a single ladder crossover using higher speed turnouts, shortening the time for trains to undertake cross moves and reducing maintenance requirements.

The cost of the project has subsequently been estimated at around $5 million, making it difficult to justify for the benefits obtained. Accordingly, this project will not be pursued unless a stronger justification emerges.

9.3 Steggles siding

This stockfeed siding is slightly more than 400 m long and trails off the Down coal line at 108.7 km.

Current shunting procedures at the siding require at least part of the shunting train to be left on the running

line at all times. As a result, when wagons are being placed onto or lifted from the siding no other train can use the Down coal line.

It is proposed that the siding should be altered so that the shunting trains can be 'locked away' in the siding to allow through trains to run past the siding. This would extend the shunt train time, but this is preferable to delaying the procession of empty coal and grain trains, an issue of increasing importance as coal tonnages grow.

This project is being dealt with as part of the ARTC's minor capital works program.

9.4 Speed restriction through Thornton

A speed restriction of 65 km/h applies on the coal line though Thornton.

The reason for the restriction is unclear, but it probably relates to the junction, crossovers and/or signalling, since the nominal track geometry is the same as Tarro, which has a higher track speed.

It would be desirable to have Thornton cleared for 80 km/h running before raising the '120 tonne wagon' train speeds from 60 km/h to 80 km/h, because a 65 km/h speed limit at Thornton would negate most of the potential time gains of higher speed running.

An associated issue is the Bloomfield coal loop branch junction and the ladder '101'/'102'/'103' crossovers at its Up end, involving a very tight curve on the branch line and slow speed turnouts in the ladder. In order to reduce conflict times for trains moving between the branch line and the coal line or between the coal line and the main line, it may be desirable to replace the existing turnouts, when they become due for renewal, with high speed turnouts further toward Beresfield.

An initial cost estimate suggests the capital cost of this project would be about $6 million, so its costs and benefits would need to be closely assessed before making any decision on whether to proceed with the project.

9.5 Speed restriction through Maitland

A speed restriction of 50 km/h applies on the coal line though Maitland.

Again the reason for the restriction is unclear, but it could be related to track geometry through the station area and/or signal sighting distances.

It would be desirable to lift the speed on the coal lines through Maitland so that through freight trains can maintain momentum and keep headways to a reasonable minimum through this area.

At present loaded Up trains that have had to reduce their speed to 50 km/h through Maitland are not able to reach their maximum speed again until near Metford, only to then have to reduce their speed to 65 km/h at Thornton.

Any action to improve track speed through Maitland should be done in conjunction with improved speed through Thornton (section 9.5). These two projects are not a high priority at this stage, but analyses to identify the factors that lie behind the reduced speeds and possible solutions will be carried out in the near future.

9.6 A high-speed crossover at Maitland

Several years ago the track arrangements at Maitland were altered to provide direct routes between the main line and the North Coast line and between the coal line and the Main North line to and from the northwest.

This provides an appropriate layout for most of the trains on each route.

However, the completion of the Sandgate grade separation project (section 1) will open up a number of additional train paths on the main line between Maitland and Waratah, to the advantage of increasing numbers of trains running to or from the Main North line (e.g. through freight trains travelling to destinations south of Newcastle and grain and coal trains travelling to Port Waratah). The existing link between these two lines at Maitland is an awkward, slow-speed connection through two spare platforms and is quite unsuited to maximising the throughput on either line.

A high-speed crossover between the Up Main North line and the Down North Coast line at the divergence point, with another high-speed crossover between the Down and Up main lines at a suitable tangent track location (probably at the Up end of Maitland), would allow loaded freight trains to be routed to either the Up coal line or the Up main line without any significant speed or time impost.

Down trains needing to be routed from the Down main line to the Down Main North line would use the crossover at the point of divergence and then the Farley crossover at low speed, although with the expectation that the latter crossover would be replaced by a high speed installation at a later date.

This project is of mid-ranking priority, but would be most efficiently done as part of the Maitland–Branxton bi-directional resignalling project (section 8) so that the signalling would need to be modified only once.

The estimated capital cost of the project is about $5 million, so it will need to be closely assessed to verify its value for money. This assessment will be carried out as part of the development of the scope of the bi-directional resignalling project.

9.7 Single passenger platform at Singleton

Although the line through Singleton has been double track for several decades, the original single platform has been left to cater for passenger business in both directions.

With the increasing frequency of coal trains, the need for Down passenger trains to cross to the Up track to access the platform is now becoming an obstruction to Up coal trains, and will certainly be a hindrance to achieving a consistent ten-minute headway as part of the line's coal capacity enhancements.

At present four local (CityRail) and one long-distance (CountryLink) Down passenger trains need access to the Singleton platform each day. None of them terminates at the station.

There are several options to overcome this impediment:

- A duplicate platform on the Down side. This would need to meet all current disabled and other access requirements and would probably need to displace

Singleton station, looking south, with a single platform on the Up (southbound) track.

one of the Singleton yard's tracks. Ramped access to the Down end overbridge might simplify the access issues sufficiently make this option workable, albeit with the potential loss of the Down end of the yard's sidings.

