26th Australasian Transport Research Forum
Wellington
New Zealand
1-3 October 2003

Problems Of Success – Impact of Growth In Freight on Sydney's Rail System

Matthew Jones
Rail Infrastructure Corporation, NSW

Introduction[1]

A very large proportion of Australia's principle rail freight movements, coastal shipping movements and much of the road freight movements involve transit through Sydney. Sydney is also the main destination for over 70 per cent of Port Botany's container imports and is a critical conduit for agricultural export trade from country NSW. Sydney is important as an unavoidable transit point for north-south and east-west movements. Rail lines from the north, west and south of the state converge on Sydney and north-south through traffic and traffic between western NSW and regions to the north or south of Sydney is also largely routed through the Sydney metropolitan area. Yet, the Sydney metropolitan railway system is highly congested with passenger traffic having legislative priority over freight, leading to long transit times and off-peak scheduling of freight paths.

Rail freight tonnages have grown dramatically in recent years and show every likelihood of continuing to grow in the future, driven by buoyant economic growth and industry restructuring. Government policy (NSW EPA, 1998) has indicated that it would like to see a greater use of rail in the movement of freight (NSW DoT 1998), from 15 per cent of all movements in Sydney to 25 per cent by 2008. At the same time the case for rail freight funding usually has to be a commercial one with out regard to the wider social and environmental benefits.

In confronting these challenges, Rail Infrastructure Corporation has a major role in the planning and development as well as the maintenance of Sydney's rail system. The following details some of the work we have undertaken in this process and outlines potential solutions that have been considered but in which no firm decisions have yet been made.

Background

Rail Infrastructure Corporation[2] (RIC) has the responsibility to maintain, grow and adapt the New South Wales rail network for the use of passenger and freight traffic and also so as to meet a variety of environmental and transport policy goals. RIC is

[1] Whilst the paper quotes work carried out within Rail Infrastructure Corporation in addition to external sources, responsibility for the contents, opinions, interpretations and data contained herein lies solely and exclusively with the author.

[2] In late 2000, following the recommendation of the McInerny report into the Glenbrook rail accident of late 1999, the NSW Government legislated to merge Rail Access Corporation (the infrastructure owner) and Rail Services Australia, (the infrastructure maintainer), into a new organisation named the Rail Infrastructure Corporation, effective from 1st January 2001.

a State Owned Corporation formed in January 2001 operating under the *Transport Administration Act (1988)* and the *State Owned Corporations Act (1989).* RIC owns and operates the major infrastructure facilities of the NSW rail network, including rail track, bridges, electrification equipment, signals and communication facilities. The RIC network is the second largest rail network in Australia, and includes the largest metropolitan network in the country. The NSW network is an integral part of the nation's rail infrastructure and comprises 8,700 km of track and more than 5,000 rail and road bridges. The network supports some 900,000 passenger journeys and 220,000 tonnes of freight daily.

RIC's core business is the provision of access to its network which accounts for over 90 per cent of RIC's public and private sector revenue. The NSW Government covers much of the cost incurred by RIC in making the network available for the use of access seekers through funding for the Country network, and funding State Rail Authority (SRA) access fees for the Metropolitan network.

The Transport Administration Act (1988) defines the NSW rail network. This includes railway lines vested in or owned by RIC encompassing assets such as track, bridges, signals, train control systems, overhead wiring and associated structures, electricity substations, electricity transmission lines and communication lines. It does not include stations, platforms, some rolling stock maintenance facilities, freight centres, depots, or private sidings.

Current Freight Task - Australia

Rail's primary task has remained that of a carrier of bulk commodities accounting for 86 per cent of the tonnage carried in 1999/2000, according to the Australian Bureau of Statistics (ABS. 2002). Bulk commodities includes coal—as well as grain and minerals—accounts for some 86 per cent of rail's total tonnage. Minerals includes a range of commodities from small quantities of quarry material and cement through to very large iron ore movements. The remaining 14 per cent of rail's tonnages is largely composed of none containerised freight. Containerised freight remains a relatively small proportion of total general freight tonnages although it accounts for a respectable 17 per cent of all containerised freight across all modes in Australia.

