NSW Infrastructure Capability Assessment

Transport Hypotheses Evidence

Supplement to the Transport Capability Assessment Report

March 2012

Report Outline

- **Transport Hypotheses Summary**
- Hypothesis 1 – Global Economic Corridor Access and Connectivity
- Hypothesis 2 – Motorway Capacity and Connectivity
- Hypothesis 3 – Regional and Interstate Roads Connectivity
- Hypothesis 4 – Accessing NSW’s International Gateways
- Hypothesis 5 – Rural and Regional Freight
- Hypothesis 6 – Asset Maintenance
- Hypothesis 7 – Road Safety

To build on the Transport Capability Assessment report, INSW commissioned GHD to test a number of hypotheses

INSW Hypotheses

	Transport Sector Hypothesis	Description	Comments
1	Global economic corridor access and connectivity	Constraints on the transport networks facing the Global Economic Corridor (in particular the CBD) may hinder the further development of high value jobs in this area	Rail services are capped by available train paths (20-26 per hour). There has been limited growth in bus patronage and the number of services which suggests the network is at or near capacity or the private buses are gaining increased share (no private bus data to support)
2	Motorways	The Sydney motorway network suffers from inadequate capacity and connectivity	The Sydney motorway network provides good connectivity to Sydney's major economic hubs, however there are missing links and critical pinchpoints
3	Regional and interstate roads	Outside the metropolitan area, most roads function well all the time and there is adequate connectivity between centres	The physical condition of rural roads is improving and they out performing other roads in NSW. There is limited data on the reliability of the regional network. Connectivity is good for general traffic. Adverse weather and natural disasters adversely impact regional road performance and connectivity
4	Accessing NSW's International Gateways	Transport network constraints may increase the costs faced by: • People accessing the airport • Import and export container trade through Port Botany • Bulk freight trades through Port Botany, Kembla and Port of Newcastle	The transport network constraints that increase road congestion and limit vehicle productivity are likely to increase direct transport costs and externalities (pollutants and emissions) for passengers accessing airport, freight operators utilising Port Botany and bulk commodities on road (particularly in the metropolitan area)

GHD

To build on the Transport Capability Assessment report, INSW commissioned GHD to test a number of hypotheses (cont)

INSW Hypotheses

	Transport Sector Hypothesis	Description	Comments
5	Rural and regional freight	• Transport network constraints may increase the costs of transporting freight within NSW or interstate • Existing rail infrastructure is highly inefficient	• The transport network constraints that limit vehicle access and productivity are likely to increase direct transport costs and externalities • Without long term planning and investment, the regional rail freight infrastructure (in particular, the grain network) will continue to be highly inefficient. The NSW Grain Freight Review concluded that there is an economic case for keeping the majority of the grain branch lines open and would require some investment
6	Asset maintenance	Maintenance backlog/ deficit may not be as significant as claimed.	Unconfirmed. Anecdotal evidence suggests there is a maintenance backlog, however more detailed analysis of 'levels of service' data is required to ascertain whether the maintenance backlog is significant
7	Road safety	The same safety outcomes could be achieved by spending less in different ways	Unconfirmed. Road safety performance has improved significantly over the last several decades and road safety programs and initiatives have been targeted toward key areas of risk. However more detailed analysis would be required to quantify the improvements and cost effectiveness of road safety programs

GHD

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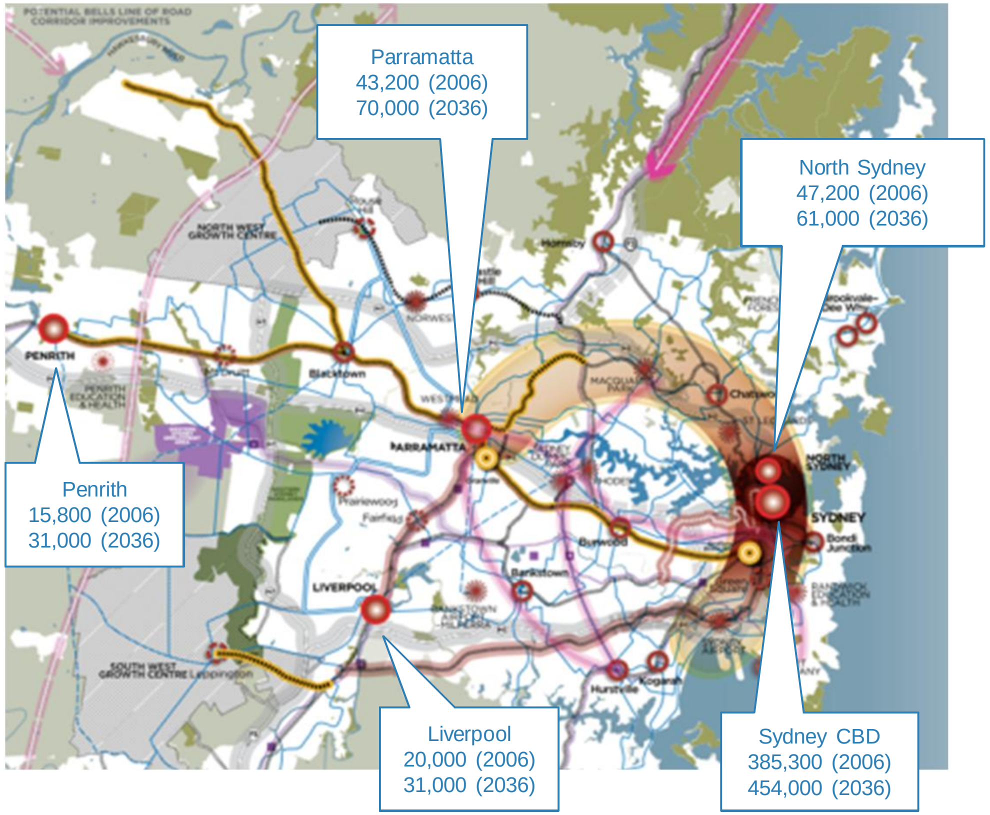
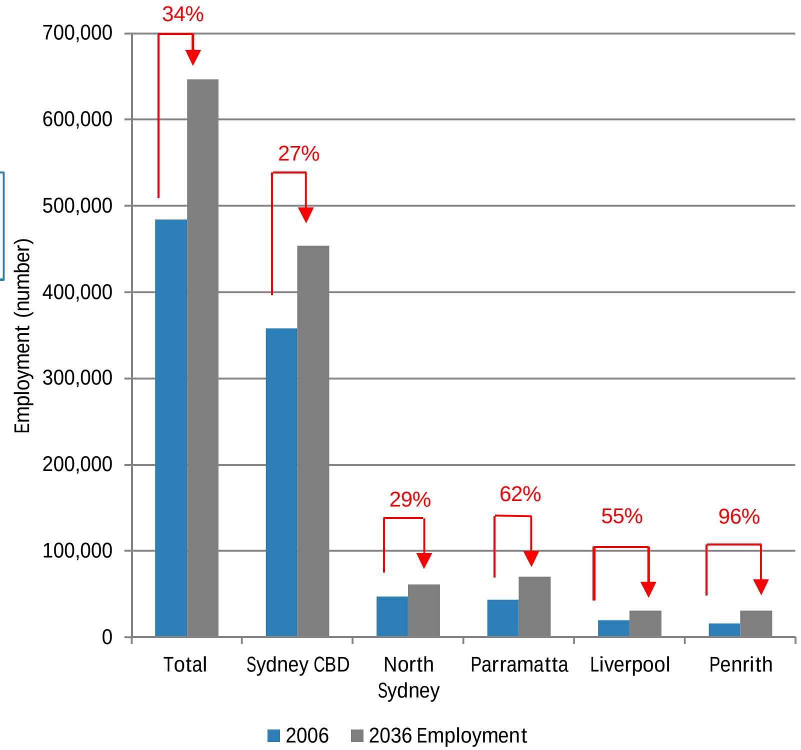
Total employment in Sydney's global economic corridor and regional cities is forecast to increase by 162,500 (34%) jobs by 2036 of which greater than one-third is expected for the CBD alone

Key Transport Infrastructure and the Global Economic Arc [1]



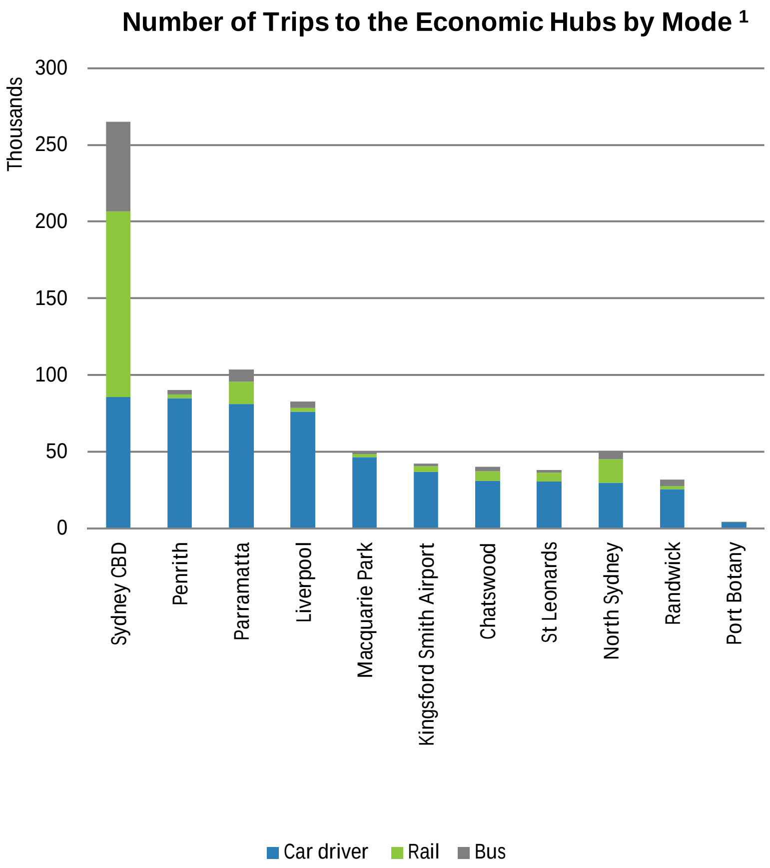
Employment Growth 2006 – 2036 [1]

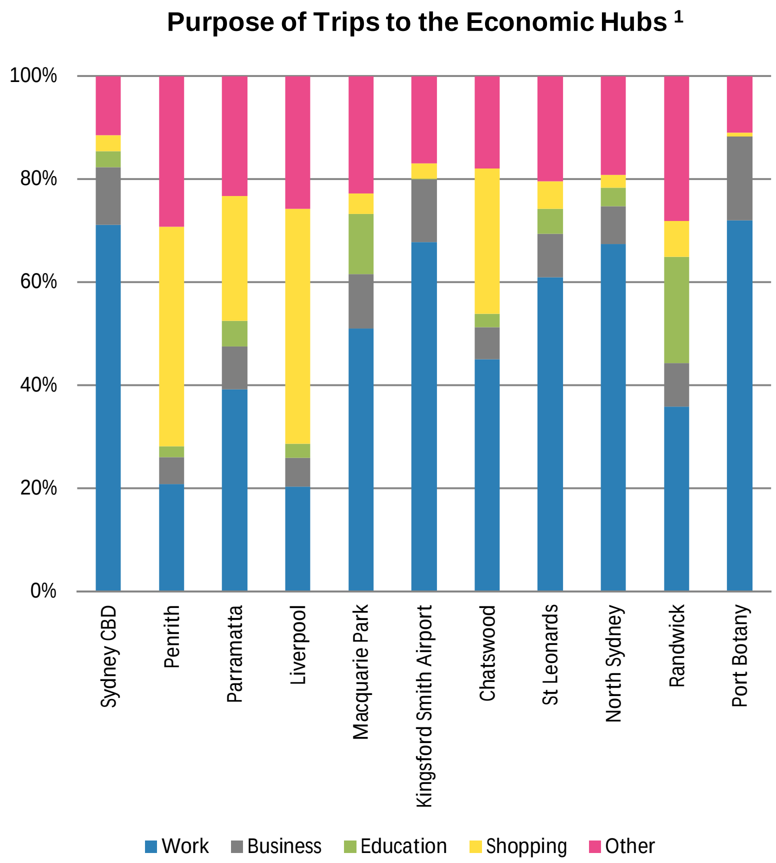


[1] NSW Government (2010) Metropolitan Plan for 2036

1

Except for the CBD, car dominates the travel mode to main economic hubs of Sydney with considerable variability in main trip purpose across the various destination hubs





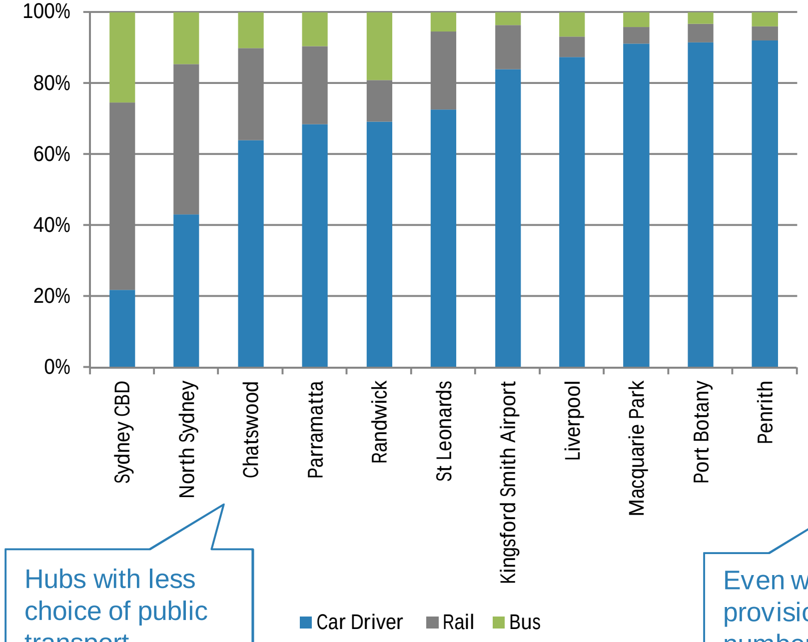
NOTE: Method for determining hubs is identified in Appendix A

[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

1

Public transport access to some growth centres is limited which means the private car is the dominant mode

Mode Split by Destination Hub, average weekday AM peak, 2011 [1]



Hubs with less choice of public transport alternatives are more dependant on car travel

Hub Connectivity to the Transport System [1]

	Car	Bus	Train
CBD	√	√	√
North Sydney	√	√	√
Macquarie Park	√	√	x
Chatswood	√	√	√
St Leonards	√	√	√
Randwick	√	√	x
Airport	√	x	√
Port Botany	√	x	x
Parramatta	√	√	√
Penrith	√	√	√
Liverpool	√	√	√

Even where public transport provision appears good for a number of hubs, car dominates mode choice with over 80% of AM peak weekday trips inbound

[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

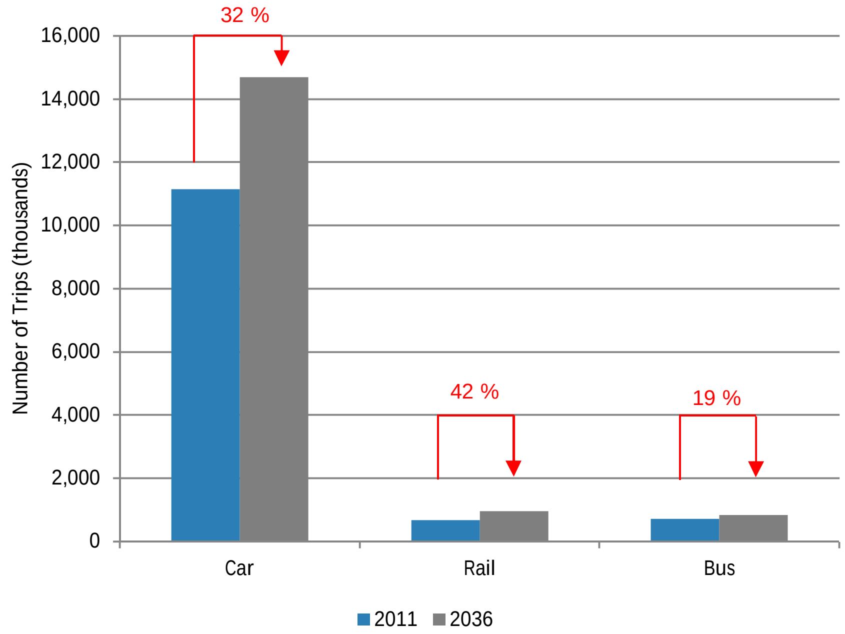
1

Train travel is forecast to grow by 42% over the next 25 years – although car will remain the dominant mode in Sydney