- A combination of the use of bi-directional signalling, as proposed between Whittingham and Newdell Junction (section 8), and strategically placed cross-overs to allow Up coal trains to move to the Down track when Down passenger trains are accessing the single platform on the Up track (when a down passenger train is at Singleton there would not normally be any down freight trains within 10-20 minutes either ahead or behind).
- Slewing of the Up and Down main tracks to leave the single platform on a passenger loop rather than a main running line. While this would not entirely resolve the conflicts, it would at least enable Up coal trains to operate normally while a passenger train was at the platform for an extended period.
- Elimination of the first Down local passenger service and last Up local passenger service, as described in section 9.10 below, reducing the impact of this issue

The first option is most attractive as a complete solution but is likely to have the highest incremental cost. The second option would provide a fair degree of freedom to keep trains running while Down passenger trains were at the platform and would not involve any additional expenditure over the already projected cost of bi-directional working. Elimination of the first Down and last Up local passenger trains is appealing for a number of reasons, and should be further explored regardless of the option chosen for Singleton.

Resolution of this platform issue at Singleton is not a high priority at present, but it will become more important as coal tonnages build up.

It is therefore proposed that the issue should initially be dealt with as part of the bi-directional resignalling project. If it were to remain a constraint at high coal volumes after bi-directional signalling had been implemented, construction of a simple Down track platform with minimal facilities could be investigated.

9.8 Camberwell and Mt Owen Junctions

The Camberwell/Rixs Creek and Mt Owen coal loading loops both have moderate throughputs, of two or three trains per day and four or five trains per day respectively. Over the next few years these numbers are expected to change only slightly, falling to only one train per day on the Camberwell loop and increasing to six trains per day on the Mt Owen loop.

Both junctions are low speed and located on the Up side of the line, so that Down empty trains need to cross the Up track to enter the branch line.

In time it would be desirable to have higher speed main line turnouts installed, although for differing reasons.

Camberwell Junction is at the top of Nundah Bank, and as the numbers of trains on the main line increase it will be an advantage for empty trains to be able to cross to the branch line as quickly as possible, in order to limit delays to following or opposing trains. Stopping a loaded Up coal train on the approach to this junction is not an option under normal operating conditions, so empty trains are likely to be delayed.

Mt Owen has a similar problem, without the complication of approach grades for loaded trains. In this case, however, the ability of loaded trains to accelerate off the branch line without restraint, in order to gain momentum for Nundah Bank, will be an important aspect of achieving uniform ten-minute headways through to Sandgate.

It is therefore proposed that both of these junctions should be upgraded with 'standard' 1:18 turnouts in the medium term, when the existing turnouts are life expired.

9.9 Drayton branch line level crossing

The public level crossing on the Drayton branch line, about 800 m from the main line junction, causes delays to trains departing from and arriving at the branch.

Current operating practices require loaded trains to be held back about 1 km from the junction until the departure

signal is cleared, extending the time for clearing the main line by several minutes.

The benefits of the project to improve Drayton Junction with high-speed turnouts (section 3) will be partly negated by the continued impact of this level crossing.

The new Macquarie Generation branch line from Antiene to a new unloader loop will pass beneath the Drayton line, and it may be possible to divert the road to use the same underpass, thus eliminating the crossing altogether. Alternatively, it may be possible to either relocate and/or provide protection of the crossing to remove the existing operational constraints.

The ARTC is discussing this issue with the owner of the Drayton branch line, in conjunction with discussions on the options for Drayton Junction (section 3) and upgrading of the branch line more generally (sections 3 and 9.13).

9.10 Scone track alignment

The passing loop at Scone is short (410 m) and has an asymmetric layout, requiring all trains to negotiate a curved turnout leg and slowing speeds through the station area.

Level crossings and the proximity of the town make an extension of the loop unattractive.

Passenger trains are the only services that now transact business at Scone. It is therefore proposed that the track arrangement at Scone should be altered to give an unrestricted run through the number 2 (non-platform) road, with the platform on the loop being retained for passenger trains.

The first morning Down local passenger service and the last evening Up local passenger service are primarily for positioning purposes. Reconfiguration of the loop at Scone would permit these trains to be stabled at the Scone platform without impeding normal through freight operations, thereby freeing up capacity south of Scone.

This is regarded as a medium-term project.

9.11 Track alignment through Gunnedah

Gunnedah station's platform is on a loop, requiring 25 km/h speeds at both ends of the station.

Activity at the station includes passenger business (one train each way per day) and quite substantial business for Manildra, which has its own locomotive to operate its various sidings at Gunnedah. The location is unsuitable for an extension to provide a long loop.

It is proposed that the straight track through the station (the number 2 road) should be set up as the main line, in conjunction with the replacement of electric staff working by CTC signalling over the next four to five years (section 7).

Passenger trains would still be able to access the platform, and Manildra's operations would be simpler and cheaper to manage (the station is continuously staffed for all but 16 hours of the week).

9.12 Speed limit for loaded 100-tonne wagon trains north of Muswellbrook

Loaded '100 tonne wagon' coal trains are restricted to 65 km/h between Muswellbrook and Boggabri, compared with 80 km/h on the rest of the coal network.