Since rail's ability to offer a competitive alternative mode of transport is largely confined to long distance movements, rail is actually occupying a much higher mode share than 17 per cent since it is only competitive on a small number of corridors compared to road. The Australian Rail Track Corporation's (ARTC) 2001 Interstate Rail Network Audit confirmed this with, for example, its citing of rail's mode share of 70 per cent on the Melbourne – Perth corridor.

Table 1 Rail Freight Mode Share across key Interstate Corridors

Interstate Rail Corridor	Rail Mode Share in 2000 (estimate) (per cent)
Melbourne – Sydney	11
Sydney – Brisbane	19
Melbourne – Brisbane	21
Melbourne – Adelaide	20
Melbourne – Perth	70
Sydney – Perth	65
Total for all corridors	22

Source: ARTC 2001

The recent ABS survey (ABS 2002) of freight tonnages indicates that coal alone represented 43 per cent of rail's freight market.

Table 2 Australian Freight Task by Mode 2000-01

Tonnes Carried ('000)	Road	Rail	Sea	Air	Total
Coal	48,129	222,055	2,527	-	272,711
Grain	42,243	18,927	288	-	61,458
Minerals	24,441	198,378	20,126	-	342,945
General Freight					
Steel	15,982	6,174	1,665	-	23,821
Bulk Liquids	29,503	1,550	10,832	-	41,885
Vehicles	21,459	63	109	-	21,631
Other General Freight					
General Freight Non-Container	253,709	48,046	2,290	131	304,176
General Freight Container	56,404	13,368	9,159	27	78,964
Not Elsewhere Classified	22,047	557	342	56	23,002
Total General Freight	399,109	69,758	24,397	214	493,478
Total All	613,922	509,118	47,338	214	1,170,592

Source: Freight Movements, Summary 9220.0, Year Ended 31 March 2001, ABS

With the exception of the Alice Springs to Darwin rail line currently under construction the Australian rail network has remained relatively unchanged in recent years. At the same time however, the rail task has grown quite dramatically across both passenger and freight markets. Whilst the urban passenger task has grown by around 10 per cent in the five years to 2000, on the back of booming employment growth in most of the state capitals, freight has expand by 27 per cent over the same period.

Table 3 Rail Network Information

	1996	1997	1998	1999	2000a
Australia's rail network					
Kilometres of track	40 300	39 200	39 900	39 930	39 848
Locomotives	2 100	2 000	2 000	2 000	2 025
Wagons	92 650	92 500	92 400	92 350	92 079
Carriages	4 400	4 400	4 400	4 400	4 564
Passengers carried ('000)					
Urban rail patronage	440 919	455 850	457 283	462 838	482 219
Non-urban rail patronage	9 104	9 800	9 888	9 948	10 493
Freight carried					
Million tonnes	399.4	470.1	487.5	492	508.0
Billion net tonne-km	104.3	114.4	125.2	127.4	134.2

Table Sourced from BTE web site (June 2002), (a. Financial year 1999-2000, previous years are calender years.
Source: Australasian Railway Association–personal communications.)

There is little getting away from the fact that rail freight is a niche activity in comparison to road freight, serving mainly longer distance corridors with specialised transport haulage services and short haul corridors where rail volumes are high. Whilst the data measuring growth in road freight tonnage remains poor, there is plenty of evidence to suggest that rail haulage has been growing across all sectors, not just bulk haul.

Current Freight Task – New South Wales

The New South Wales rail network currently has around 11 freight operators although by far the biggest was FreightCorp—before becoming part of the National Rail Consortium—carrying 89 million tonnes of freight in 2000/2001[3] (the organisation receives a CSO to run services in the country areas of NSW). Of this, 76.3 million was coal with 65.6 million tonnes of this originating in the Hunter Valley. Regional freight terminal facilitated the movement of a further 7 million tonnes of grain and 3.2 million tonnes of bulk material (includes non-metallic minerals, quarry and petroleum products). In terms of containerised trade at least 196,000 TEU from regional New South Wales was hauled through Sydney Metro rail network.