Average Annual Growth Rates by Mode 2011 – 2036 [1]

Average Annual Growth Rate	Car	Train	Bus
Historic	0.9 %	0.8 %	1%
2011 - 2036	1.28 %	1.68 %	0.76 %

Total Number of Trips Sydney Greater Metropolitan Area, by Mode 2011 - 2036 [1]



[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

1

Connectivity to the CBD is varied – road journey times in the inner city are half those of public transport, while public transport is quicker from the metropolitan outskirts

Average AM Peak Journey Time to CBD from Key Hub by Mode (minutes) [1]

Hub	Road	Public Transport
Sydney CBD *	4.26	14.56
North Sydney	12.34	24.37
St Leonards	18.08	36.70
Randwick	19.95	32.32
Kingsford Smith Airport	24.14	45.75
Port Botany	26.39	53.63
Chatswood	27.23	40.07
Macquarie Park	35.31	58.15
Parramatta	75.03	52.90
Liverpool	94.81	87.90
Penrith	136.86	87.44

NOTE: Method for determining journey times is identified in Appendix A

The Strategic Transport Model suggests that journeys from Sydney's west are quicker by public transport than road – this is not the case for journey's originating in other hubs within the economic arc

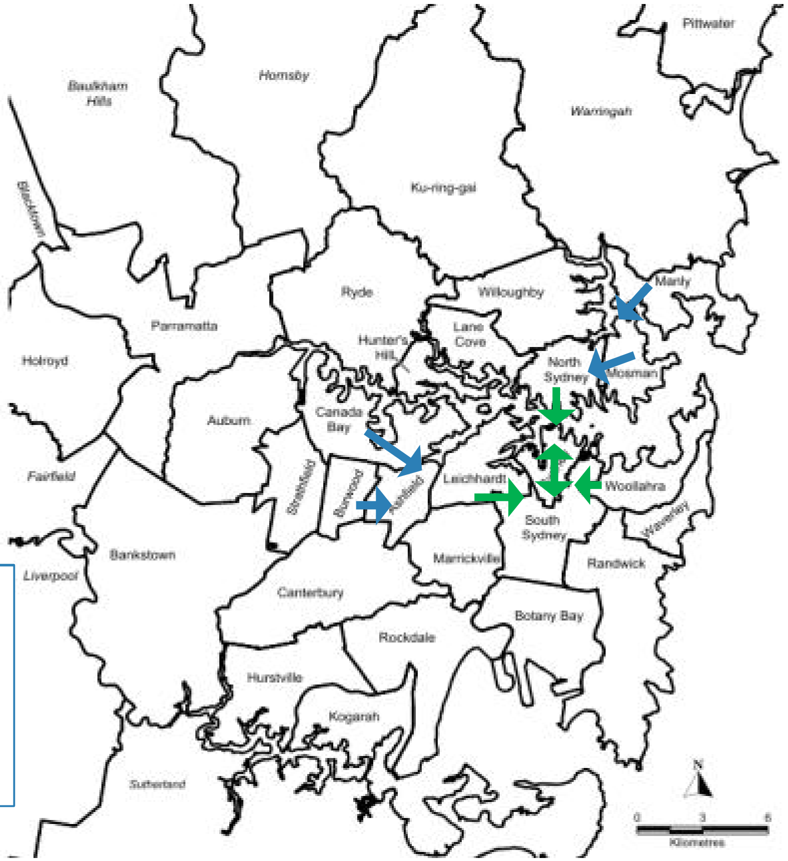
LGAs with the Slowest AM Peak Journey Times to the CBD by Mode [1]

Car

(3.76 min/km) Manly
(3.39 min/km) Burwood
(3.37 min/km) Mosman
(3.36 min/km) Canada Bay

Public Transport

(10.85 min/km) Sydney
(8.71 min/km) Woollahra
(6.44 min/km) Leichhardt
(6.10 min/km) North Sydney



[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis
* Intra CBD trips within the Sydney of Sydney LGA

1

Travel times between the CBD and the outer regions are typically slower by public transport except for trips from Campbelltown, Blue Mountains and Wollongong

Journey Time and Average Speed to CBD from Suburban and Exurban Centre [1]

	Car		Public Transport *
Suburban/Exurban Centre	**Average Speed (kph)**	**Average Travel Time (min)**	**Average Travel Time (min)**
Newcastle	46.43	197.94	233.69
Port Stephens	45.96	243.60	363.51
Wyong	36.78	157.50	178.03
Kiama	35.89	196.57	220.61
Gosford	31.62	151.04	154.59
Wollongong	30.74	158.44	142.99
Hawkesbury	29.52	129.70	162.76
Blue Mountains	28.53	178.15	153.97
Willoughby	24.62	24.25	42.93
Campbelltown	24.09	126.82	97.82
Hornsby	22.48	76.33	84.14

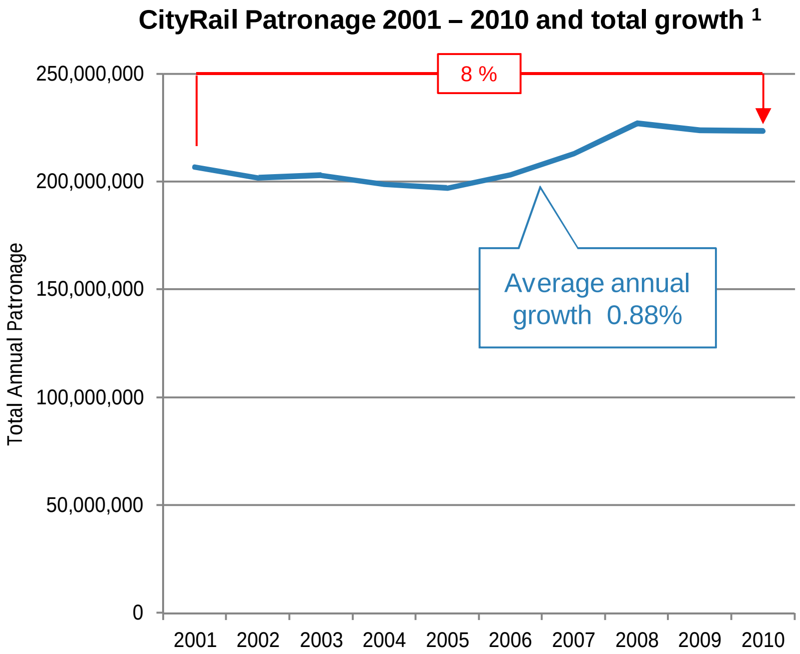
NOTE: Method for determining journey times/speeds is identified in Appendix A

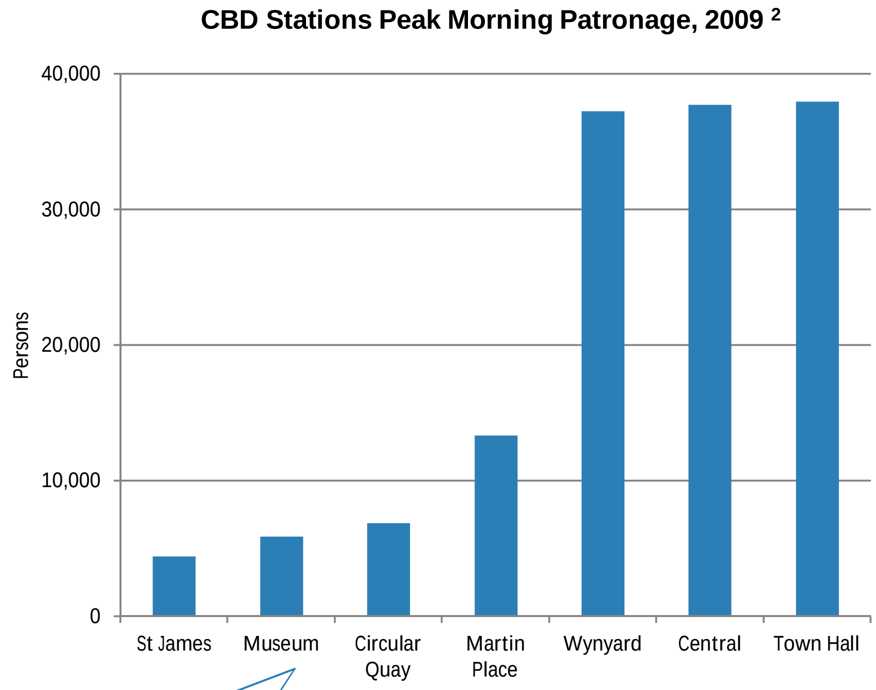
GHD

[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis
* Public transport refers to bus and rail trips

1

Rail patronage has increased by 8% since 2001 with the majority of passengers exiting at three CBD stations





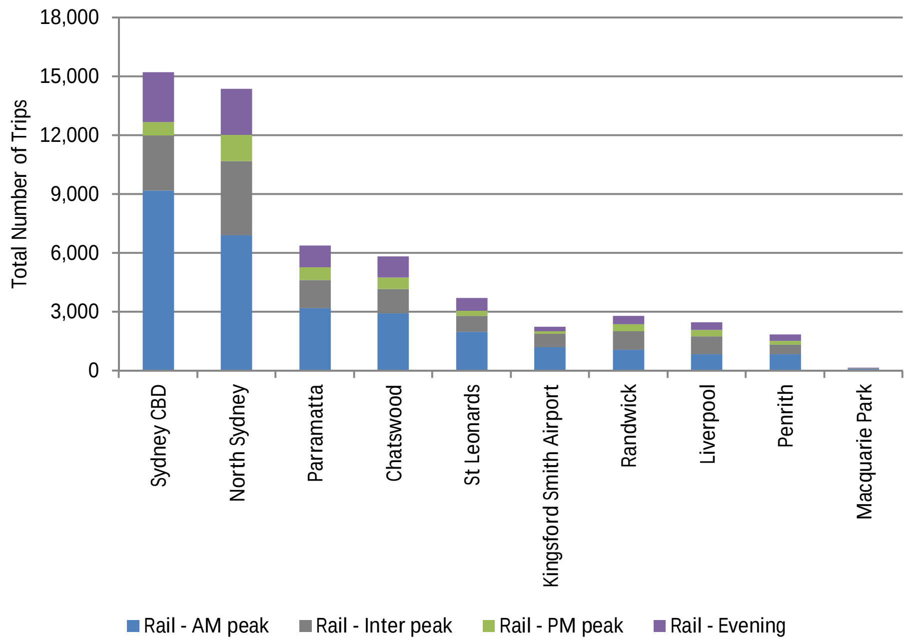
- Morning peak station exits are concentrated in the CBD
- Within the CBD 79% of morning peak patronage in concentrated in Wynyard, Central and Town Hall

[1] Bureau of Transport Statistics (2010) CityRail data
[2] City Rail (2010) A Compendium of City Rail Travel Statistics

1

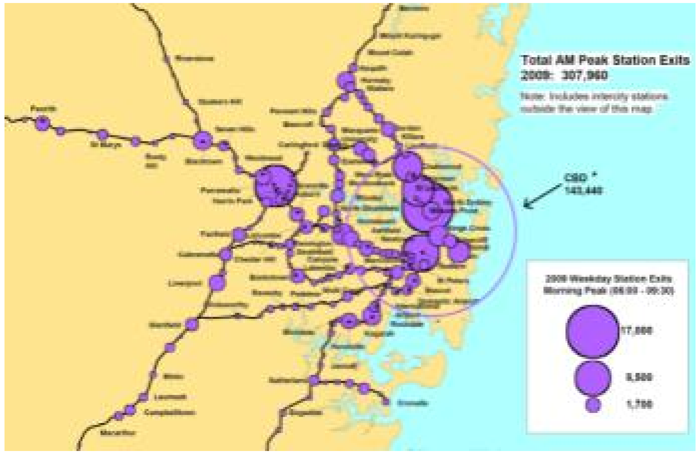
The pattern of station AM peak period entries and exits indicates the dominance of a relatively small number of major nodes for trips by rail with the Global Economic Corridor prominent

Number of Train Trips to Economic Hub by Time of Day, 2011 [1]

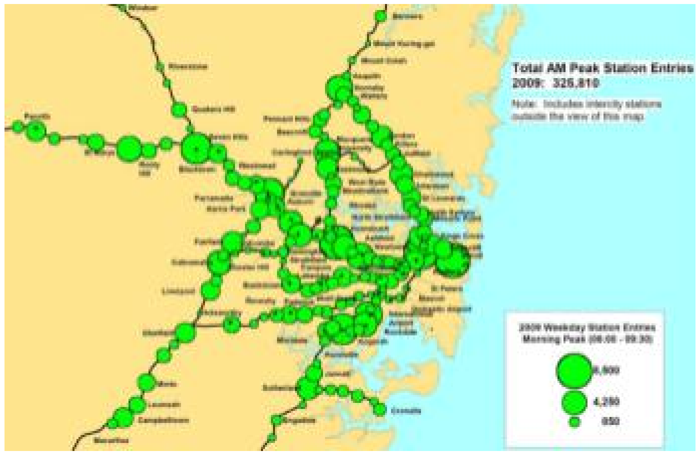


- Most economic hubs experience at least 50% of their rail demand in the AM peak

Average Weekday AM Peak Station Exits [2]



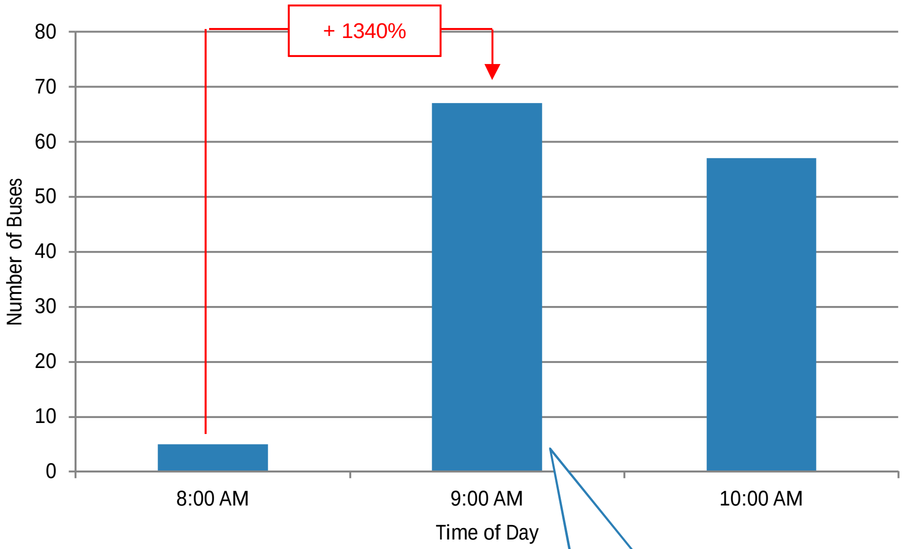
Average Weekday AM Peak Station Entries [2]



[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis
[2] Bureau of Transport Statistics (2010) CityRail data

Bus services into the CBD are constrained by available road space on key CBD access corridors