As coal tonnages build up this restriction will provide a minor capacity impediment.

It is likely that limited approval to run at up to 80 km/h at selected locations would provide virtually all the benefits of faster running without having to upgrade or up-rate the track throughout.

This project has a low priority.

It is proposed that locations where higher speeds would be an advantage should be identified, so that the upgrading and maintenance implications can be assessed. Implementation would probably best be undertaken as part of the normal maintenance routine.

9.13 Speed limits on mine branch lines

As discussed in sections 3 and 9.8, improvements are proposed for most of the Hunter coal loader junctions.

In some cases, however, the branch lines between these junctions and the balloon loops are restricted to very low speeds, as low as 20 km/h.

Low speeds on these branch lines would largely negate the benefits of higher speed main line turnouts and could jeopardise the achievement of a consistent ten-minute headway.

The fact that most of the branch lines are privately owned is another complication.

It is proposed that all branch line tracks for a distance two train lengths from their junction (nominally 3,000 m) should be kept at a standard allowing entry and exit speeds to match the crossover speeds at the junction.

This would minimise empty train clearance times on the main line and permit unencumbered acceleration of loaded trains running to or from the branch.

It would also be an advantage for the longer branches to have a reasonable speed for their full length, but this is primarily a matter for the track/loader owners and their train operators.

9.14 Maintenance sidings

As train frequencies increase it will become progressively harder to get 'on track' time for maintenance and the provision of suitable sidings for heavy track maintenance machinery will become an important aspect of efficient maintenance.

Maintenance siding requirements are being identified by ARTC, and where there are shortfalls appropriate facilities will be incorporated into the overall enhancement program, to minimise the construction costs.

Two new maintenance sidings are proposed as part of the Ulan line's CTC project. Maintenance sidings were also considered as part of the current Togar and Murulla loop extension projects on the Muswellbrook–Werris Creek line, but it was determined that adequate facilities already exist in these areas.

10 Overview of the recommended projects

The projects recommended in this *2006–2011 Hunter Valley Coal Network Capacity Improvement Strategy*, their timings and their associated increases in the rail network's coal transport capacity are summarised in *Tables 1 to 3* and *Figures 15, 16 and 17*.

Indicative budget estimates for all the projects are summarised in *Table 4*.

When it commencement its NSW lease, the ARTC indicated that it would spend at least $153 million on investments in the Hunter Valley over the first five years of the lease.

In combination with on-going infrastructure renewal investments and the Sandgate grade separation project, the projects set out in this *Strategy* now lift the ARTC's expected expenditure on the Hunter Valley network to $375 million over the next five years.

(In comparison, in the May 2005 'Version 4' of this *Strategy* the forecast expenditure was $270 million, an estimate that included not only the major projects but also minor upgrades, the consolidation of train control and major periodic maintenance/renewals.)

Figure 18 provides an equally indicative summary of design and construction timeframes for the proposed major projects, derived simply by applying preliminary estimates of the durations of the projects ahead of the start of the calendar year during which each of them would need to be completed in order to accommodate the forecast demand.

Although the capital commitments to be made by the ARTC are large and have increased significantly, these commitments will be made in the context of—and within timeframes that match—an even greater growth in the volumes of coal to be transported over longer distances.

As a result, there would be a significant reduction in Hunter Valley coal haulage costs per tonne kilometre (*Figure 19*), making Hunter Valley coal significantly more competitive.

Table 1. **Newcastle–Muswellbrook capacity enhancement projects.**

Line section	Existing capacity (mtpa)	Projects required by first half of 2007		Projects required by second half of 2007		Projects required by 2008		Projects required by 2009		Projects required by 2010		Projects required by 2011		Capacity available in 2011	Capacity forecast to be required in 2011 (mtpa)[1]	Capacity forecast to be required in 2015 (mtpa)[1]
		Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)			
Sandgate	106	Grade separation	165											165	146	159
Sandgate–Bloomfield	>165													165	146	159
Bloomfield–Maitland	>165													165	143	155
Maitland–Allandale[3]	165													165	141	153
Allandale–Branxton[3, 4]	140									Resignalling of Up track for 8-minute headways	165			165	141	153
Branxton–Whittingham	90	Resignalling for 80 km/h approaches	102	Resignalling for 10-minute headways	135					Third track for 8-minute headways	165			165	141	153
Whittingham Junction	135									Third track at and south of junction	155 Down, 165 Up			155 Down, 165 Up	141	153
Whittingham–Camberwell Junction[3, 4]	140									Resignalling of Down track, Singleton–Camberwell Jn, for 8-minute headways	165			165	109	121
Camberwell Junction–Glennies Creek[3]	70	Resignalling for 80 km/h approaches	86	Resignalling for 10-minute headways	140							Third track, to harmonise with 8-min headways further south	165	165	107	120
Glennies Creek– Newdell Junction[2, 3]	165													165	95–97	108–110
Newdell Junction[3]	90							Junction renewal	120					120	97	110
Newdell Junction–Drayton Junction[3]	165													165	74	87
Drayton Junction[3, 4]	80											Junction renewal	120	120	74	87
Drayton Junction–Antiene[3, 4]	165													165	52	68
Antiene–Grasstree[4]	35					Duplication	165							165	67	83
Grasstree–St Heliers[4]	140							Resignalling (with adjacent duplications)	165					165	67	83
St Heliers–Muswellbrook[4]	35			Muswellbrook Yard and loop extension	65			Completion of duplication	165					165	67	83