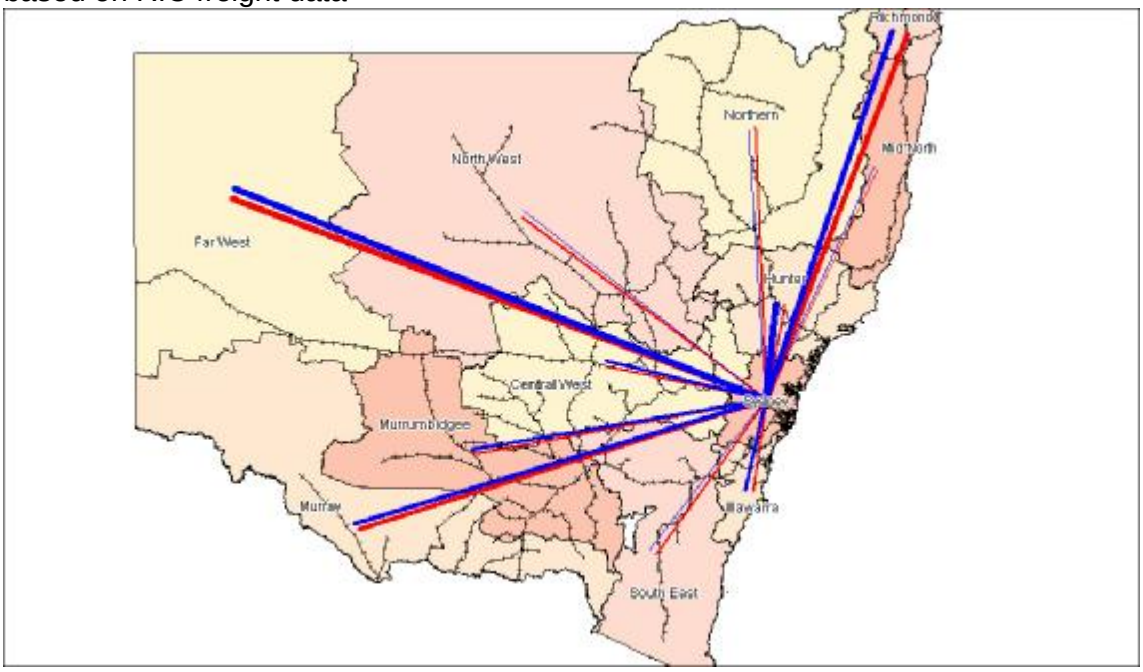
Nearly all rail freight movements, coastal shipping movements and much of the road freight movements involve passage through Sydney. Sydney is also the main destination for over 70 per cent of Port Botany's container imports and is a critical conduit for NSW originating, international trade. Sydney is important as an unavoidable transit point for north-south and east-west movements. Rail lines from the north, west and south of the state converge on Sydney and north-south through traffic and traffic between western NSW and regions to the north or south of Sydney is also largely routed through the Sydney area. Yet, the Sydney metropolitan railway

[3] Freight Corp Annual Report 2000/2001

system is highly congested with passenger traffic having priority over freight, leading to long transit times and off-peak scheduling of freight paths.

At the same time rail freight tonnages within New South Wales have grown dramatically in recent years. The New South Wales rail network currently has around 11 freight operators although by far the biggest was FreightCorp—before becoming part of the National Rail Consortium—carrying 89 million tonnes of freight in 2000/2001. Of this, 65.6 million tonnes originated in the Hunter Valley going straight to Newcastle port. Regional freight terminals facilitated the movement of a further 7 million tonnes of grain—mostly for export—and 3.2 million tonnes of bulk material (includes non-metallic minerals, quarry and petroleum products). For containerised trade at least 196,000 TEU from regional New South Wales was hauled through the Sydney metropolitan rail network.

Figure 1 Map of Key Freight Flows into, out of and through Sydney in 2000/2001 based on RIC freight data



Source RIC

Prospects for New South Wales

New South Wales' economy is very similar to the Australian average. Its mining, tourism and other sectors mirror the rest of Australia as a proportion of total state activity. This has meant that New South Wales' economic performance is rarely faster or slower than Australia overall. Over the last five years, economic activity has been strong, as has employment growth. This situation was reversed as a consequence of a weaker economy post Olympics and very weak tourism combined with slower information technology (IT) and manufacturing exports. Assuming that NSW maintains its current share of Australian output at around 38 percent and long

term growth in GDP averages around 3.2 per cent per annum, it seems very likely that the freight task will continue to expand.