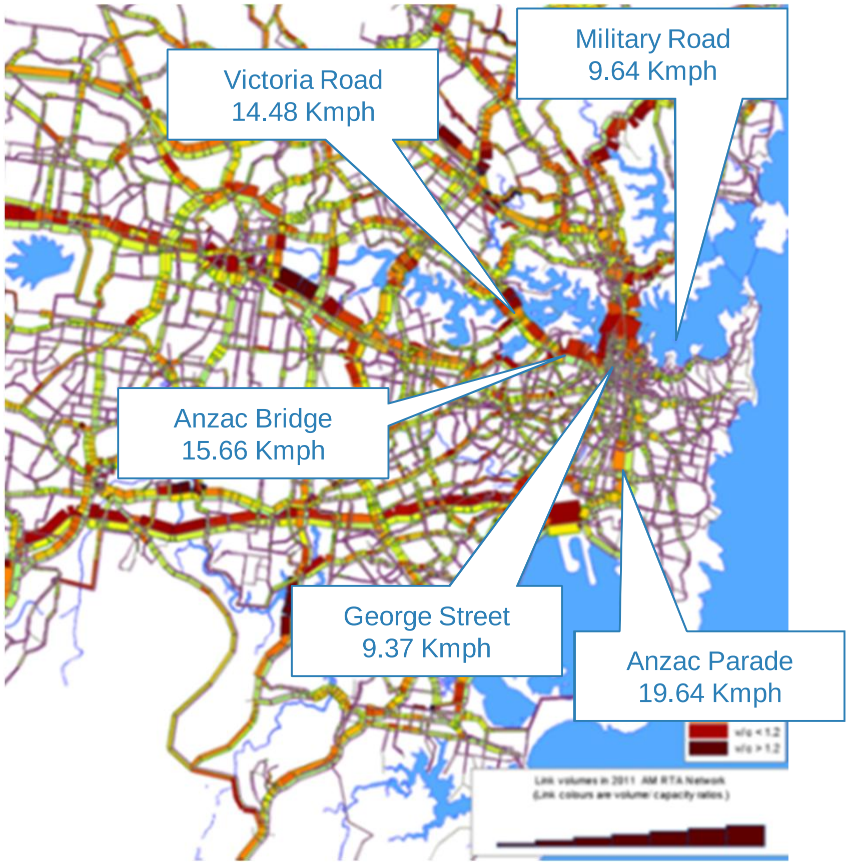
Number of Buses waiting outside the CBD on the Sydney Harbour Bridge [1]



NOTE: Year of data outlined in the figure above is not published

- In excess of 60 buses are waiting on the Sydney Harbour Bridge in order to access the CBD

Average Bus Speeds on Key CBD Access Corridors AM Peak, 2011 [2]

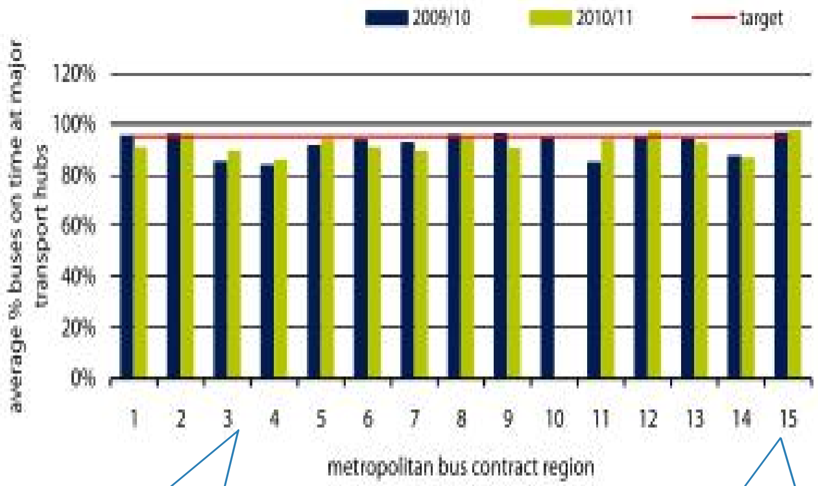


NOTE: Method for determining journey speed is identified in Appendix A

[1] Transport for NSW
[2] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

Despite the bus network facing considerable road capacity constraints, on time running performance appears to be good

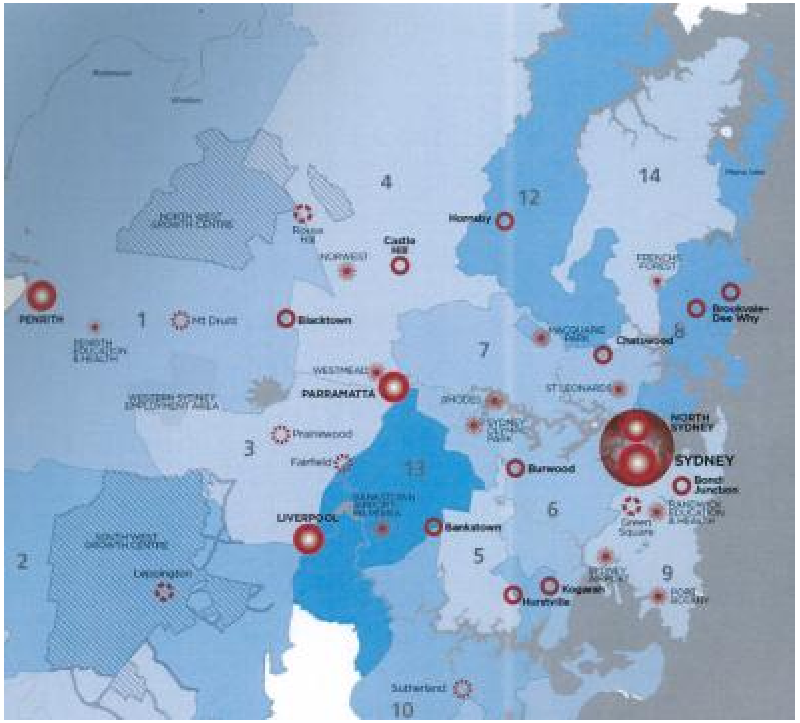
Bus On Time Running by Contract Region [1]



- The west and north west of Sydney experience the greatest levels of unreliability of on time running

- The south west experiences the greatest levels of on time running reliability

Metropolitan Sydney Bus Contract Regions [1]



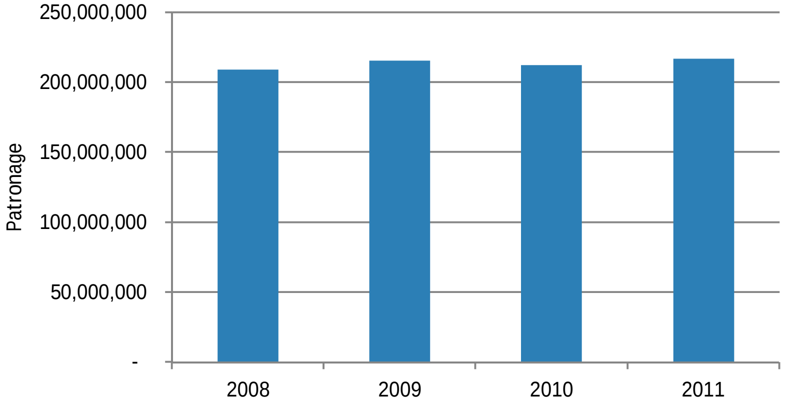
[1] Transport for NSW

1

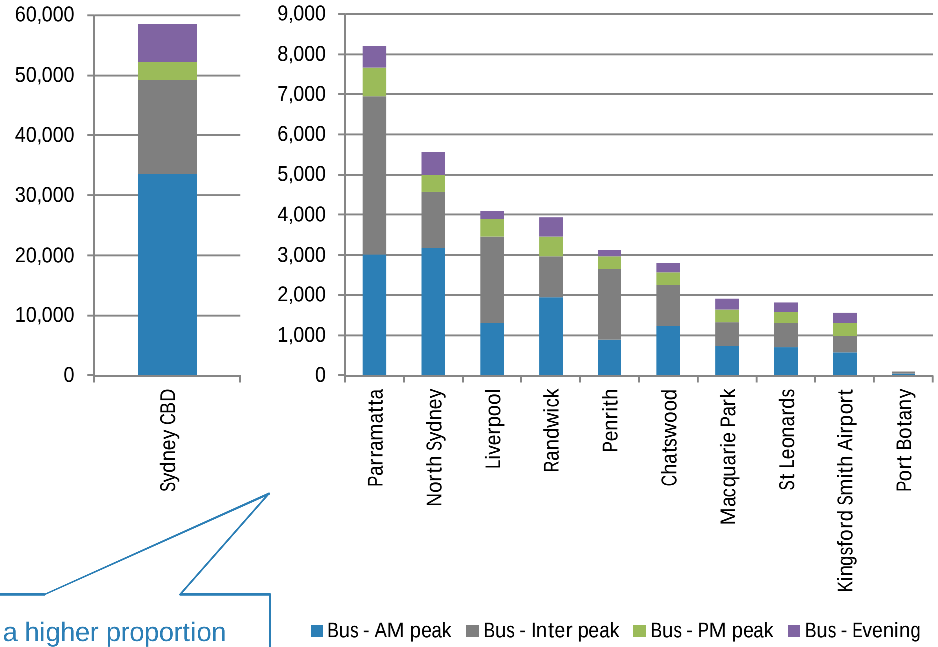
Bus patronage and service growth has been modest in recent years with a higher proportion of travel in inter peak periods than rail travel

- The CBD is the destination to over 50,000 more trips than Parramatta

Greater Sydney Metropolitan Region Patronage Growth [1]



Daily Number of Bus Trips to Economic Hub by Time of Day, 2011 [1]



- Buses experience a higher proportion of trips in the inter peak period than trips by train (which are more commonly made during the AM peak)

[1] TfNSW (2012) Bus Patronage Figure 2010/11
[2] IPART (2011) CityRail and Metropolitan and Outer Metropolitan Bus Services: Prices and Services Report 2011

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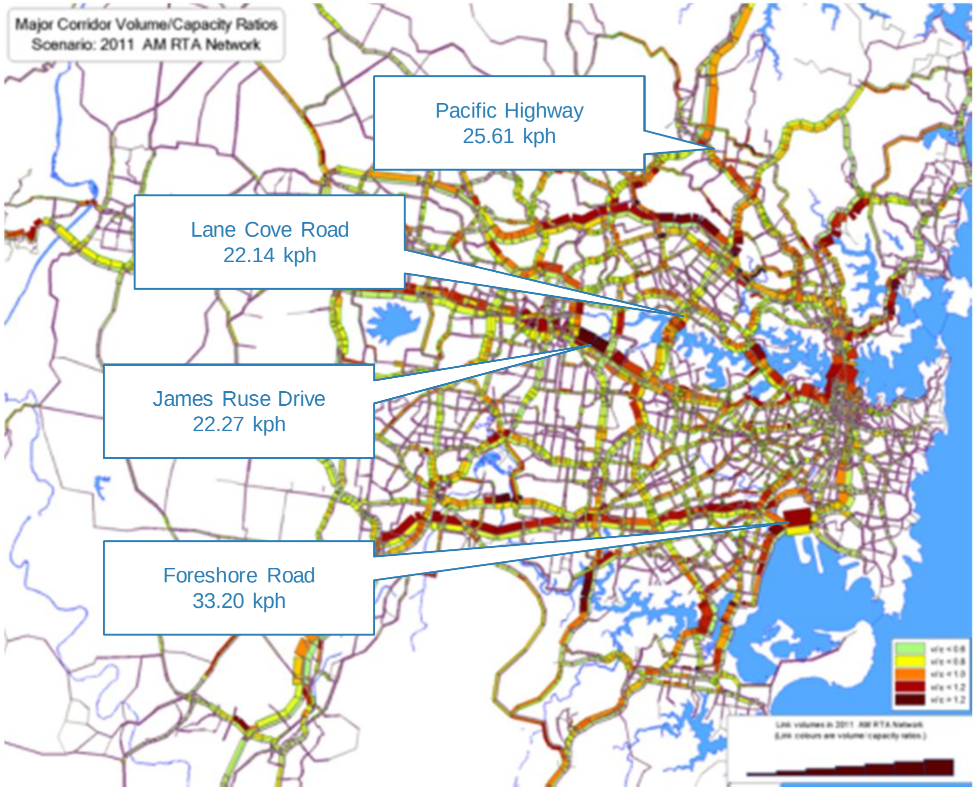
2

The Sydney motorway network provides good connectivity to Sydney’s major economic hubs, however there are missing links and critical pinchpoints

Sydney Motorway Network Arterial Support Roads Pinch Points and Average Speeds, 2011 [1]



NOTE: Method for determining journey speed is identified in Appendix A

Motorway missing links

- Sydney’s orbital network provides over 160 km of uninterrupted motorway making it one of the State’s most critical transport assets [2]
- It provides critical connections between hubs vital in increasing the regions economic productivity such as Port Botany and key business parks
- However the networks suffers from a number of disconnects, for example:
  - The M4 East would connect the M4 which currently stops at Strathfield to the City West Link/Anzac Bridge
  - M2 to F3 connection would provide a motorway service standard for vehicles travelling north of Sydney easing congestion on the Pacific Highway [3]

[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis
[2] Evans and Peck (2009) Delivering the Missing Links to Sydney’s Motorway Network
[3] RTA (2012) http://www.rta.nsw.gov.au/roadprojects/projects/building_sydney_motorways/images/orbital/index.html#home

2

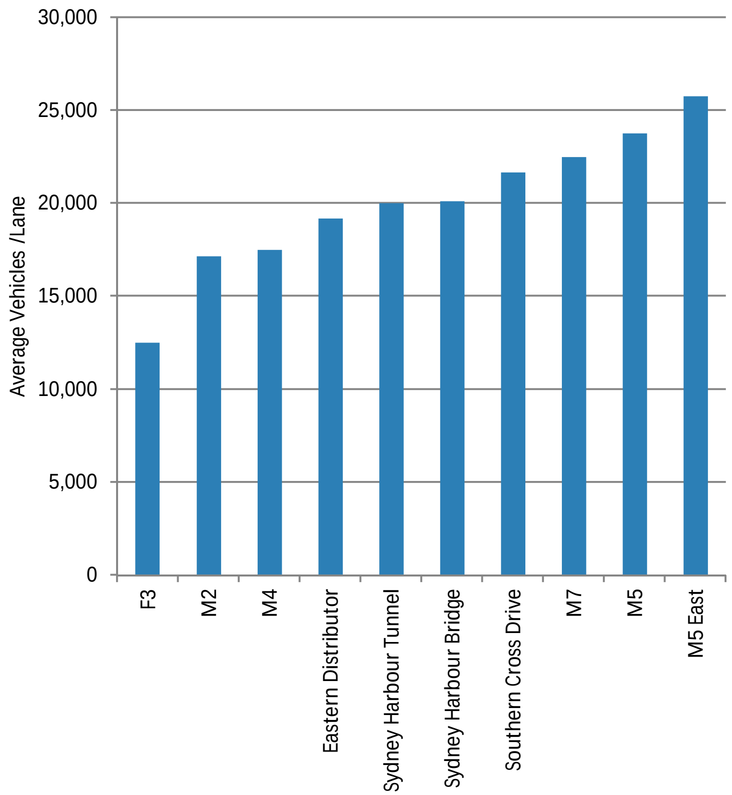
Parts of the Sydney motorway network are heavily congested, particularly during peak periods with over half the network experiencing 10 or more hours of congestion per day

Definition: Congestion
Traffic is travelling at slower than designed speeds and experiences queuing

Sydney Motorway Network Daily Congestion [1]

Motorway	Location	Hours of Congestion
F3	Wahroonga to Somersby Interchange	2.9
M7	All sections	7.8
Sydney Harbour Tunnel	All sections	8.6
M2	All sections	9.9
M5	All sections	10
Southern Cross Drive	SCD link Road Zetland to GHD the Grand Parade	11
M4	Concord to Lapstone	13
M5 East	All sections	13.3
Eastern Distributor	All sections	13.5

Average Vehicle per Lane per day 2012 [1]