Notes: **1.** The forecast capacity requirements are the highest annualised values forecast for any quarter in the relevant calendar year. 2. Ashton coal is loaded onto northbound trains which reverse direction at the Newdell balloon loops. **3.** It is assumed that bi-directional signalling will be installed between Maitland and Branxton and between Whittingham and Antiene, accounting for 7.5 mtpa of the capacities shown for these sections. **4.** It is assumed that bi-directional signalling for 8-minute headways will be installed with the duplication works between Antiene and Muswellbrook. **5.** It is assumed resignalling for 8-minute headways between Allandale and Branxton, Singleton and Camberwell Junction and Drayton Junction and Muswellbrook will be carried out in conjunction with bi-directional signalling work. **6.** The infrastructure proposed for 2011 would have an additional capacity of 35 mtpa if trains were lengthened to close to their maximum permissible length (1,550 m). This is a matter for rail operators and loaders.

Table 2. Muswellbrook–Ulan capacity enhancement projects.

Line section	Existing capacity (mtpa)	Projects required by second half of 2007		Projects required by 2008		Projects required by 2009		Projects required by 2010		Projects required by 2011		Capacity forecast to be required in 2011 (mtpa)	Capacity forecast to be required in 2015 (mtpa)
		Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)		
Ulan line through Muswellbrook	14	Muswellbrook Junction and loop extension (*Table 1*)	46									46	46
Muswellbrook–Bengalla	14	Muswellbrook Junction and loop extension, Centralised Train Control	46									46	46
Bengalla–Anvil Hill	14	Centralised Train Control		New passing loop at around 304 km	33							32	32
Anvil Hill–Wilpinjong	10	Centralised Train Control		New passing loop at around 381 km	18	New passing loop at around 410 km	20	New passing loops at around 348 and 370 km	28			24	24
Wilpinjong–Ulan	28	Centralised Train Control										16	16

Table 3. Muswellbrook–Narrabri capacity enhancement projects.

Line section	Existing capacity (mtpa)	Projects required by second half of 2007		Projects required by 2008		Projects required by 2009		Projects required by 2010		Projects required by 2011		Capacity forecast to be required in 2011 (mtpa)	Capacity forecast to be required in 2015 (mtpa)
		Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)	Project	New capacity (mtpa)		
Werris Creek line through Muswellbrook	9	Muswellbrook Junction and loop extension (*Table 1*)	21									21	37
Muswellbrook–Dartbrook	15							New Koolbury passing loop	34			21	37
Dartbrook–Murulla	5	Togar passing loop extension	9			Parkville passing loop extension	15	(With new Koolbury passing loop)	17			17	34
Murulla–Werris Creek	6	Murulla passing loop extension	7	Ardglen, Willow Tree (or Chilcotts Creek) and Werris Creek Yard passing loop extensions	9	Ardglen–Kankool duplication (unless a realignment option is adopted) and Quirindi passing loop extension	10	Murrurundi passing loop extension	15			15	31
Werris Creek–Gunnedah coal loading loop	4	New Gunnedah passing loop and motorised turnouts at all passing loops	7			Curlewis passing loop extension and Centralised Train Control or ATMS train order working	12	New Burilda passing loop	15			14	22
Gunnedah coal loading loop–Boggabri coal loading loop	4	New Gunnedah passing loop and motorised turnouts at all passing loops	10					Emerald Hill passing loop extension and Centralised Train Control or ATMS	14			13	21
Boggabri coal loading loop–Narrabri colliery	8											5	5

Note: The coal capacity estimates in this table assume average coal train loads on this route will increase from 3,150 to 4,950 tonnes—an increase of 57%—from 2008.