Recent work (BTE 1999) has further emphasised the notion that the freight task is growing, with road tonnages overall in Australia increasing at 4 per cent per annum on average, while interstate road freight increasing at 5 per cent per annum. The paper goes on to suggest that with typical average rates of economic growth, tonnages moved by road Australia-wide would increase 80 per cent in the 15 years to 2015, while interstate road tonnages moved would more than double. The paper points out that the task for road is arguably much greater since even if rail general freight grows at twice its current rate, road freight tonnages Australia-wide would still increase by around 76 per cent over the next 15 years. Such statistics may serve to emphasise the scale of the problem for road based transport but for rail these potential increases in the haulage task are deeply challenging. Current rates of growth in rail freight are between 3 to 4 per cent for general freight. For this increase to double it would require substantial improvements to rail capacity, a point made many times over by studies undertaken for ARTC (ARTC 2000) and RIC.

Rail Freight Forecasts

Freight forecasting is often characterised as more complex than passenger forecasting, itself a highly complex and problematic field. Freight forecasting requires as much judgement, market understanding and educated guess work as more conventional and formal passenger modelling and certainly a greater qualitative input than is expected in passenger forecasting. As the owner, maintainer and provider of rail access across New South Wales RIC has an interest in understanding the size, scope and direction of the changing trends in the freight task. RIC has developed rail freight forecasts both in aggregate and for specific markets both in conjunction with consultants and through its own activities.

RIC's billing system records freight movements and train weights for the calculation of access fees chargeable to third party operators on the NSW rail network. For historical reasons the system breaks down the freight market into four distinct freight types;

- Coal
- Grain
- Minerals
- General freight.

Base freight data in the form of GTK (gross tonne kilometres) and gross tonnes by origin and destination is all recorded at this level of sub market. Train weight is recorded combining the rolling stock and commodity tonnages with the effect being that the conversion from gross tonnages to net tonnages can be problematic when studying the data that the RIC billing system produces. A particular example of this is that whilst average ratio of gross to net tonnes is around 2.0 (depending on the commodity) this ratio varies by route direction. A crude example is provided when

applying this factor to coal traffic since this does not obviate the need to understand that all the Hunter coal travels from the mine to the Port and not vice versa. A brief review of the freight market follows.

Coal – Typically Japan, Korea and Taiwan account for over 80 per cent of NSW coal exports and whilst there have been short term cyclical movements in Hunter Valley coal throughput, the prospects for growth in the coal market remain positive. In addition, recent consolidation of the local coal industry has resulted in better co-ordination of the transport task and improved forward planning. Aided by increased production efficiency, falling storage and handling costs and more efficient mine to port transfers as a results of improvements facilitated by RIC, Hunter Valley Coal throughput is forecast to rise from a little short of 70 million tonnes in 2001/2002 to around 100 million tonnes over the next ten years.