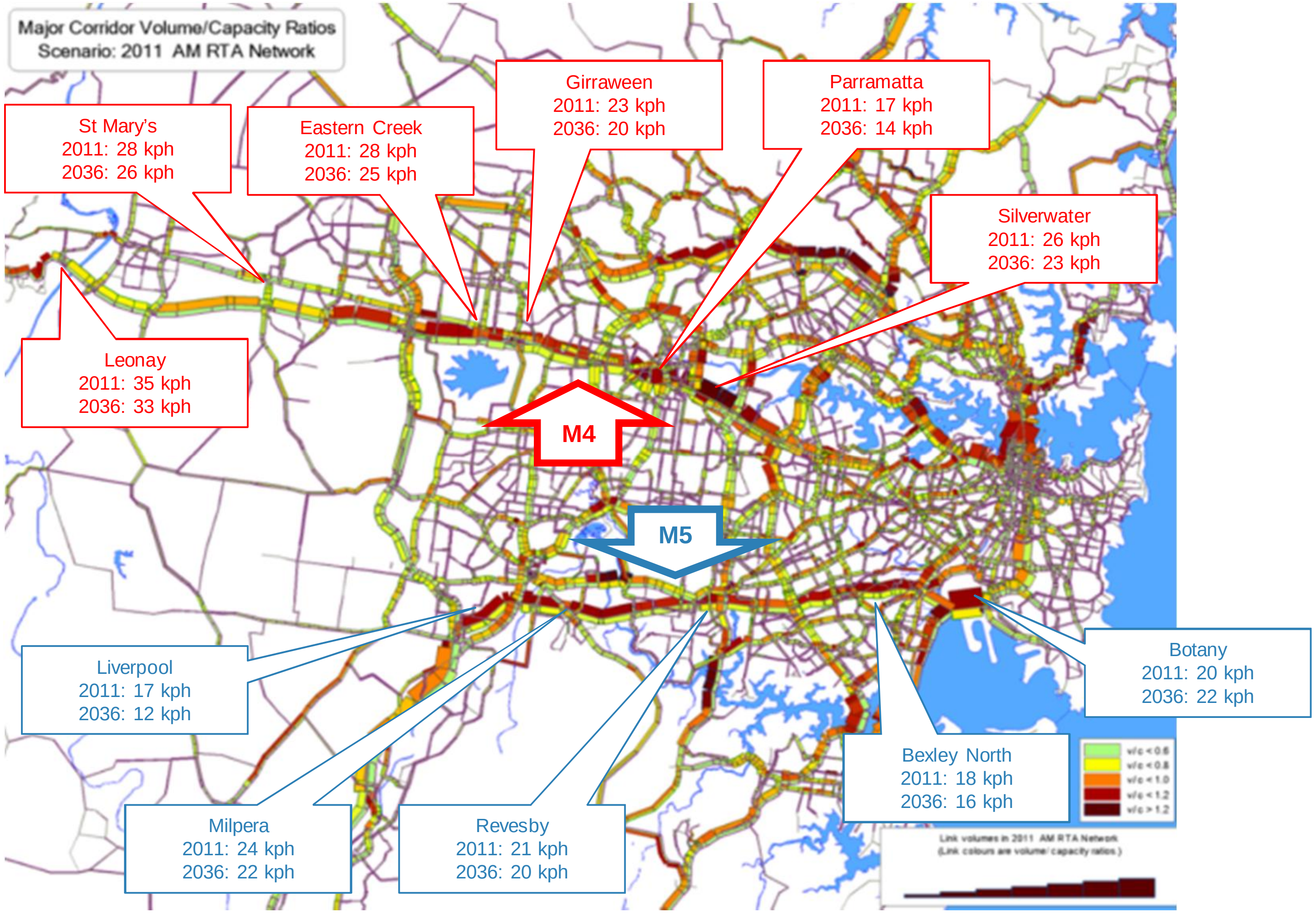


[1] Ernst and Young (2011) Port Botany - Sydney Airport Precinct Scoping Study

2

Sections of the M4 and M5 suffer some of the slowest average speeds which are predicted to worsen by 2036

M4 and M5 AM Peak Average Speeds at Key Motorway Sections



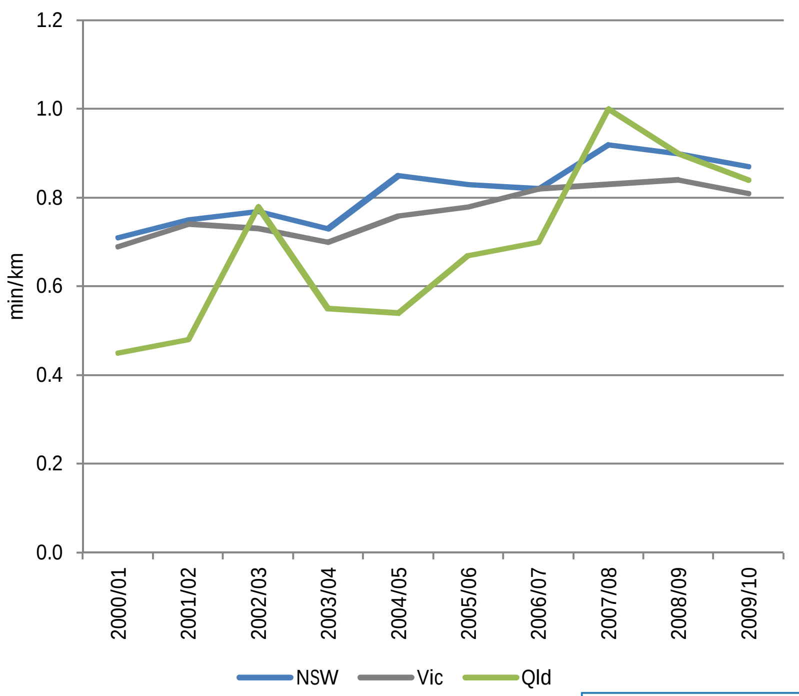
NOTE: Method for determining journey speed is identified in Appendix A

[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

2

The motorway network in NSW performs very similarly to those in Victoria – Average speeds have declined and time per km increased

Average Minute per km Comparison by State



Motorway Speed Comparisons by State

- Average journey speeds and durations are calculated by Austroads – detailed methodologies are not publically available

NOTE: Details of methodology can be found in Appendix A

Austroads (2012) http://algin.net/austroads/site/index.asp?id=5

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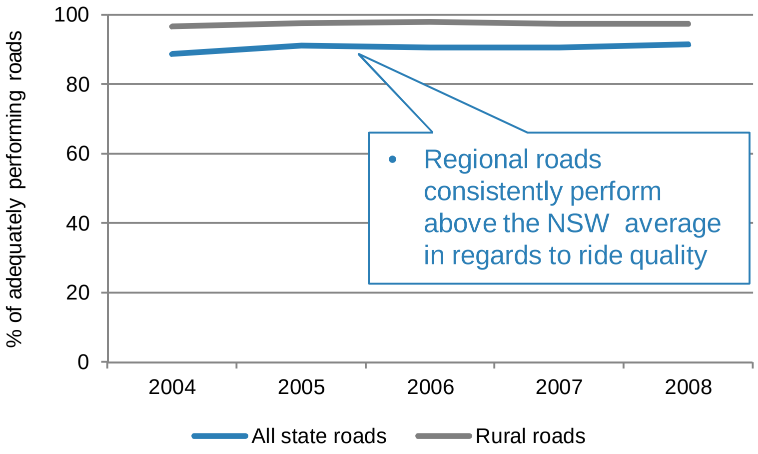
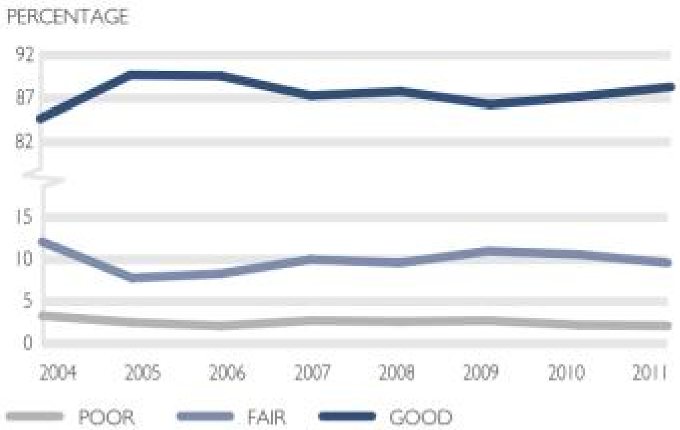
3

The overall physical condition of rural roads is improving both on rural and interstate networks

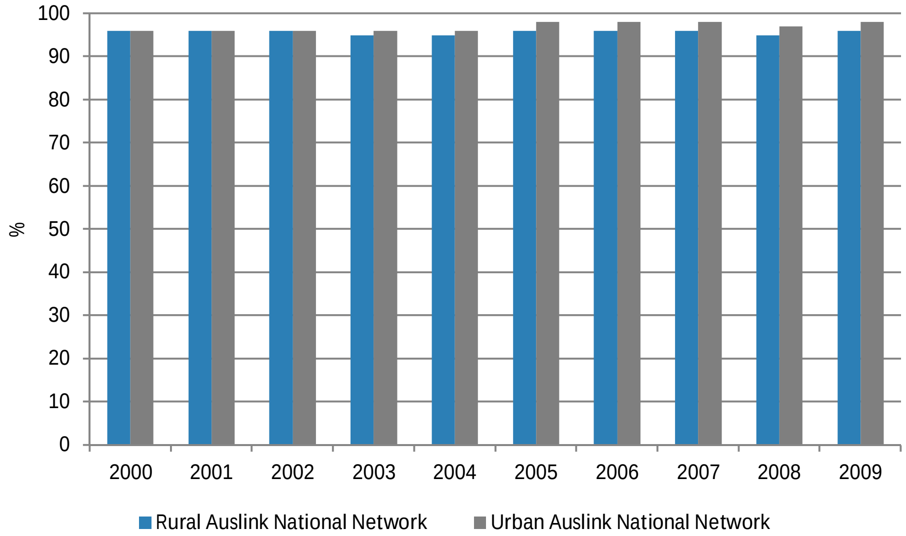
NSW Roads Ride Quality 2004 – 2008 [1]



NSW Rural Roads Pavement Durability 2004 – 2008 [2]



Percentage of Travel Undertaken on the Auslink National Network Annually with a Roughness Level of Below 4.1 IRI in NSW [3]



Discussion

- Roughness below 4.1 International Roughness Index (IRI) provides adequate road conditions for travel
- Rural road pavement durability outperforms that of urban roads with over 87% of rural roads being in 'good' condition, in comparison to under 40% of urban roads
- The performance of rural roads has remained fairly stable over the previous 7 years – seeing some increase in maintenance expenditure due to wetter climatic conditions
- Such weather conditions has also seen the deferral of some routine pavement maintenance activities – which adversely affects the roads performance

[1] RTA (2009) Condition of NSW State Roads: Update September 2009

[2] RTA (2011) Annual Report

[3] Austroads (2012) http://algin.net/austroads/site/index.asp?id=5

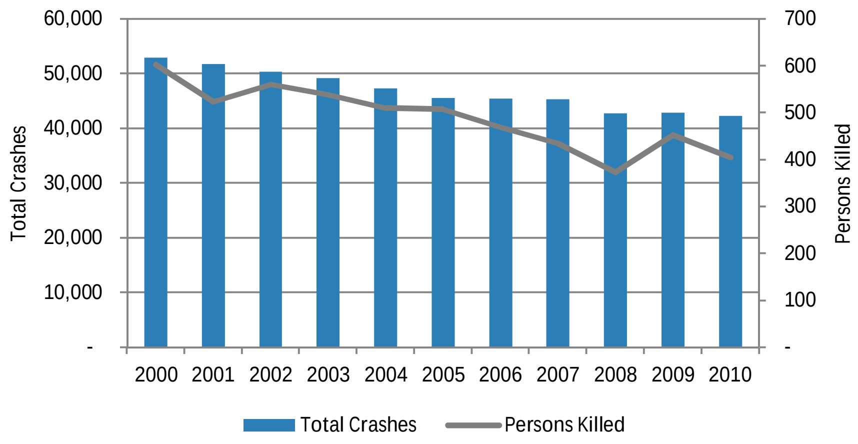
3

Investments in safety and infrastructure enhancements have improved safety and connectivity between regional centres

Safety – Black Spot Initiative

- 60% of road deaths occur in non metropolitan areas
- The Black Spot Program targets non metropolitan locations
- 50% of funds within the state are allocated to non metropolitan areas [1]
- In 2010/11 $17.3 million was spent on treating 56 high crash risk locations throughout NSW
- Treatments include traffic signals, roundabouts and turning bays, road realignments, safety barrier installation and clear zone enhancements [2]
- This continued effort to increase road through such initiatives is evident in the declining road crash and fatality data

NSW Total Crashes and Persons Killed 2000 – 2010 [3]



Connectivity – Regional Road Projects [1]

The RMS have a continuous program upgrading and modifying existing road assets to improve the connectivity and safety for vehicles using the routes. Each region in NSW has multiple projects underway of recently completed the list below provides a outline of some and there achieved or intended outcomes:

- **Harwood Bridge – Completed**

  Significant maintenance project to minimise future disruption to traffic on the Pacific Highway north of Grafton

- **New England Highway at Sunnyside – Completed**

  Realignment of highway north of Armidale

  The purpose of the work was to improve safety, reduce travel times, improve access for road users and reduce maintenance costs

- **Great Western Highway Upgrade – Underway**

  Improve the freight link between Sydney and the Central West region

  Connecting towns along the highway

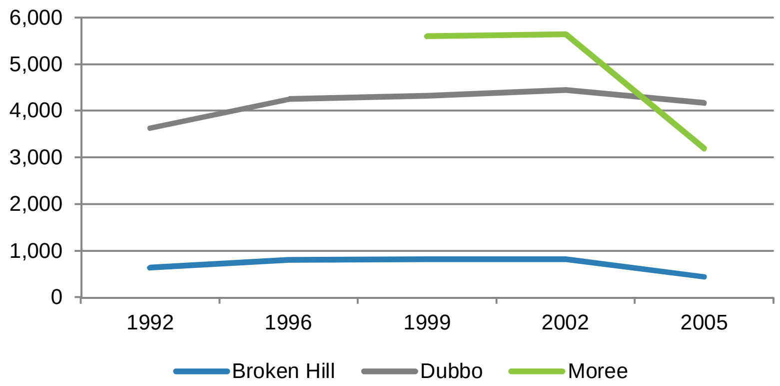
  Connect key tourist destinations

[1] RMS (2012) http://www.rta.nsw.gov.au/roadprojects/projects/index.htm
[2] Department of Transport and Infrastructure (2012) http://www.nationbuildingprogram.gov.au/funding/blackspots/bs_funding_conditions.aspx/
[3] RTA (2010) Road Traffic Crashes in NSW 2010

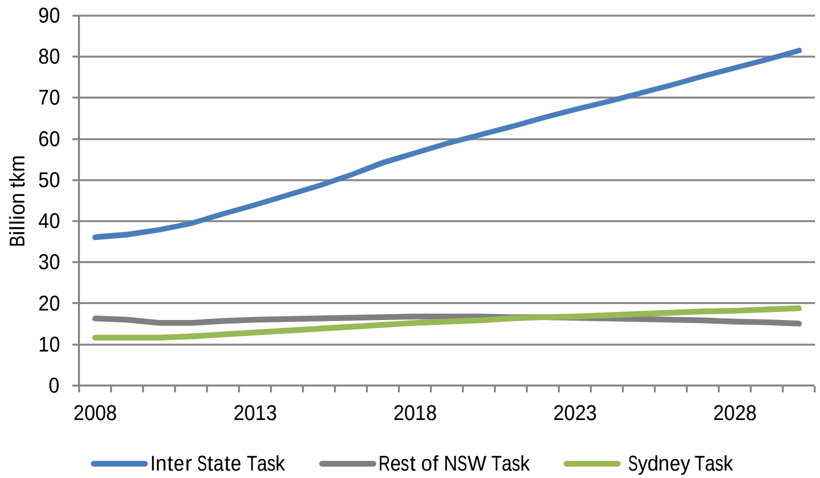
3

Traffic volumes in regional areas are declining, however the regional road freight task is expected to increase which may have implications for the network performance in the future