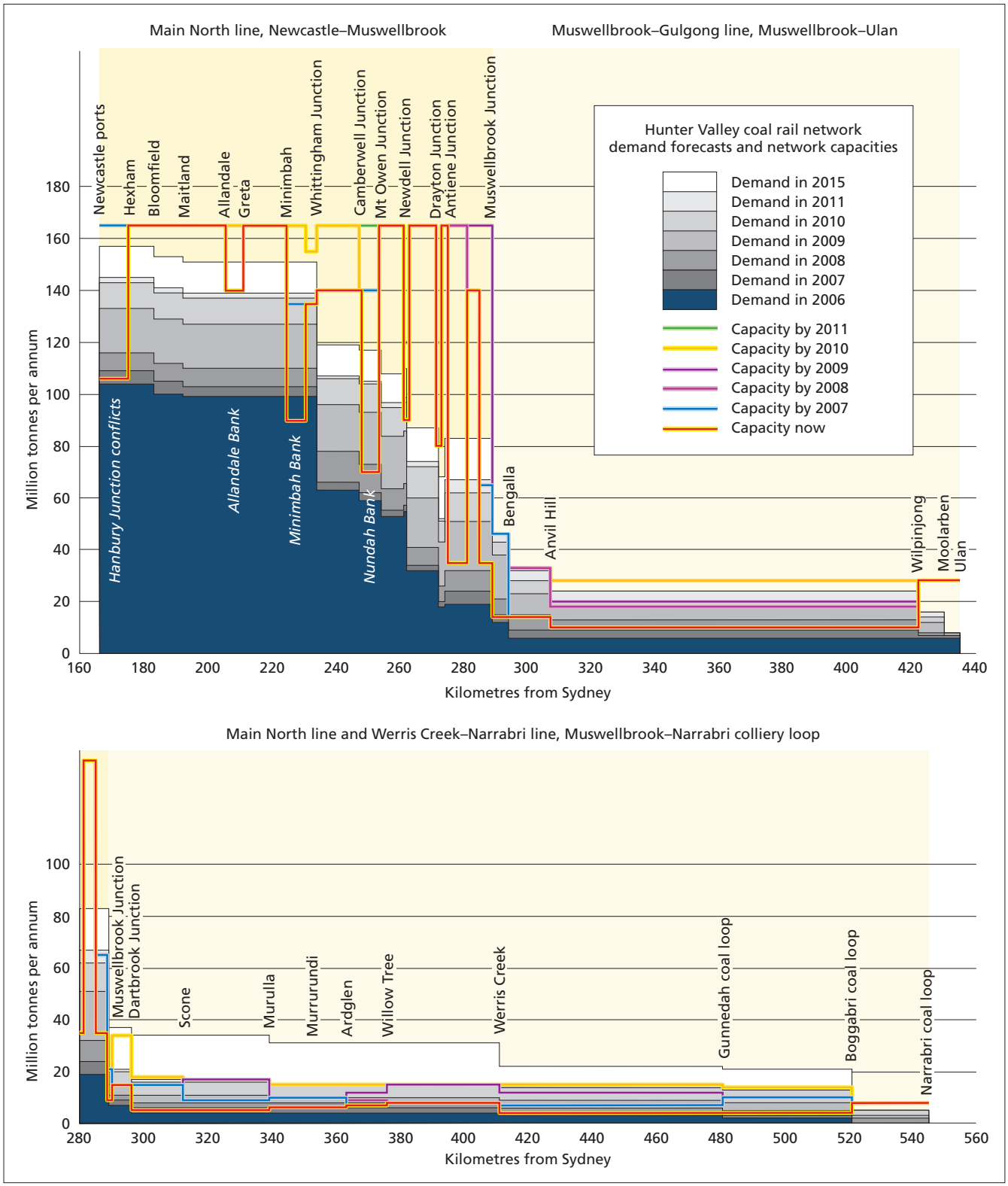


Figure 15. Forecast coal demand and the rail network's coal transport capacities, with the projects recommended in this Strategy, in 2006, 2007, 2008, 2009, 2010, 2011 and 2015 (millions of tonnes per annum). The demand and capacity comparisons for 2006, 2008 and 2011 are reproduced separately in Figures 16 and 17.