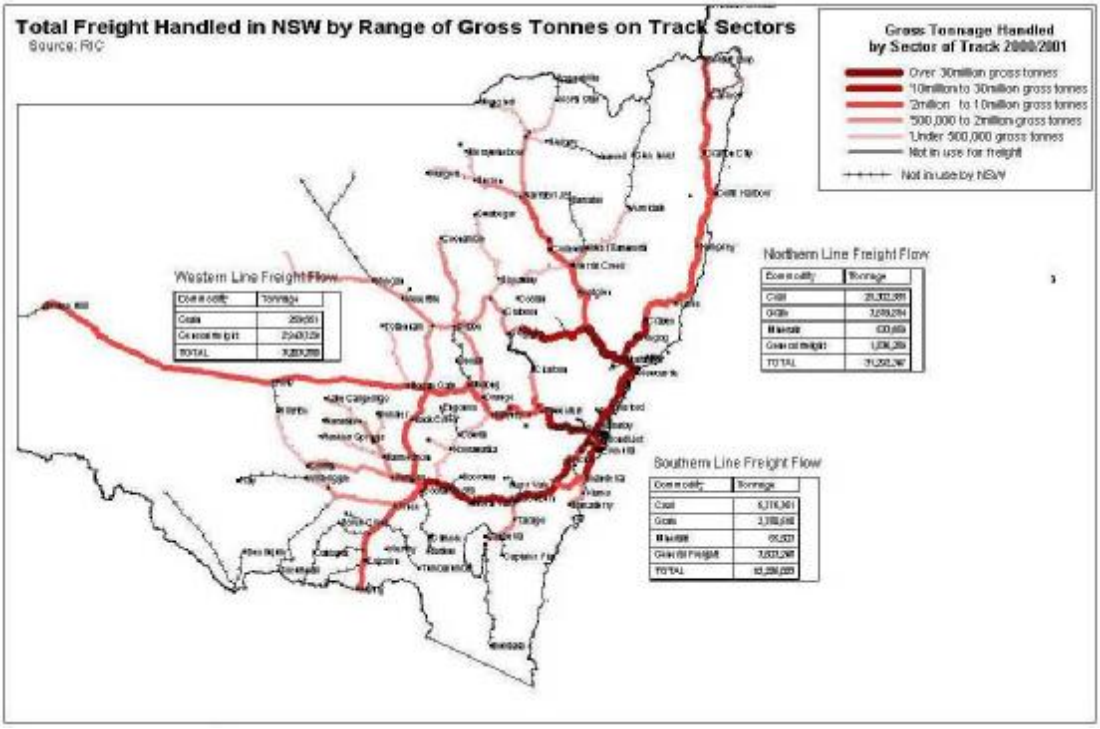
Grain – Rail's freight task for grain is stable with the outlook as much a product of the El Nino weather cycle as the prospects for Australian grain in overseas markets. The average NSW wheat harvest over the ten years to 1998-99 was 4.6 million tonnes which is actually slightly lower than the average harvest between 1980-81 and 1989-90 of 4.7 million tonnes. In more recent years the NSW wheat harvest has been good, touching 7 million tonnes in 1999 and 2000. For 1998-99 the rail grain haulage estimate of 5.2 million tonnes (with 3.9 million tonnes for export) reflects this above-average result, implying that the average future haulage task will not be much greater than this. Once predicted harvest fluctuations are evened out, ABARE forecasts suggest that Australian wheat exports will increase by an average rate of only 0.7 per cent per annum over the next five years or so. However there supply side constraints on growth in the grain harvest (aside from the weather) and these include, the limited amount of new NSW land suitable for use in grain production, potentially higher returns in livestock industries in marginal lands and overall and difficulties in improving yields without the introduction of genetically modified crops. The result is that an average of some 4.6 million tonnes per annum over the next ten years seems likely.

Minerals – The major mineral regions where minerals are produced include, Cobar, Berrima, Kandos and Dunmore. Minerals are predominantly transported from NSW's hinterland to the ports or to major production areas with this traffic accounting for a relatively small share of network volumes. Some minerals such as fertiliser are affected by seasonal factors but the main traffic flows are from Cobar to Sydney and Newcastle and movements to and from Port Kembla. Generally, the traffic flows of minerals on the NSW network are predominantly intrastate traffic and seem likely to remain so in the future. A small rise in volumes is possible.

General Freight – In this context general freight traffic incorporates the following commodity groups import and export containers including cotton, meat, containerised grain, paper and textiles, steel traffic, some bulk traffic which includes dry and liquid commodities. Most general freight traffic is loaded, unloaded or passes through Sydney since the city represents the state's largest centre of consumption. Chemicals, paper, machinery and manufacturing products are the largest

commodities consumed and they represent 69 per cent of total imports through the Port of Sydney. Wollongong and [Newcastle represent other major import and export centres for general freight traffic, particularly steel, and containerised grain. Rail's market share in this sector has experienced a steady decline right up until the mid 1990's most notably in the import-export container market where improvements in road vehicle technology and increased mass limits have attracted much of the freight to road. More positively rail continues to dominate the steel market with close to 90 per cent market share for total NSW steel production. In terms of the drivers of the general freight market, domestic output (as measured by GDP) for domestic and imported produce is a reasonably reliable indicator. Studies for RIC (Booz.Allen, 2001) have estimated that the output elasticity for general freight demand in this case is approximately 1.3. Export demand for general freight is more complex and a function of the Australian dollar combined with a range of overseas market effects. However, assuming the long term decline trend in rail have been arrested and that more recent growth in this market will endure, the freight task for this sector could easily rise by 50 per cent over the next 10 years.