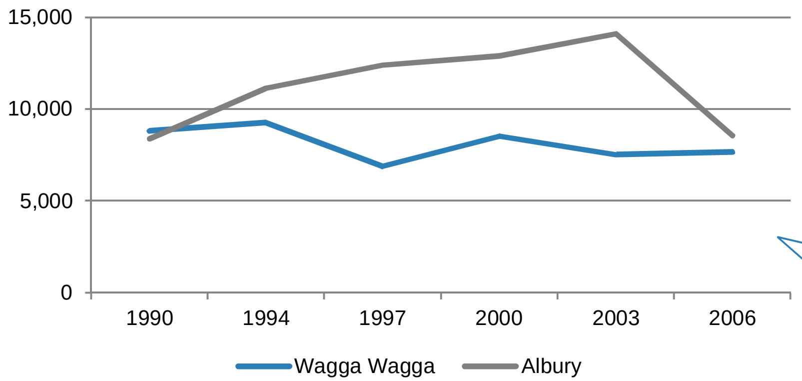
Annual Average Daily Traffic – Western Region NSW [1]



NSW Forecast Freight Task [2]



Annual Average Daily Traffic – South Western Region NSW [1]



Definition: Freight that either; travels through; originates in or it's final destination is location in NSW

- Declining or plateauing daily traffic volumes indicate that there in no or very low growth on roads in regional areas of NSW

- The total NSW freight task is forecast to grow by 80% (2008-2030) [2]
- This is being driven by interstate freight which either travels to, from or through NSW
- This will result in an increase in freight on regional freight corridors

[1] RTA (2012) http://www.rta.nsw.gov.au/trafficinformation/downloads/aadtdata_dl1.htm

[2] BITRE (2010) Report 121 - Road freight estimates and forecasts in Australia: interstate, capital cities and rest of state

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4

The international gateways of NSW are critical to economic growth, productivity gains and investment returns for both NSW and Australia

Transport and the economy

- Sydney's port infrastructure Port Botany, in particular, Kingsford-Smith Airport (KSA) and the regional ports of Port Kembla and Newcastle are key international gateways for NSW and Australia
- KSA is Australia's largest airport, accounting for:
  - 46% of international air passengers;
  - 23% of domestic air passengers; and
  - 50% of international air freight [1]
- Port Botany is the second largest container port in Australia, handling 2 million twenty-foot equivalent units (TEU) in 2010-11, or around one-third of Australia's annual international containerised freight. Additionally, Sydney Harbour is Australia's largest import location for oil and petroleum products (11.5 million tonnes) and sixth largest exporter (0.77 million tonnes) [2]
- Port of Newcastle and Port Kembla are key export gateways for hinterland industries, particularly coal, in NSW. Despite export volumes being dominated by coal, significant value comes from non-coal trades
- In terms of implications of economic growth and traffic to / from NSW ports it is worth noting: "*For many years, road freight and the freight task in general have grown faster than the economy as a whole*" [3]

Supply chain dynamics

- These international gateways are supported by complex supply chains that connect a widely dispersed network for consumers and producers with international markets
- The supply chains are dependent on the land transport infrastructure to provide effective connectivity between the origin and destination points within Sydney, NSW (plus elsewhere in Australia) and the gateways
- Constraints can have a significant impact on the efficient flow of people and freight accessing the international gateways. These constraints, as a result, can have direct cost impacts on the users of these services due to time delays
- Traffic congestion in Sydney has been estimated to cost between \$3.5 billion and \$12 billion in 2005 and is projected to rise to between \$8 billion and \$17 billion by 2020 [4]
- Freight made up 15% of vehicle-kilometre travelled in the Sydney greater metropolitan area during 2006 [4]

[1] NSW Government (2011) Port Botany and Sydney Airport Transport Improvement Program – Submission to Infrastructure Australia
[2] Ports Australia (2011) Trade Statistics
[3] Consult Australia (2010) Transporting Australia's Future – A Discussion Paper
[4] NSW Government (2008) Infrastructure Audit Submission to Infrastructure Australia.

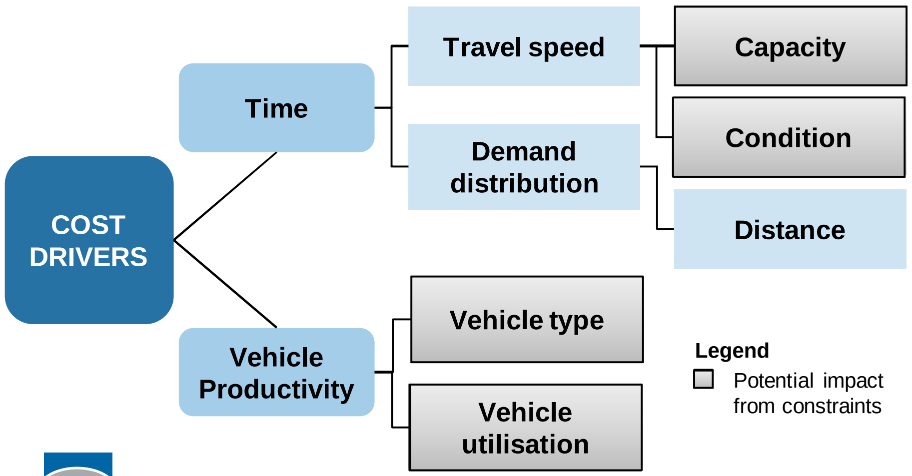
4

Constraints influence the major drivers of road transport costs - time and productivity

Vehicle costs

- Vehicle costs comprise *fixed* and *variable* elements
- Fixed costs reflect the level of investment by the operator and are typically recovered (plus a margin) through the total freight volume moved (for example, in a year). As a result, if the volume of freight increases, scale economies enable a reduction in freight charges. However, if the annual capacity of a vehicle decreases, the fixed costs are recovered over a smaller volume, thereby increasing the freight costs on a per unit basis
- Variable costs reflect the number of operating hours and / or kilometres, which is a function of speed and distance. These costs comprise of labour, fuel, and maintenance/ "wear and tear"
- The two cost elements are inter-related. For example, if a vehicle cycle time for a given haulage task is increased, the capacity of that vehicle decreases (assuming 24hr operations)

Cost Drivers [1]



Relationships between cost drivers and constraints

- The main drivers of transport costs are time and vehicle efficiency (productivity)
- Cost drivers can be influenced by constraints and the commercial decisions undertaken by service providers to optimise profitability
- Constraints can be physical, regulatory or interface related. All constraints influence time, and therefore costs. Physical constraints impact directly on operational performance – speeds and mass, for example. Regulatory constraints limit the operational speeds, drivers' hours and carrying capacity. Interface constraints influence the time and efficiency in the transfer activities between supply chain participants
- Changes in any of the transport related factors can have an impact on transport costs
- Constraints tend to impact:
  - *Capacity* – the number of vehicles that can be carried on the network over a particular time period
  - *Condition* – the speed that vehicles can travel safely on the network and minimise damage
  - *Vehicle type* – The payload capacity of a vehicle limited by regulation
  - *Vehicle utilisation* – efficient use of vehicle capacity, such as load limitations

[1] GHD (2012)

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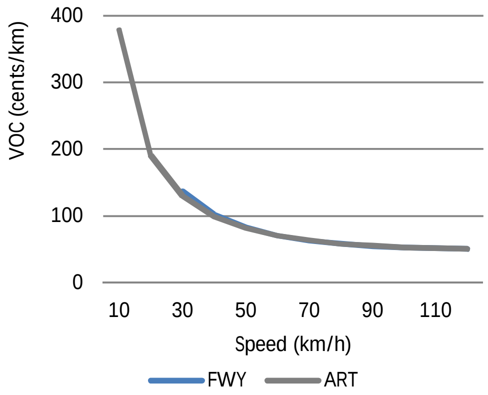
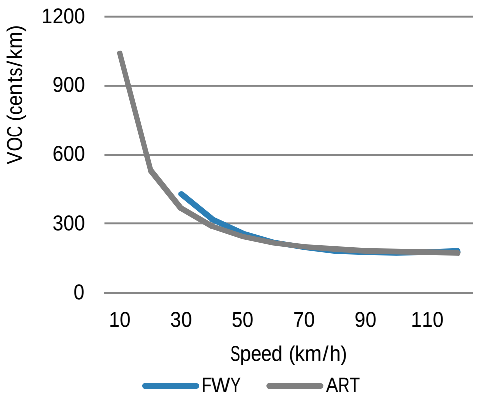
Vehicle operating costs (VOC) increase exponentially with a reduction in speed

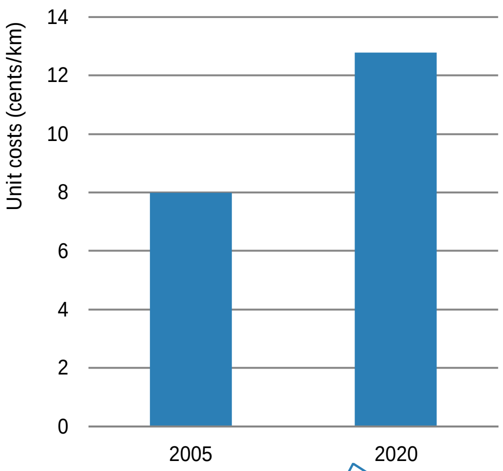
Estimated passenger vehicle operating and time costs (Freeway and Arterial) [1]



Estimated heavy commercial vehicle operating and time costs (Freeway and Arterial) [1]



Average unit cost * of congestion for Sydney, current and projected [2]



Note: the cost of congestion estimated by BITRE was based on the road use projection in 2007, the actual road use data (BITRE, 2011) shows lower growth rates in road use, especially for car use, in recent years.

* Costs refer to avoidable social costs, and are based on the deadweight losses associated with the congestion levels. That is, these unit social costs refer to the estimated aggregate costs of delay, trip variability, vehicle operating expenses and motor vehicle emissions – associated with traffic congestion above the economic optimum level for the relevant networks – divided by the total VKT on the network.

Vehicle operating costs (variable costs)

- Vehicle operating (variable) costs reflect the number of operating hours, and is a function of *speed* and *distance*
- Where constraints influence time, through reduced travel speed from congestion, differences in costs are expected
- Vehicle operating costs increase exponentially with a reduction in speed. This is particularly evident at speeds less than 40 kilometres per hour
- Lower speeds reduce the annualised capacity of a vehicle, as less trips can be made. As a result, more capital must be deployed to meet the transport task, and the capital recovery is made over less revenue generating units
- With an increasing freight task, a compounding effect will result

[1] Austroads (2007) Guidelines to Project Evaluation & GHD Analysis (The speed used is the all day average speed on a link including intersection delays. Costs inflated to 2012$ using CPI increase)

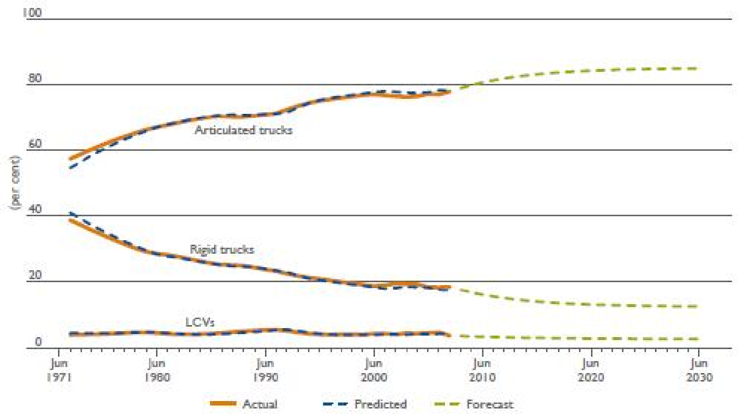
[2] BITRE (2007) Estimating Urban Traffic and Congestion Cost Trends for Australian Cities & GHD Analysis

As the capacity of the vehicle is constrained, the road transport costs will be higher per kilometre or per unit

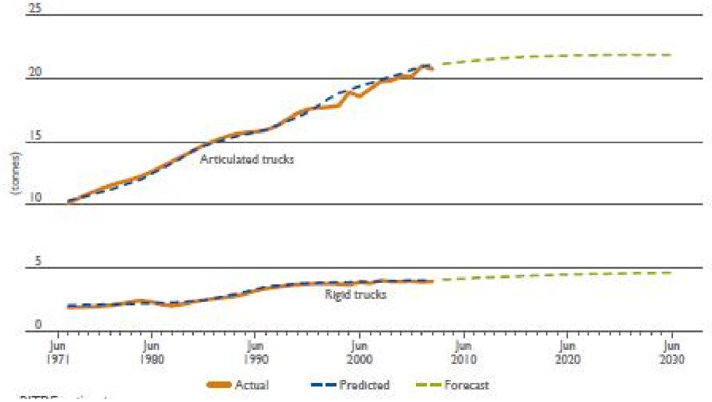
Discussion

- Vehicle productivity is influenced by the capacity of a vehicle (how much it can carry) and how well the capacity is used
- Increasing the payload per vehicle assists the operator to exploit economies of scale and achieve lower costs per unit of freight. This trend has been observed with the increasing share of articulated vehicles and the increasing average load resulting from the increased uptake and access for B Double vehicles (and other High Productivity Vehicles – HPVs)
- Whilst vehicle capacity has increased, utilisation of the available capacity is required to translate regulatory changes into real productivity gains. This is shown through increased occupancy levels in passenger vehicles and increases in the TEU per heavy freight vehicle ratio – including backhaul loads
- The combination of improving capacity and increasing utilisation allows higher freight productivity and efficiency, as the number of vehicles required to meet a given transport task decreases and the operator can exploit economies of scale to reduce transport unit costs
- As a result, where capacity of vehicles is constrained, transport costs will be higher per kilometre (or per unit)

Actual and projected heavy vehicle freight shares, 1971–2030 [1]



Actual and projected average loads, 1971–2030 [1]



[1] BITRE (2011) Truck productivity: trends and future prospects.

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Emissions, such as greenhouse gases and pollutants increase with slower speeds due to the additional operating hours and higher fuel burn

Externalities of vehicle travel

- The increase in vehicle numbers operating at lower speeds due to congestion and / or speed restrictions will increase vehicle operating hours. The level of externalities will increase as a result of increased vehicle operating hours
- There are a range of externalities for passenger and freight vehicles as defined by Austroads. Calculation of externalities is based on vehicle kilometres travelled for passenger vehicles and per tonne kilometre for freight
- Constraints are expected to slow traffic, rather than change the route length – while there will be some mode shift to rail. As a result, there will be little change to vehicle kilometres travelled (vkt)
- While vehicle kilometres travelled will have little change due to constraints, the increase in vehicle operating hours will result in increased fuel consumed, which produces more emissions of air pollutants and greenhouse gases
- Therefore, it is reasonable to assume that emission externalities will rise with an increased vehicle operating hours resulting from increased congestion

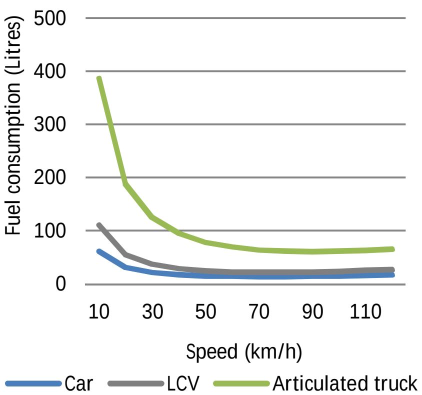
Externality unit costs for passenger and freight vehicles [1,2]

Externalities	Passenger ($ per km)		Freight ($ per 1000 tonne-km)	
	Car	Bus	LCV	HCV
Air pollution	0.03	0.32	178.09	23.74
Greenhouse	0.02	0.13	55.47	5.28
Noise	0.01	0.02	30.37	3.97
Water	0.00	0.05	26.71	3.56
Nature & landscape	0.00	0.00	19.81	0.39
Urban separation	0.01	0.02	29.06	2.64
Upstream and downstream costs	0.04	0.20	184.88	21.13

Conversion ratios fuel (litre) to emissions (grams per litre) [1]

	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SOx
Passenger cars							
Petrol	2305.08	0.030	0.030	2.250	8.690	0.770	0
LPG	1577.24	0.615	0.038	3.631	17.900	1.531	0
Diesel	2698.14	0.033	0.099	2.747	1.275	0.681	0.04
Light Commercial Vehicles (LCV)							
Petrol	2305.08	0.018	0.029	2.700	8.918	1.388	0
LPG	1577.24	0.408	0.041	2.408	11.872	1.015	0
Diesel	2698.14	0.024	0.072	2.000	0.928	0.496	0.04
Buses							
Diesel	2698.14	0.225	0.141	24.413	30.225	5.408	0.04
Medium trucks							
Diesel	2698.14	0.174	0.053	9.236	11.435	2.046	0.04
Heavy trucks							
Diesel	2698.14	0.052	0.092	15.077	8.862	4.800	0.04