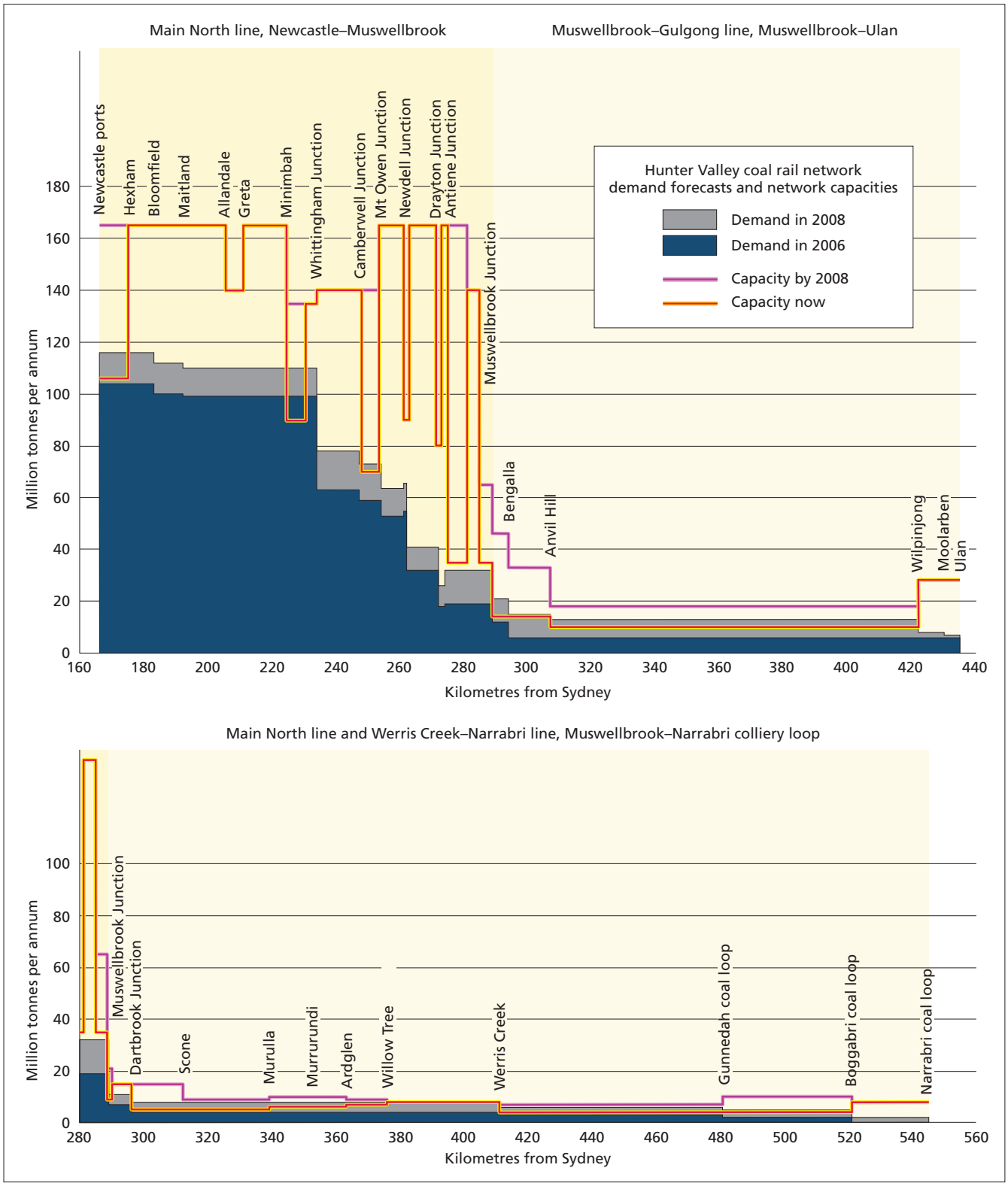


Figure 16. Forecast coal demand and the rail network's coal transport capacities, with the projects recommended in this Strategy, in 2006 and 2008 (millions of tonnes per annum).