Figure 2 Map of Total Freight Flows on Rail across NSW in 2000/2001 based on RIC freight data



Source RIC

Clearly the general freight market is the one which represents the greatest potential for growth as well as providing the greatest challenges. Not only will this market drive additional track capacity needs simply so as enable both increases in train length and numbers in the coming years, but it is a market that is particularly vulnerable to poor on time running performance and unreliability.

The Current Operating Environment of the Freight Task

The New South Wales Government through transport and other infrastructure agencies (including state owned corporations) is currently engaged in developing a variety of freight related infrastructure projects. Whilst financial support for freight projects is almost always provided in a commercial framework, greater emphasis is being given, where possible in demonstrating the community preference for a mode shift in freight flows towards rail. As an indication of this freight activity and in no particular order the following rail projects are relevant here;

- Port Botany line track amplification;
- Sydney intermodal terminal capacity provided either through ;
- Proposed 70 hectare reclamation at Port Botany by Sydney Ports Corporation to accommodate a projected 150 per cent increase in container trade over the next 20 years;
- Proposed Port Botany expansion as indicated by the recent commitment to undertake an EIS;
- Pacific National Rail's (previously Freight Corp) partnering with freight forwarders in developing freight terminals, for example those at St Mary's, Minto and Yennora in Sydney and Parkes and Bathurst in the country;
- An inland railway proposal built by connecting existing sections of track between Melbourne and Brisbane, called the Australian Inland Rail Expressway (AIRE); and
- Capacity improvements on the Hunter Valley coal network to meet growing coal movements.

ARTC role in this process

The Australian Rail Track Corporation Ltd (ARTC) was created after the Commonwealth and State Governments agreed in 1997 to a single point of contact for all operators requiring seeking access to the National interstate rail network. As a result ARTC currently has responsibility for the management of 4430 route kilometres of standard gauge interstate track, mainly in South Australia, Victoria and Western Australia. The Defined Interstate Rail Network comprises:

ARTC owned rail corridors:

- Adelaide to Wolseley
- Adelaide - Port Augusta - Kalgoorlie
- Port Augusta to Whyalla
- Tarcoola to Alice Springs
- Broken Hill to Crystal Brook

In Victoria, ARTC leases the two mainline interstate and standard gauge corridors from the Victorian Government. These are:

- Melbourne to Wolseley

- Melbourne to Albury

Over all these corridors, the ARTC is responsible for:

- Selling access to train operators
- The development of new business
- Capital investment in the corridors
- Management of the Network
- The management of infrastructure maintenance

NSW has insisted that safety standards across the country network are set by the new state Transport Safety and Reliability Regulator. Other key corridors that make up the inter-state network, but which remain under the control of the State jurisdictions include:

- Brisbane to Sydney (QR/R/IC)
- Sydney to Broken Hill (RIC)
- Kalgoorlie to Perth (Westrail)
- Sydney to Albury (RIC)
- Sydney to Port Kembla (RIC)
- Cootamundra to Parkes (RIC)

The agreement between ARTC and the New South Wales government (in particular this includes Rail Infrastructure Corporation) to obtain a long term lease of the NSW mainline interstate, Hunter Valley and certain metropolitan rail freight corridors and rail track network appears to have been reached in principle. The ARTC proposal involves a 60 year lease of the main non metropolitan lines excluding the electrified network (that the network bordered by Newcastle in the north, Macarthur and Nowra in the south and Lithgow in the west), whilst the NSW Government retains track ownership. Lines included in the ARTC proposal are:

- Albury - Macarthur,
- Moss Vale - Unanderra,
- Cootamundra - Parkes,
- Parkes - Broken Hill,
- Parkes - Dubbo,
- Dubbo - Werris Creek,
- Hunter Valley (Port Waratah / Kooragang - Werris Creek, Muswellbrook - Ulan – Merrygoen),
- Broadmeadow - Queensland border.