Fuel consumptions versus speed [1]



Unit values of emissions ($ per tonne) [3]

	Values ($ per tonne)
Carbon dioxide equivalent (CO_2-e)	23[3]
Carbon monoxide (CO)	3
Oxides of nitrogen (NOx)	2,142
Particulate matter (PM10)	340,981
Total hydrocarbons (THC)	1,073

GHD

[1] Austroads (2007) Guideline to Project Evaluations & GHD Analysis
[2] Costs inflated to 2012$ using CPI increase.
[3] Carbon tax, see http://www.carbontax.net.au

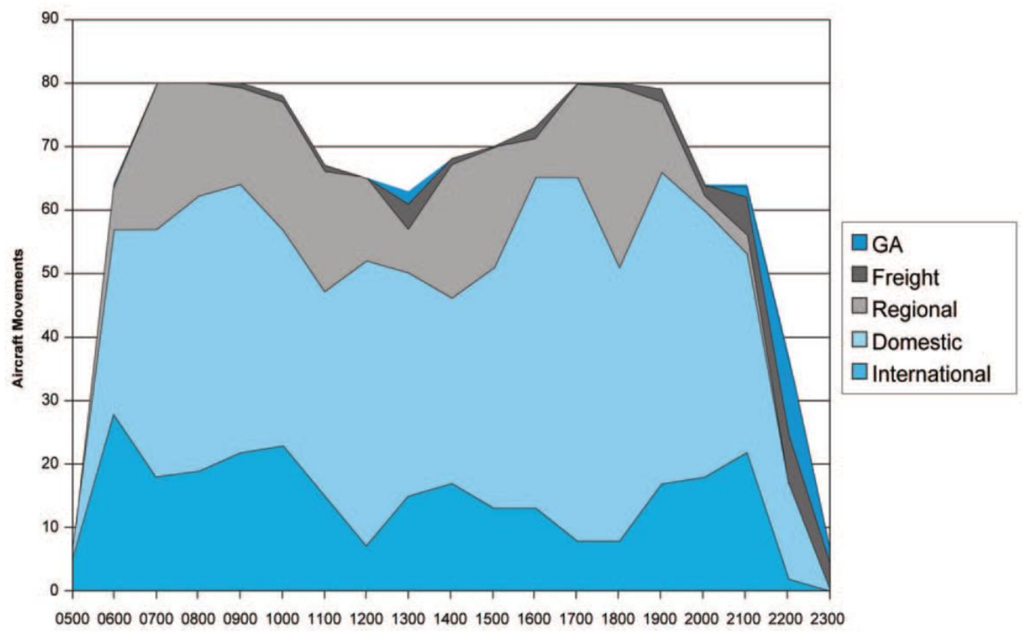
4

Passengers and air freight through Sydney airport are expected to more than double by 2029 placing additional demands on ground infrastructure

Airport passenger and air freight growth [1]

- KSA handles more than 97,000 airline passengers each day, or 35.6 million passengers annually. The peak times for aircraft arrival are between 7am and 10am, and 4pm and 8pm
- The demands on the networks supporting the movement of passengers is at a peak during these time intervals – most of which are car or taxi journeys, creating additional traffic on key corridors serving the airport
- Passenger movements are expected to grow to nearly 80 million by 2029, whilst the air freight task is forecast to grow from 471,000 tonnes in 2007 to 1,077,000 tonnes in 2029. This represents an average annual growth rate of 3.8%
- The projected growth in the air freight task to 2029 will place further demands on land infrastructure to support the movement of cargo to / from the airport
- The future task of circa. 1 million tonnes represents the equivalent of approximately 45,450 truck trips per year contributing to the demand for road space. This assumes a 22 tonnes per truck trip, based on the average 2012 payload as shown on page 8)

Aircraft Movements (arrivals) at Sydney Airport Across a Day [1]



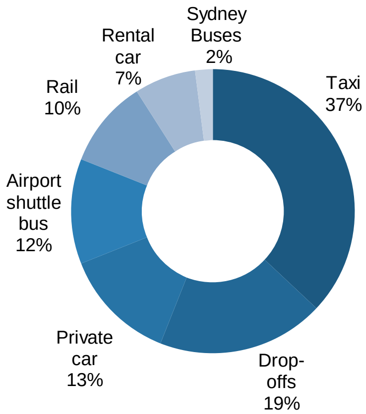
[1] Sydney Airport Corporation Limited (SACL) (2009) *Sydney Airport Master Plan*.

Approximately 90% of passengers access Sydney airport by road of which 76% travel by a car or taxi

Airport passenger travel profile [1]

- Three-quarters of the passengers accessing / egressing KSA do so by car or taxi. Public transport use to the airport is low by international standards despite its proximity to the CBD (~8km)
- Lack of a purpose-built rolling stock, use of urban commuter services, perceptions of poor 'value for money' train fares and lack of alternative bus services, contribute to over reliance on car and taxi as mode of transport – which contributes to congestion on the road network
- Rail passengers compete with commuters going into the city on services which are not dedicated airport services – but through services with stops at the domestic and international terminals
- A concentration of movement of passengers to/from the airport takes place on corridors serving the inner part of the Sydney, with far smaller passenger numbers to more dispersed suburban locations
- By 2024 approximately 60% of the trips to the airport are expected to approach the airport from the north on Southern Cross Drive, Princes Highway, O'Riordan Street and Botany Road

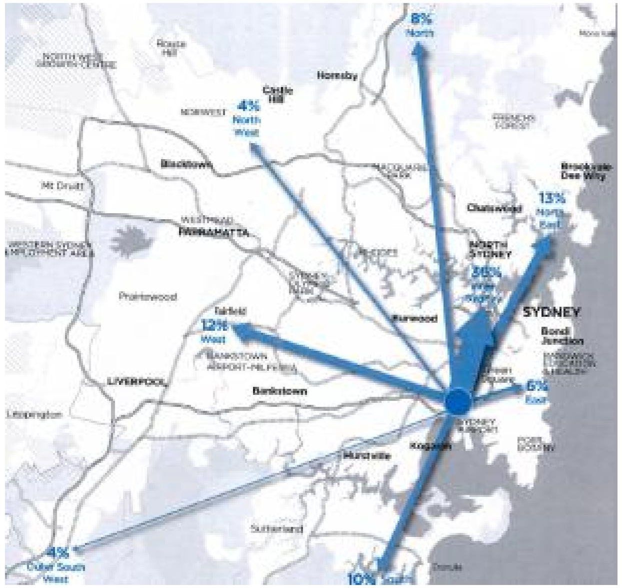
Mode shares for passengers accessing the Airport in 2006 [2]



Average travel time and estimated direct costs for one-way trips from Town Hall to Domestic Airport by mode [3]

Mode	Average travel time (mins)	Estimated direct travel cost per km
Taxi	20	2.86
Drop-offs	20	0.59
Private car	20	2.95
Airport shuttle bus	55	1.47
Rail	20	1.40
Rental car	20	7.17
Sydney buses	60	0.51

Map of Passenger Origin-Destination [4]



[1] SACL (2009) Sydney Airport Master Plan
[2] SACL (2006) Airport Ground Travel Plan
[3] Various sources: http://www.sydneyairport.com.au/go/dropping-off-and-picking-up.aspx ; http://nsw.ahg.com.au/fuel-cost-calculator.php ; http://www.131500.com.au/plan-your-trip ; http://www.airportlink.com.au/price.php ; http://www.kst.com.au/Sydney/Airport-Shuttle-Bus-to-City-Sydney/ ; http://www.taxifare.com.au/ ; https://www.budget.com.au ; http://nsw.ahg.com.au/fuel-cost-calculator.php
[4] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

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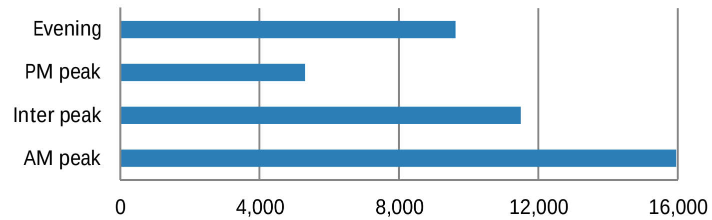
Access to the airport is limited by a number of network regulatory and commercial constraints

Constraints for passenger accessing airport
• Demand for the airport generates 16,000 trips to the airport during the morning peak, with the majority of car trips approaching from the west and north via the M5 East, and O'Riordan Street [1] • The Majority of the traffic demand during the AM peak is CBD bound, with a small proportion (14% in the case of General Holmes Drive) being airport bound[1] • There is little additional capacity for morning peak rail services to the airport. CityRail data shows that in the AM peak, the eight train services that operate on the Airport Line to the City carry 6,500 passengers at an average of 92.5% of capacity [1] • Failure to price roads to reflect the congestion costs associated with road use, particularly with the M5 Cashback scheme, limits demand management on the airport approaches • Bus access, and the provision of additional services to Sydney Airport is limited by the commercial agreement signed by NSW Government with Airport Rail Link company which is in place until 2030

Road Access to the Airport [1]

Car Trips to Sydney Airport by Time of Day [2]

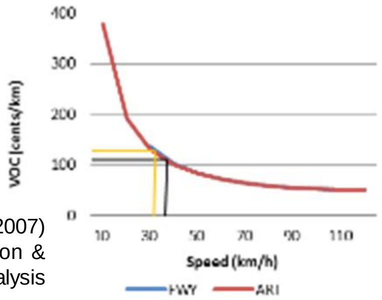


[1] SACL (2006) Airport Ground Travel Plan
[2] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

The average travel speed is projected to decline in most of the travel regions during the most frequent arrival and departure times

Future developments [1,2]

- A number of transport capacity enhancements are planned around KSA (e.g. the improvements in public transport services, truck routes and M4 and M5 East motorways)
- Establishing travel plan strategies to encourage the use of sustainable transport, measures to discourage drop-offs and improvement to public transport services to and from the airport such as expansion of existing bus services, would help to provide additional capacity on access route to the airport
- Improvements of truck routes around the airport and increase the use of rail for Port Botany freight movements should help to make use of existing capacity in supporting the movement of freight
- The NSW's Government's 'Clearways' programme is another initiative that should facilitate an increase in the frequency of rail services to and from Sydney airport providing additional rail capacity
- If the relative costs of accessing the airport remain unchanged, car or taxi will likely remain the mode of choice for many passengers accessing KSA



Source: Austroads (2007) Guidelines to Project Evaluation & GHD Analysis

Impacts and outcomes

- Assuming no change to the mode split for passenger access to Sydney airport, the doubling in passenger volumes out to 2029 will increase the number of car/taxi trips from 85,000 to 170,000 adding further pressure to the road network
- Average travel speed, as modelled by the Bureau of Transport Statistics, is expected to reduce in most of the travel regions during AM-Peak and Inter-Peak periods

Average travel speed to the airport (km/h) [3,4]				
	AM peak		Inter peak	
Region	2011	2036 *	2011	2036 *
Inner Sydney	33.3	31.2	36.5	34.8
North East	21.8	19.4	36.5	34.2
North	25.5	23.4	41.7	38.8
North West	28.2	26.4	50.1	47.7
West	21.8	20.9	34.3	34.8
Outer South West	32.6	32.5	58.4	55.2
South	20.3	22.3	38.4	41.6
East	34.0	32.8	35.6	35.1

* These figures include a number of infrastructure upgrades and are identified in Appendix A

- Modelling showed that journey time is expected to increase, due to lower vehicle speeds. As a result, transport costs are likely to increase - Due to the longer journey time, the increased vehicle operating hours will increase the level of emissions, and therefore externalities

[1] SACL (2009) Sydney Airport Master Plan.
[2] SACL (2006) Airport Ground Travel Plan.
[3] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis
[4] BTS (2011) BTS Information Sheet: Strategic Transport Model Assumptions

Container trade at Port Botany is projected to grow from 2 million TEUs to 10.9 million TEUs by 2036, however capacity is currently capped at 3.2 million TEUs

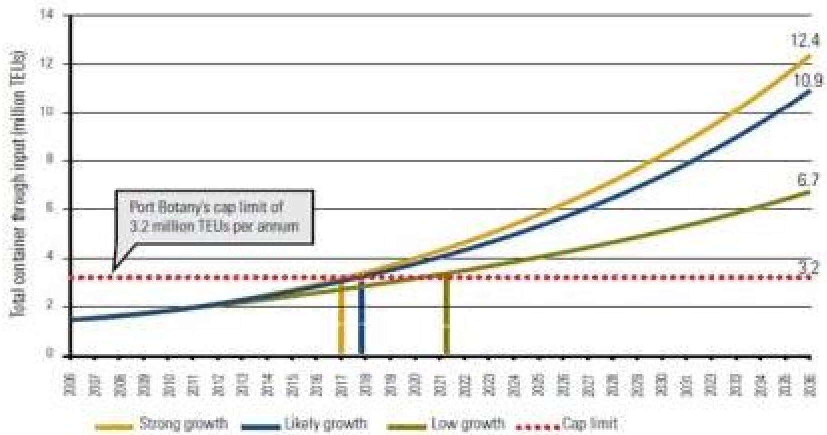
Container freight at Port Botany

- In 2010/11, just over 2 million Twenty Foot Equivalent Units (TEUs) passed through Port Botany [1]

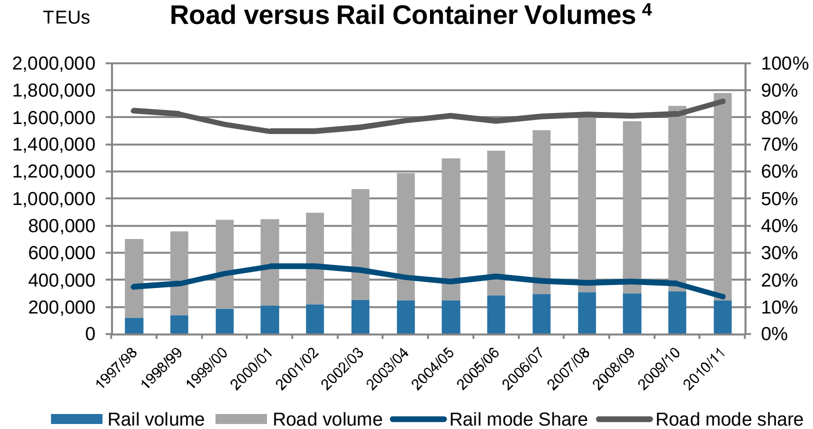
TEUs 2011/12	Total
Exports	609,327
Imports	626,905
Total 2011/12 (to date)	**1,236,232**
Total 2010/11	**2,020,086**

- Port Botany container trade has seen 7% per annum growth over the past five years and is expected to grow at 6.7% per annum over the next 25 years. Interstate freight is expected to grow at approximately 3% per annum between 2010 and 2030
- Nearly two-thirds of Port Botany's container freight is travelling to / from western Sydney; the majority by road [2]
- The vast majority of Sydney's freight - 86% - is transported by road with this figure increasing relative to rail. In 2006-07, of the 1.62 million containers through Port Botany, 81% were transported by road[3]
- Proposed development of freight shuttle train services (by 2014) to / from Moorebank will increase rail's mode share for port access / egress
- In 2006, freight made up 15% of vehicle-km travelled in the Sydney greater metropolitan area [3]
- Port Botany currently has a throughput cap limit of 3.2 million TEUs per annum

Predicted freight container growth at Port Botany (2006-2036) [2]



Road versus Rail Container Volumes [4]



[1] Sydney Ports Corporation http://www.sydneyports.com.au/__data/assets/pdf_file/0016/17305/GRAPHS_January_2012.pdf
[2] Department of Finance and Deregulation (2012) Information Paper - Moorebank Intermodal - Terminal Project
[3] NSW Government (2008) Infrastructure Audit Submission to Infrastructure Australia
[4] Ernst and Young (2011) Port Botany – Sydney Airport Precinct Scoping Study