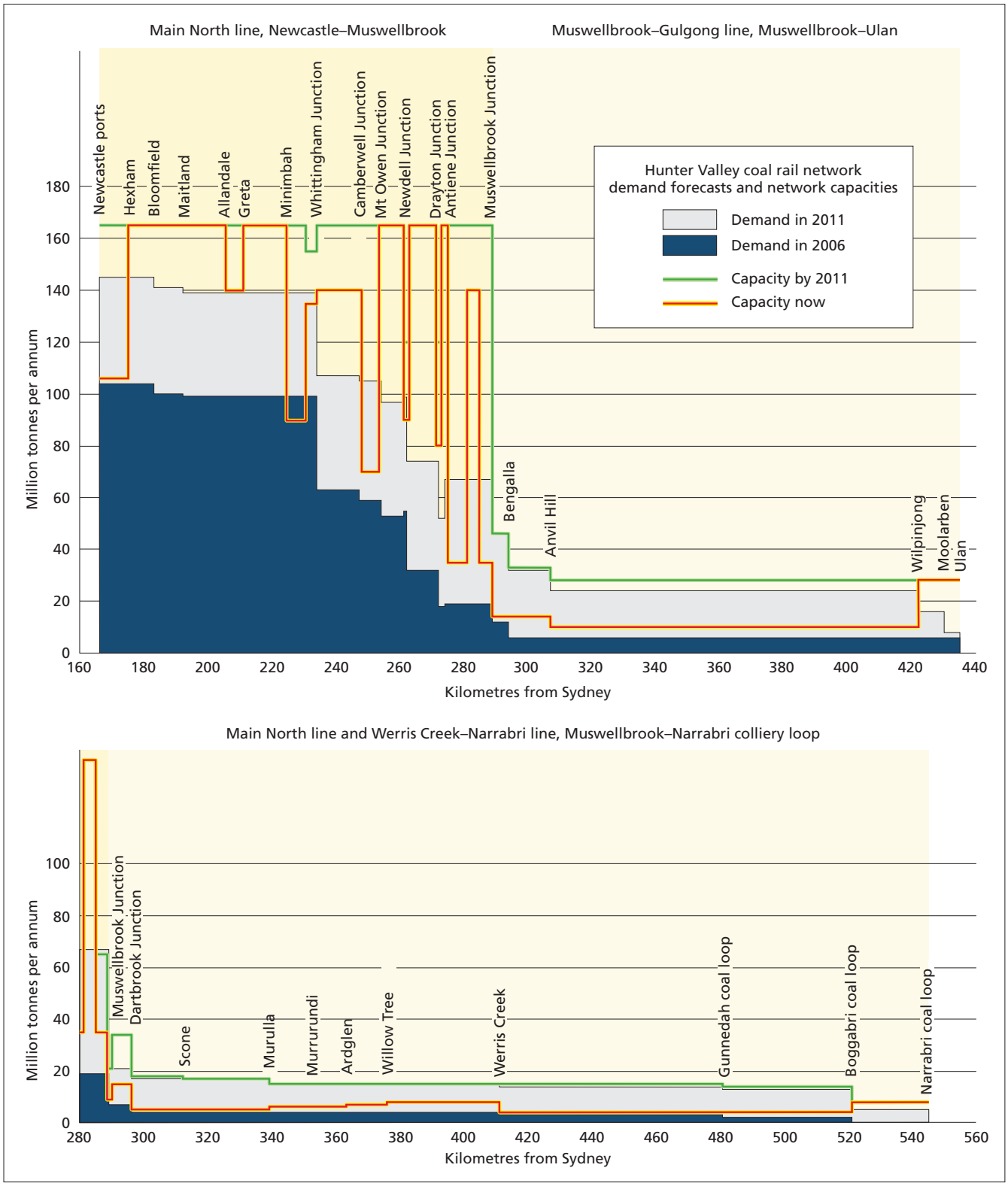


Figure 17. Forecast coal demand and the rail network's coal transport capacities, with the projects recommended in this Strategy, in 2006 and 2011 (millions of tonnes per annum).

Table 4. Indicative project cost estimates.

Required by	Project	Estimated cost (2006 $)
First half of 2007	Sandgate grade separation	$66.7 m
	Resignalling for 80 km/h approaching Minimbah Bank	$0.5 m
	Resignalling for 80 km/h approaching Nundah Bank	$0.5 m
Second half of 2007	Resignalling for 10-minute headways on Minimbah Bank	$1.0 m
	Resignalling for 10-minute headways on Nundah Bank	$1.0 m
	Muswellbrook Junction and passing loop extension	$10.2 m
	Ulan line Centralised Train Control	$15.5 m
	Togar passing loop extension	$3.5 m
	Murulla passing loop extension	$3.5 m
	Gunnedah passing loop (NSW Rail Infrastructure Corporation (RIC area)	$3.5 m
	Power operation of passing loop turnouts, Werris Creek–Narrabri (RIC area)	$8.0 m
January 2008	Bi-directional signalling, Whittingham–Newdell Junction	$11.5 m
	Antiene–Grasstree duplication (including bi-directional signalling)	$21.0 m
	304 km passing loop on Ulan line	$8.2 m
	381 km passing loop on Ulan line	$8.2 m
	Ardglen passing loop extension	$3.5 m
	Willow Tree passing loop extension (or new Chilcotts Creek loop)	$3.5 m
	Werris Creek Yard passing loop extension	$3.5 m
January 2009	Bi-directional resignalling, Maitland–Branxton	$13.4 m
	Newdell Junction upgrading	$6.9 m
	Bi-directional resignalling, Grasstree–St Heliers	$7.0 m
	St Heliers–Muswellbrook duplication (including bi-directional signalling)	$21.9 m
	410 km passing loop on Ulan line	$8.2 m
	Parkville passing loop extension	$3.5 m
	Ardglen–Kankool duplication	$12.0 m
	Quirindi passing loop extension	$3.5 m
	Curlewis passing loop extension (RIC area)	$3.5 m
	Centralised Train Control, Werris Creek to Narrabri (RIC area)	$10.4 m
January 2010	Resignalling on Allandale Bank for 8-minute headways	$1.0 m
	Third track on Minimbah Bank for 8-minute headways	$40.2 m
	Bi-directional resignalling, Newdell Junction to Drayton Junction	$7.2 m
	348 km passing loop on Ulan line	$8.2 m
	370 km passing loop on Ulan line	$8.2 m
	Koolbury passing loop	$5.0 m
	Murrurundi passing loop extension	$3.5 m
	Burilda passing loop (RIC area)	$3.5 m
	Emerald Hill passing loop extension (RIC area)	$3.5 m
January 2011	Third track on Nundah Bank for 8-minute headways	$27.6 m
	Drayton Junction upgrading	$4.2 m