The ARTC proposal includes an option to lease the line from Werris Creek to Boggabilla should the Melbourne-Queensland inland rail project proceed. As a sweetener the ARTC is proposing an infrastructure investment program including:

- A southern freight access corridor between Macarthur and Chullora (and once complete, extend to include Port Botany Flemington and Rozelle yards);
- Hunter Valley infrastructure upgrades;

- Train control, signalling and safe working system improvements;
- Rail and foundation strengthening, bridge replacements and a sleeper replacement and strengthening program ; and
- New and extended crossing loops to allow the operation of longer trains.

ARTC proposes that it be granted an option to acquire the communications infrastructure necessary to operate train services on its leased network, a three-year maintenance contract on the infrastructure with RIC and a three year train control contract with the SRA. ARTC proposes to move towards the establishment of a single train control centre, located in NSW, for its NSW operations.

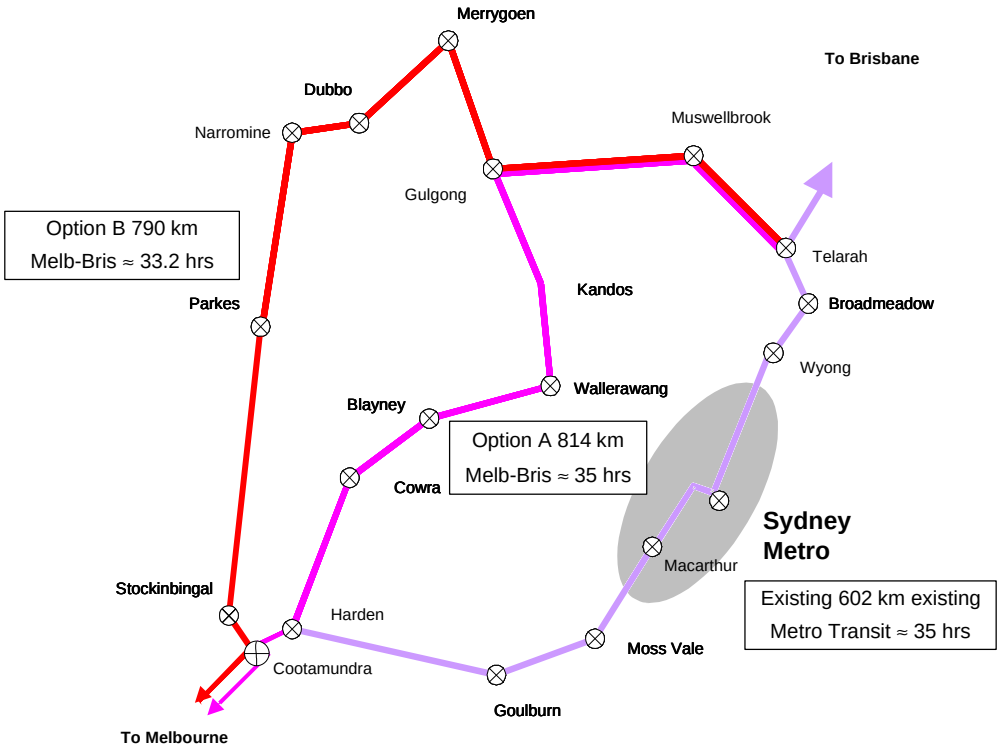
Areas that will need to be resolved include both industrial relations and staff resourcing issues. Nevertheless, a single interstate rail track entity would almost certainly produce a number of benefits including the ability to make decisions for the national benefit—and not from a purely State perspective—as well as providing a greater degree of coordinated planning for both maintenance and capacity enhancement. At the same time the notion of 'big is better' is one that has been discredited many times over and for ARTC to enjoy the economies of scale and scope that are planned from this expansion process will present a substantial management challenge.

Future Operational Improvements—some options

The ARTC (ARTC 2001) proposed a well documented series of improvements to the existing interstate rail network as embodied in its two packages of improvements (the S1 and S2 proposals) and track upgrades. The inland rail route, known as the Australian Inland Rail Expressway plans an inland railway from Melbourne to Darwin via New South Wales and Queensland. The plans follows in the footsteps of seven previous attempts starting in 1887 and consisting of connecting together into a single double stacked standard gauge rail line, existing rail lines through the three states. The most expensive part of the link is that crossing the NSW Queensland border.