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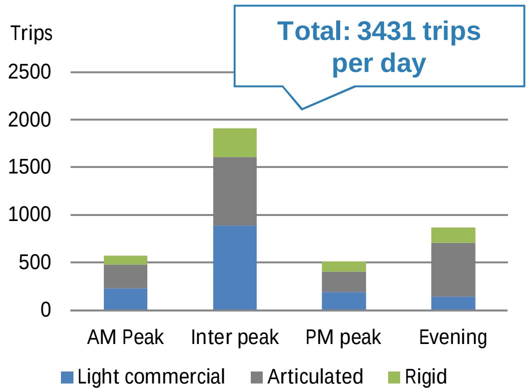
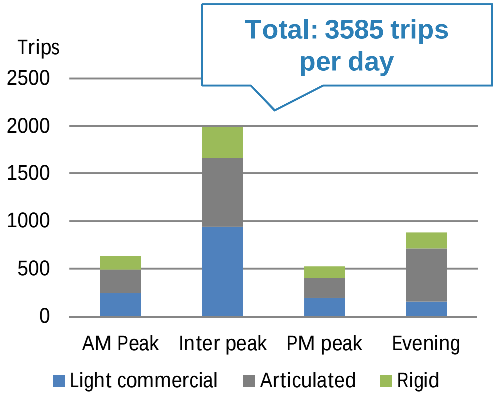
Road freight trips to and from Port Botany are mostly scheduled for inter-peak travel…

Freight Vehicle Arrivals at Port Botany by Time of Day [1]



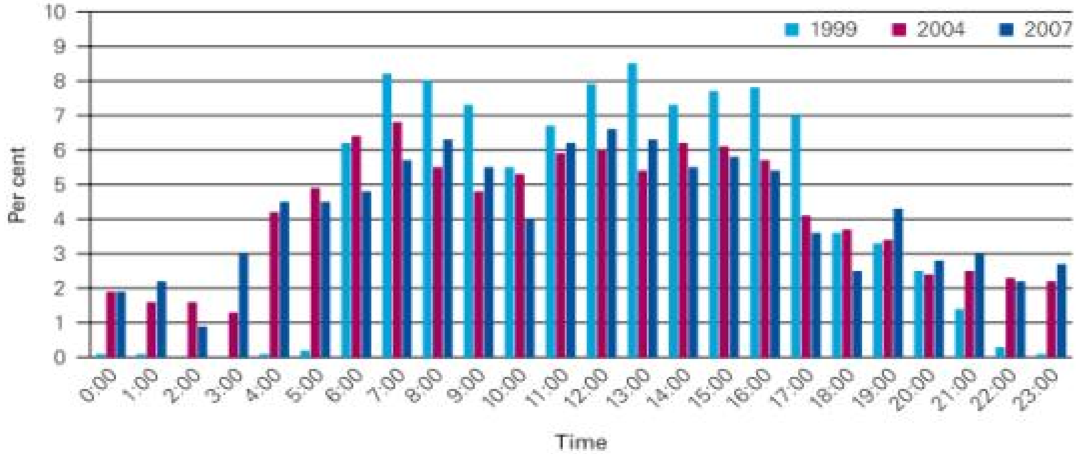
Freight Vehicle Departures from Port Botany by Time of Day [1]



Discussion

- Freight movements to and from Port Botany by time of day exhibit very similar patterns
- Freight vehicle arrivals spread evening during the morning and inter peak periods
- The peak for freight vehicle arrivals has been smoothed out over time which corresponds to the aim of shifting operation towards 24 hour basis

Freight Vehicle Arrivals at Port Botany by Hour of Day [2]



[1] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis.
[2] Sydney Port Corporation (2008) Port Freight Logistics Plan

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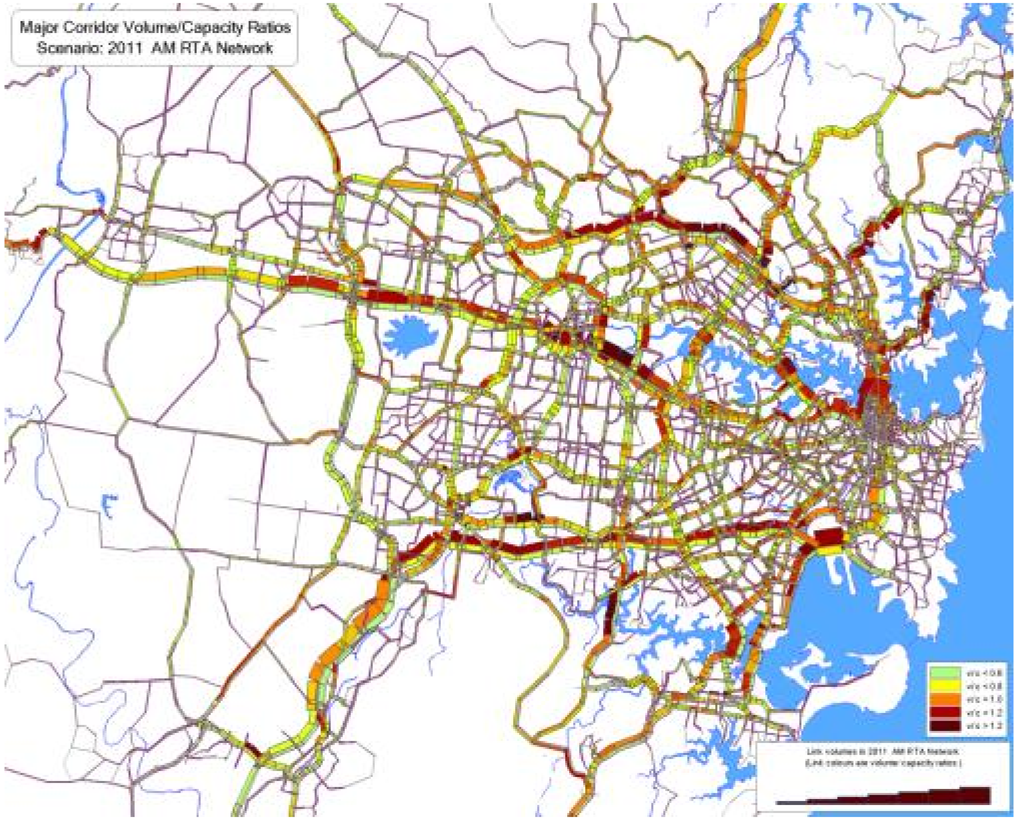
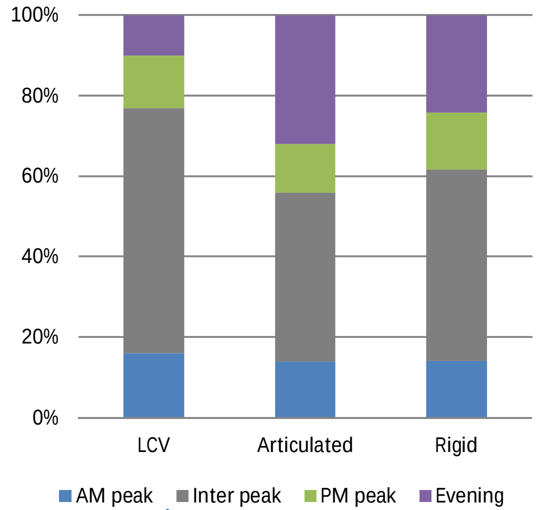
…to avoid peak road congestion hours and minimise the cost of slower vehicle speed

Heavy vehicle movements in NSW in 2011[1 2]



Freight movements in NSW by time of day [3]



- The majority of freight movements occur in the inter peak, especially those by light commercial vehicles
- The proportion of evening trips are highest for articulated trucks

[1] Transport for NSW (2010), Freight Movement in Sydney
[2] Congestion occurs when traffic is travelling at slower than designed speeds and experiences queuing
[3] Sydney Port Corporation (2008) Port Freight Logistics Plan

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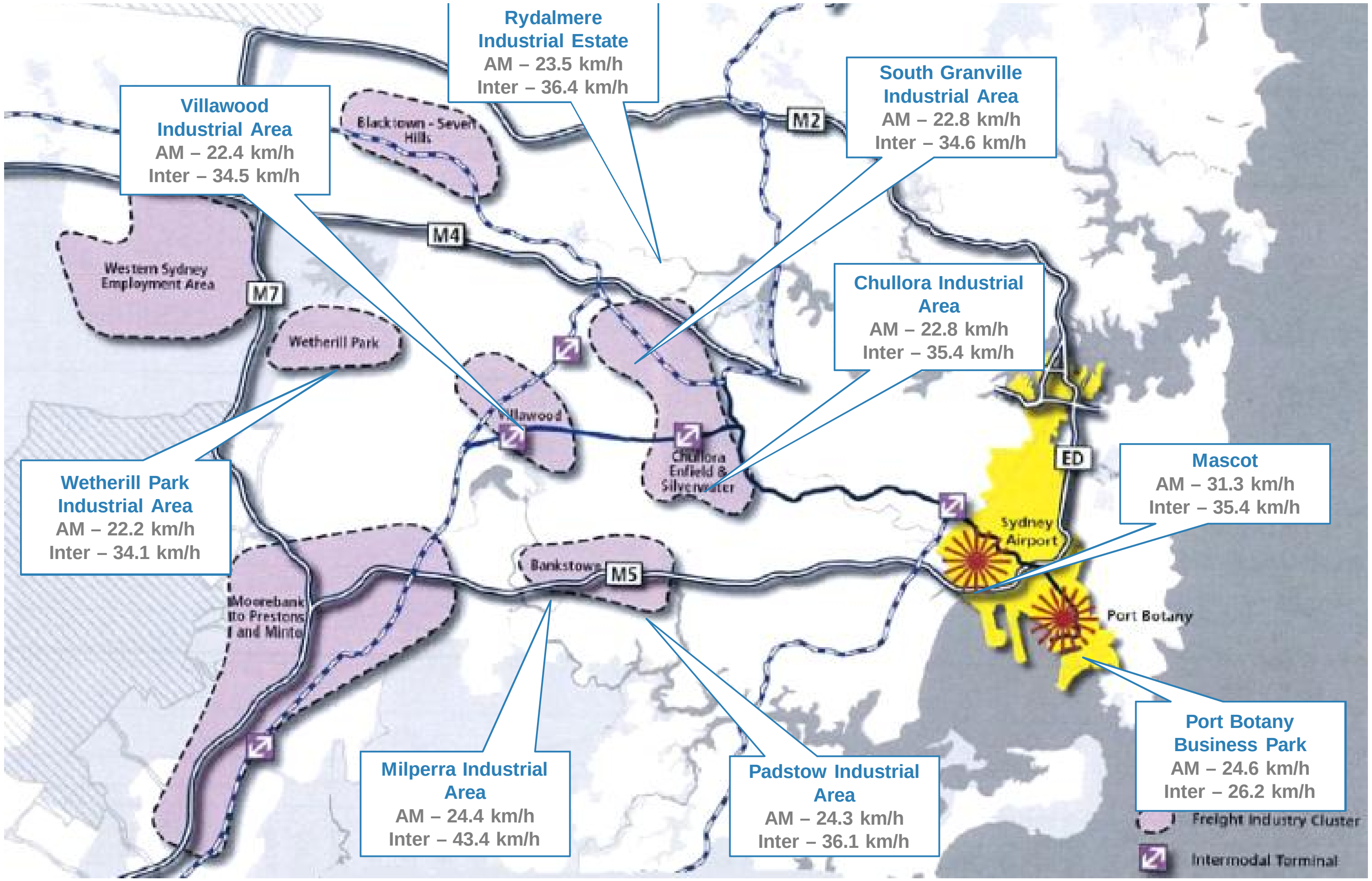
Analysis of speeds on the road network indicate that freight movement efficiency during the morning peak is constrained by road congestion

Road speed for major freight routes to Port Botany [1]



NOTE: Method for determining journey speed is identified in Appendix A

[1] Transport for NSW

[2] Bureau of Transport Statistics (2012) Strategic Transport Model and GHD Analysis

4

Constraints on container freight growth flow through the supply chain and impact port landside operations and freight customers

Constraints on road freight

- Road mass and size limits for container trucks, i.e. the expanded ability to use higher productivity vehicles from marine terminal to door locations and empty container parks
- Mass limitations on the road network influence the maximum weight of container (tonnes per TEU). Heavy containers result in a reduction of efficiency, as the mass limits of the vehicle are reached before the physical (volumetric) capacity is reached
- Increased (high) utilisation levels of the road network will lead to increased congestion, and lower vehicle speed. Once vehicle speed is reduced, the capacity of each individual vehicle decreases. Therefore to achieve the same task, the number of vehicles increases. As a result, there is an increase in vehicle operating hours, and a resultant increase in freight costs
- To minimise the impact of increased time, operators will seek alternative routes through the network. However, the constraints and capacity of other roads will limit the ability for transfer. This will be likely to increase transport costs, as sub-optimal routes are likely to be used, which will be demonstrated in an increase in vehicle tonne kilometres
- Delays in vehicles scheduled arrival time has the potential to affect the vehicle booking system, and ultimately the efficiency of port landside operations

Constraints on rail freight

- Prioritisation of passengers on rail when shared with freight and insufficient and/or not ideal train paths/slots for container trains
- Ability of the container intermodal terminals to operate 24/7 given issues of public amenity and urban encroachment
- The ability to develop a dedicated (freight only) rail connections to/from the overflow ports and strategic intermodal locations around Sydney (the most likely being a connection between Port Kembla and an intermodal terminal to the west of Sydney which could also accommodate the new motor vehicles trade)
- The supply chain effects of congestion on the rail network through Sydney to Port Botany impacts freight operators and their customers further inland

GHD

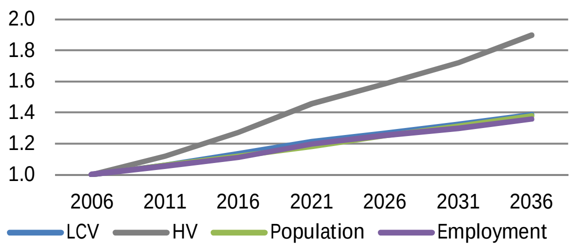
4

Increasing rail freight efficiency will require additional capacity and multi-modal logistics community-based IT systems to effectively relieve freight bottlenecks

Future developments

- NSW government target to double the proportion of rail freight to and from Port Botany to 28% by 2020
- The current high profile development options of a Freight Hub Terminal at Moorebank that connects to Port Botany through the Southern Sydney Freight Line[1]
  - *Option 1* – Commonwealth funded facility is projected to process around 1.5 million to 1.7 million TEUs per annum to be operational by mid to late 2017 with another 500,000 TEUs on an interstate facility to be operational by 2030
  - *Option 2* – Sydney Intermodal Terminal Alliance (SIMTA) is projected to handle up to 200,000 to 300,000 TEUs per annum with capacity to increase to 1 million TEUs per annum over 10 to 15 years
- The impact of increasing Port Botany throughput cap of 3.2 million TEU per year. If this is increased as a response to accommodating trade growth impacting earlier than expected, it may lead to further congestion on the road network

Indexed Growth in Road Freight Trips in NSW [2]



Impacts and outcomes

- Doubling of rail freight to/from Port Botany will relieve road congestion around Port Botany, however it will increase traffic volume around intermodal terminals (and bring amenity concerns to neighbouring areas)
- There are already a number of existing operational issues and capacity issues on the Sydney metropolitan rail network for port services. These issues include: lack of capacity at intermodal terminals, capacity constraints in stevedore windows, and a lack of capacity for train paths on the rail network.
- Issues with curfews on passenger peaks on shared rail track will need to be resolved as the rail passenger task continue to grow, particularly from growth areas in the South West, and the CityRail network will continue to come under pressure from increasing passenger demands. Additional tracks or freight lines will need to be developed to accommodate the targeted growth in rail freight.
- Coordination along the supply chain e.g. stevedores, road and rail operators, forwarders etc – will benefit from a logistics community-based information system to allow for improved multi-modal coordination and planning with seamless connections to existing vehicle booking systems (VBS), empty container park management systems etc.