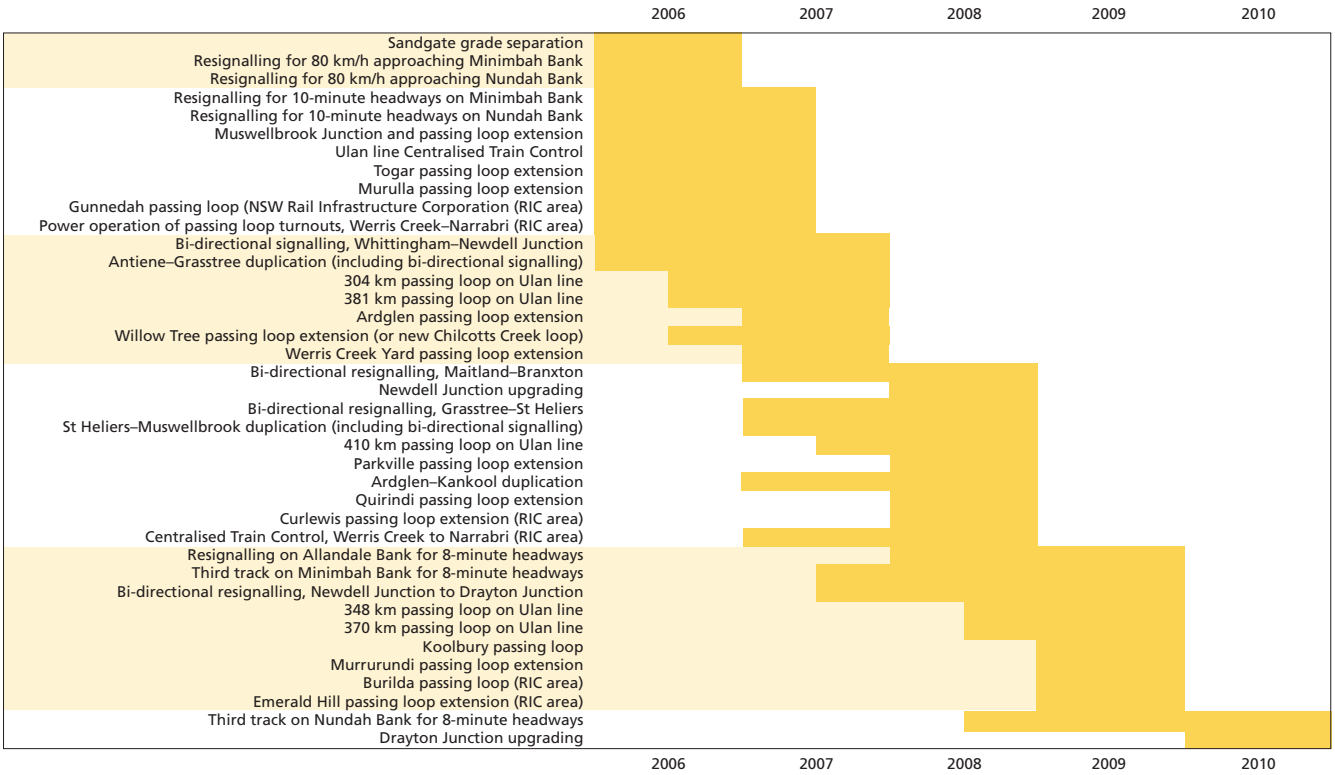


Figure 18. Indicative works program for the projects recommended in this Strategy.

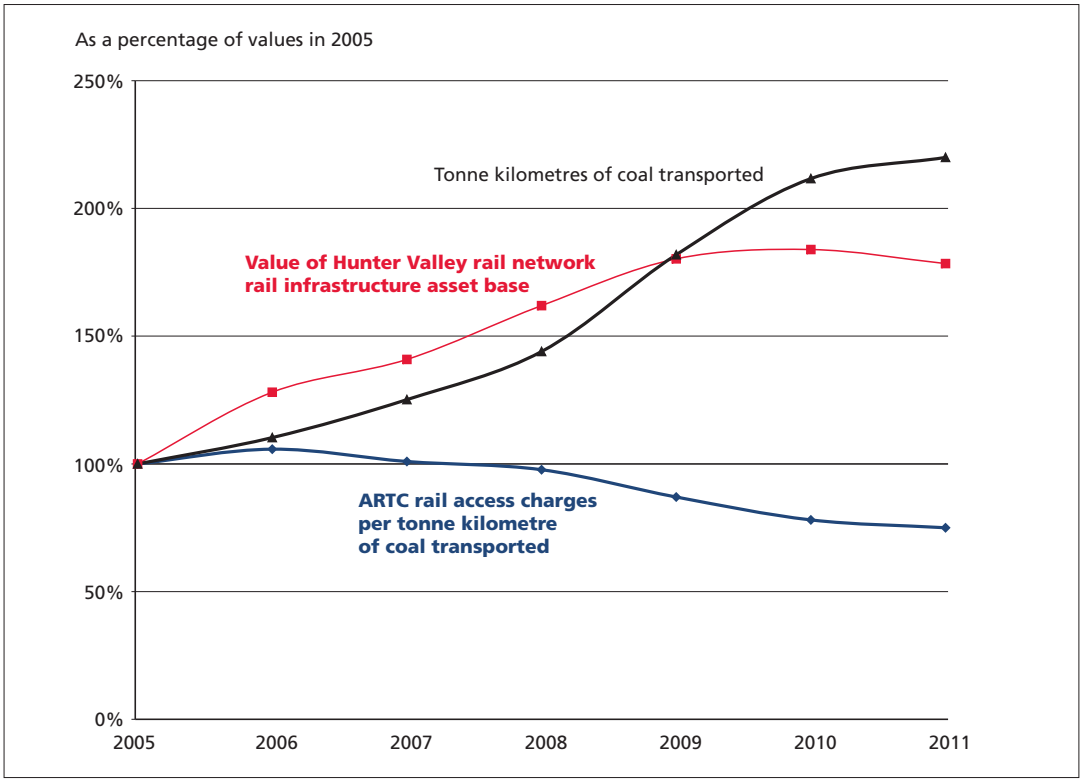


Figure 19. Despite their high capital cost, the projects recommended in this Strategy will significantly reduce coal haulage costs per tonne kilometre on the Hunter Valley coal rail network.