Supplementary to these ideas are two possible freight bypass routes around Sydney (RIC 2002), obviating the need to pass through the metropolitan area. One passing

Figure 3 Freight by-pass route options around Sydney



Note that option A and B are estimated to cost between $110m and $170m each before these approximate transit times can be achieved

Source: RIC (2002)

through Blayney and Wallerawang and the other going via Parkes and Dubbo.

Table 4 Comparison of potential solutions to Sydney's rail network congestion

Rail corridor on which improvements made	Cost ($M present value of works)	Impact on reliability	Effective extra capacity through Sydney Metro #	New transit times in hours after improvements (Note current Mel – Bris time is 35.00)		
				Melbourne - Brisbane	Melbourne - Sydney	Sydney - Brisbane
Bypass Route A – Cowra/Blayney	$234.1	Medium	4	35.00	N/a	N/a
Bypass Route B – Parkes/Dubbo	$175.4	Medium	4	33.30	N/a	N/a
Minor improvements North of Telarah and South of Cootamundra	$66.0	Low	0	31.00	13.00	18.00
ARTC Scenario 1 and the Southern Priority Line	$336.3	Medium	≈ 6	29.00	12.00	17.00
ARTC Scenario 2 and the Northern Priority Line	$713.8	High	≈ >10	26.00	11.00	15.00

Notes N/a = not available for the by pass routes as Sydney is avoided
 # capacity in this context is approximate extra train paths in both directions.
Source: RIC (2002)

The results of the analysis indicate that the by pass routes would provide some relief by diverting Brisbane – Melbourne freighters away from the Sydney Metropolitan area. At the same time, minor improvements whilst providing no capacity relief can improve much needed journey time savings to all rail services. The ARTC Scenario 1 package of works delivers some capacity enhancements as well as journey time savings for all rail services although it clearly costs more. The quantity of freight that can avoid Sydney is relatively limited. As Sydney grows to anything between 4.8 million (DUAP 1999) and 5 million over the next 20 years, the likelihood will be that the focus of the solutions to the city's freight problems will be in Sydney itself if substantial inroads are to be made in providing extra capacity, transit time improvements and reliability.

Conclusions

Rail network capacity analysis is not an exact science. There maybe what appear to be an infinite number of timetable and infrastructure configurations available to solve specific capacity problems. As a results, it is quite possible to receive contradictory advice over the extent to which the Sydney rail network is congested. Whilst there is general agreement that most available capacity at a time that current freight operators want is used up, the solutions to providing more paths are more complex. Whilst it is probable that a few additional paths could be provided through adaptation of the existing time table these will certainly buy some time but the likelihood remains that bigger solutions will be needed in the future. RIC (and probably ARTC) plus other NSW transport agencies will develop a clearer view of the likely freight transport task in the future, as time goes but indications are that some significant improvements in the metro freight network will be needed in the future if rail is to offer any kind of alternative to road.

References

Australian Rail Track Corporation, (ARTC), (2001), *Interstate Network Audit – Final Report*, Booz Allen and Hamilton, Sydney.

Australian Bureau of Statistics, (ABS), (2002), *Freight Movements Australia - Year Ended March 2001*, catalogue 9220.0, Canberra.

Bureau of Transport Economics (BTE), (1999), *Trends in Trucks and Traffic* Information Sheet 15, BTE, Canberra

Bureau of Transport and Communications Economics (BTCE), (1999), *Competitive Neutrality Between Road and Rail*, Working Paper 40, BTCE, Canberra

Department of Urban Affairs and Planning (1999), *Population Projections for New South Wales (Preliminary)*, Sydney, NSW.

New South Wales Environmental Protection Authority (NSW EPA), (1998) *Action For Air: The NSW Government's 25 Year Air Quality Management Plan*, New South Wales Environmental Protection Authority, Chatswood, NSW

New South Wales Department of Transport, (NSW DoT), (1998), *Action for Transport 2010: An Integrated Transport Plan for Sydney*, New South Wales Department of Transport, Sydney.

Rail Infrastructure Corporation (RIC), (2001), *Booz.Allen & Hamilton Freight Infrastructure Strategy Freight Demand* Final Report, BAH, Sydney.

Rail Infrastructure Corporation (RIC), (2002), *Sydney Freight By-Pass Study* Draft Report, GHD consultants, Sydney.