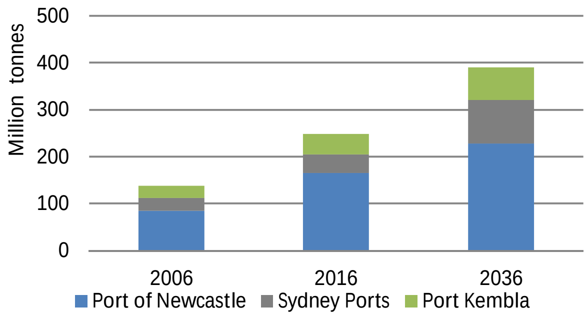
[1] Whitbourn, Michaela (2011) 'Now, to get trains of thought on track', *Australian Financial Review*, 15 March 2012.
[2] Infrastructure Australia (2010) National Ports Strategy

Bulk commodity exports from the Port of Newcastle are expected to increase dramatically as infrastructure development responds to demand

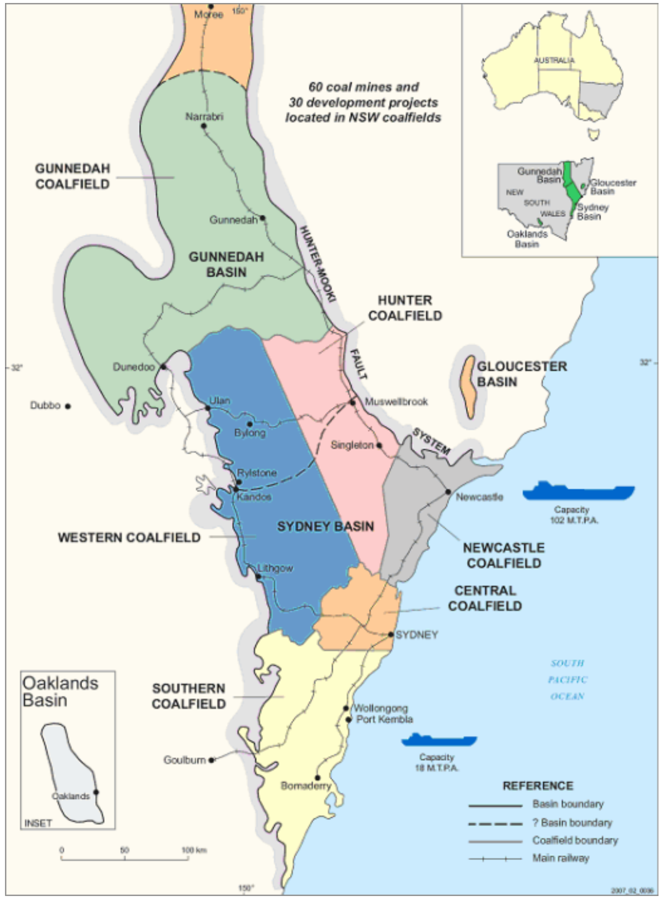
Bulk commodities growth

- Trade volume through NSW international maritime gateways is expected to triple 2006 levels by 2036, with the majority of tonnage growth in Newcastle
- Growth in volume at Newcastle will come with developments at the port, discharge terminals and the supporting rail network for coal haulage. This has been driven by high demand, particularly from Asia with existing mines looking to ramp up production and the development of new mines in the Gunnedah Basin and Hunter coalfield
- Potential developments in the Western coalfields (Southern Section) and the Southern coalfield provide the opportunity for growth in Port Kembla coal exports; however the level of growth is more moderate compared with Newcastle
- The growth of coal exports, however, is limited by the capacity of the supply chain, and the level of resources that are economically recoverable
- Despite the dominance of coal exports at NSW ports, there are numerous other bulk commodity imports and exports. These include wheat, metal concentrates, fertilisers, woodchips and petroleum products. Non coal commodities, while lower in volume, are typically higher in value on a per tonne basis

Current and Future Port Trade Volumes [1]



NSW Coalfields [2]



[1] Transport for NSW, 2010

[2] Department of Trade & Investment website, http://www.dpi.nsw.gov.au/minerals/resources/coal/coalfields

4

Train path availability is a critical constraint on the rail network but scale economies contribute to rail's dominant role in export commodity haulage

Bulk commodity specifics

- The majority of bulk commodities in NSW are transported by rail. This is due to the ability to achieve scale economies that come with high volumes and relatively long distances where rail has measurable cost advantages over road haulage.
- While the majority of the bulk commodity volume is transported by rail, a significant proportion of non-coal trade is transported by road, particularly higher value commodities
- Rail transport has significant operational and service quality factor differences to road. Trains operate to dedicated scheduled and network access is limited to available paths. For a train to be scheduled, a path needs to be available and then allocated. Road is much more flexible and can in effect operate a 24/7 load and despatch regime
- Constraints on the network are reflected in the capacity of the system and the number of trains that can be scheduled. In this way, reliability of the network, and the ability to utilise available paths is critical – miss a slot and it's gone; delays flow through the network etc.
- The transport of bulk commodities differs to container haulage in some important ways. Typically the haulage is a one way task, as there is limited (or no) opportunity for backhaul. Additionally, the trailers used for bulk commodity transport are often product-specific and cannot carry general freight, therefore impacting on vehicle productivity and costs to users

Constraints on the bulk commodity network

- The majority of bulk commodity freight in NSW is not transported on the urban freight network, and therefore does not suffer the capacity issues experienced in Sydney
- Some bulk commodity rail freight utilises the Sydney metro network, but path availability for longer and slower trains is a significant constraint.
- The rail network in NSW is multi-user, therefore passenger, general freight and bulk commodity trains share the network and interact in numerous locations. This is unlike some of the coal systems in Queensland, and the iron ore lines in Western Australia. As a result, the capacity of the network is constrained by the available paths, and the priority that the different types of trains receive over others. Another factor impacting on rail capacity is that the more 'mixed' the traffic on the network, the lower the overall capacity where 'mixed' relates to train lengths, operational speeds, train performance and operational priorities
- Bulk commodities that are transported by road experience the same constraints and impacts as other road users. However, where the commodity involved is of a low value on a per tonne basis, they are more sensitive to cost impacts
- Constraints at any point in the supply chain limit the capacity of the bulk commodity export supply chain

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4

Constraints on rail limit supply chain capacity and the ability for bulk commodities to benefit from increased economies of scale

Future developments

- Significant public and private investment is being undertaken to accommodate growth in the export of bulk commodities. The majority of bulk export infrastructure development is planned for Newcastle, with expansion to be undertaken for all parts of the supply chain, both to increase capacity and remove constraints[1]
- National forecasts show an increase in modal share for sea and rail, with a decline in road transport for bulk commodities.[1] This reflects the cost sensitive nature of the commodities, the expansion of the rail network to accommodate growth and achievement of scale economies
- National forecasts show an increase in modal share for rail, a decline in sea transport, with the balance held by road transport for bulk commodities. This demonstrates the distinct advantages of rail transport in the growth areas of bulk commodities (coal), and the lower unit cost of transport over longer distance - as experienced by the bulk sector

Impacts and outcomes

- Transport infrastructure constraints for bulk commodities transported on rail limit export capacity
- The scheduling of trains, and the ability for operators to optimise fleet to meet the transport task, means that transport costs are unlikely to rise from current constraints. However, if constraints emerge in the future and the capacity of the rail system decreases, there is the potential for rail transport costs to increase. Constraints on the rail network are more likely to limit the ability to achieve further economies of scale, or greater transport efficiency, rather than an increase in costs
- Bulk commodities that are transported by road are more likely to experience an increase in transport costs due to constraints; however, the level of impact will be influenced by the potential reduction in speed and productivity of the vehicles

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[1] Hunter Valley Coal Chain Coordinator (2011) NSW Government – Presentation to the Korean Business Forum, 5 Jul 2011.

Report Outline

- Transport Hypotheses Summary
- Hypothesis 1 – Global Economic Corridor Access and Connectivity
- Hypothesis 2 – Motorway Capacity and Connectivity
- Hypothesis 3 – Regional and Interstate Roads Connectivity
- Hypothesis 4 – Accessing NSW’s International Gateways
- **Hypothesis 5 – Rural and Regional Freight**
- Hypothesis 6 – Asset Maintenance
- Hypothesis 7 – Road Safety

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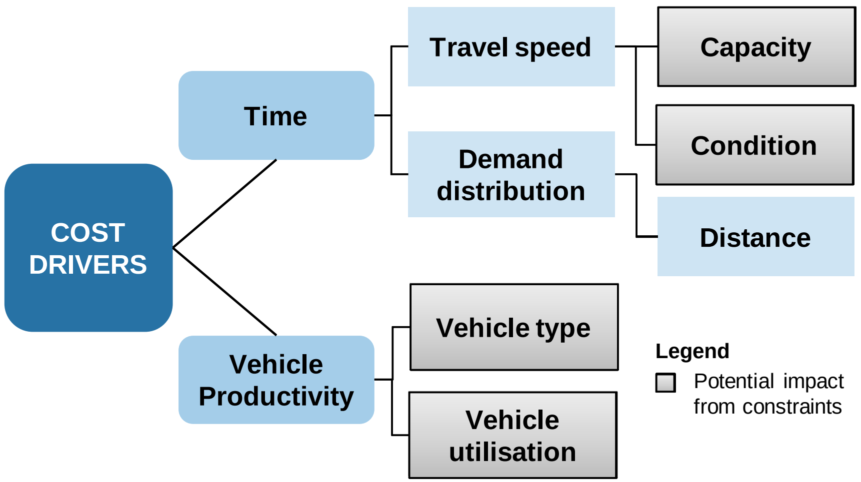
Regional freight is typically low value high volume produce and is more sensitive to small changes in transport costs

Introduction

- The NSW transport system is critical for the viability of communities in rural and regional areas
- The extensive road and rail network connects localities to regional centres, export ports, as well as main metropolitan areas and Sydney
- The transport network in NSW is critical infrastructure, especially freight movement, where:
  - One-third of the nation's road freight is moved through NSW, including half of all interstate freight [1]
  - Freight is the major user of rail outside Metropolitan Sydney, and the primary focus of investments in order to satisfy future freight demand

Drivers of Regional and Rural Transport Costs [2]



Nature of regional/rural freight

The drivers of regional and rural transport costs are the same as metropolitan freight, however, there are key differences in the nature of freight transport activities that influence price. Some of the key differences are:

- The distance between origin and destination is longer, but typically transported at higher speed
- Pinch-points and bottlenecks are experienced (particularly at merge points for the interstate road network at larger regional population centres), but the frequency, length and intensity are typically less
- Trade volume is more imbalanced (particularly from exporting regions)
- Vehicle configurations are not conducive for mixed freight purposes - for example, trucks configured for bulk cannot transport containers. As a result, vehicle productivity is generally lower
- A high proportion of rural and regional exports are low value on a per tonne basis. Therefore rural and regional freight is sensitive to small changes in transport costs (time and productivity related), therefore seek reliable least cost pathways

Transport cost proportions of agricultural products [2]

Product	Destination	Proportion of Farm-gate Value
Wheat	Export, Japan	49 %
Cotton	Export, China	7 %
Apples	Domestic, Sydney	4 %

[1] Transport for NSW (TfNSW) (2012) NSW Long Term Master Plan - Discussion Paper
[2] GHD (2012)
[3] Goucher, G (2011), Transport Costs for Australian Agriculture, Research Report, Australian Farm Institute

5

Land transport costs make up a significant proportion of regional freight value - accessing least-cost pathways is critical to remain competitive (domestically and internationally)

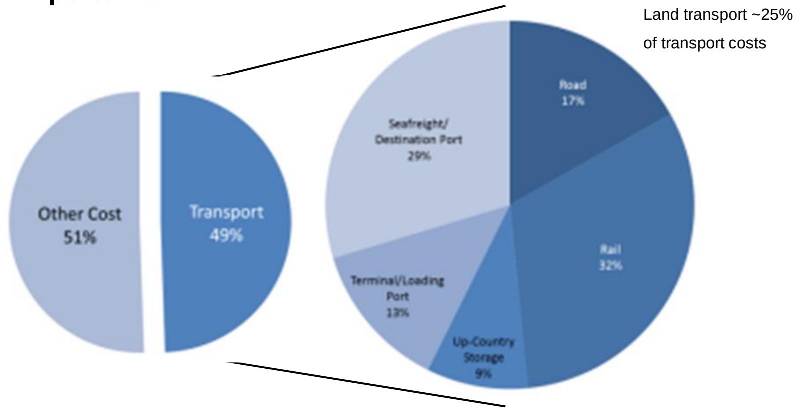
Vehicle Operating Costs (variable costs)

- Transport costs, in particular, land transport, can represent a significant proportion of regional freight value. For example, land transport for wheat exports from NSW can account for approximately 25% of the total cost in delivering to export markets. Therefore reliable least cost pathways are critical for the viability of cost sensitive markets
- Despite the high transport costs:
  - The generally higher vehicle speed achieved on the rural and regional network minimises vehicle operating cost impact of delays. Therefore, the proportionally small impact of delays (over the total journey time) at bottlenecks and pinch points, would result in a small cost increase on freight
  - The access and scheduling requirements of rail transport, limit cost impacts from constraints. However, where the number of train paths reduce (due to reduced capacity), transport costs will be likely to increase
  - The major impact of constraints, are the limitations on capacity, and the ability to accept new access seekers or additional volume. As a result, cost reductions cannot be achieved by exploiting further economies of scale, and volume beyond capacity will need to seek a more expensive mode – if cost competitive

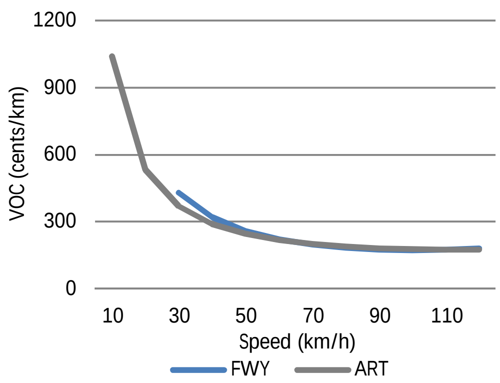
Relationships Between Cost Drivers and Constraints

- The longer cycle times (due to longer transport distances) limit the cost impact of delays, as they are a small proportion of the overall cycle time
- Delays, however, may result in driver hour exceeding maximum. This will result in the need for additional drivers, or breaks, thereby reducing vehicle productivity and/or increasing the Vehicle Operating Cost

Proportion of Transport Costs and Components – Wheat Exports NSW [1]



Estimated Heavy Commercial Vehicle Operating and Time Costs (Freeway and Arterial) [2]

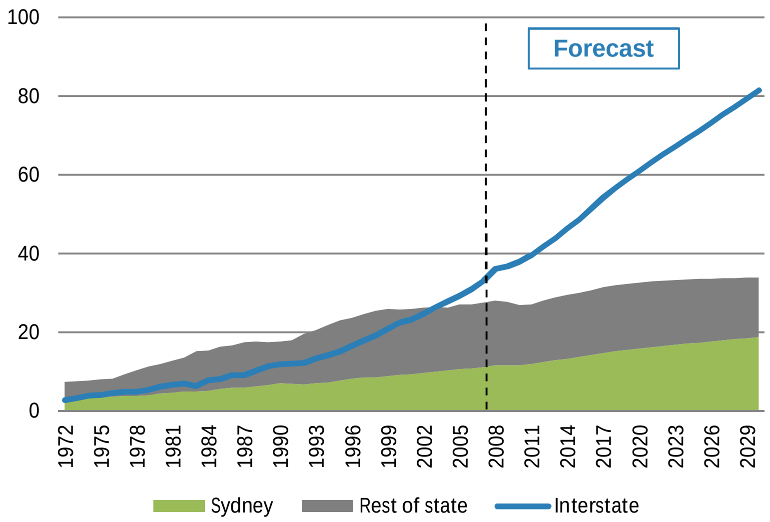


[1] Adapted from Goucher, G (2011), Transport Costs for Australian Agriculture, Research Report, Australian Farm Institute
[2] Austroads (2007) Guidelines to Project Evaluation &GHD Analysis . The speed used is the all day average speed on a link including intersection delays. Costs inflated to 2012$ using CPI increase.

5

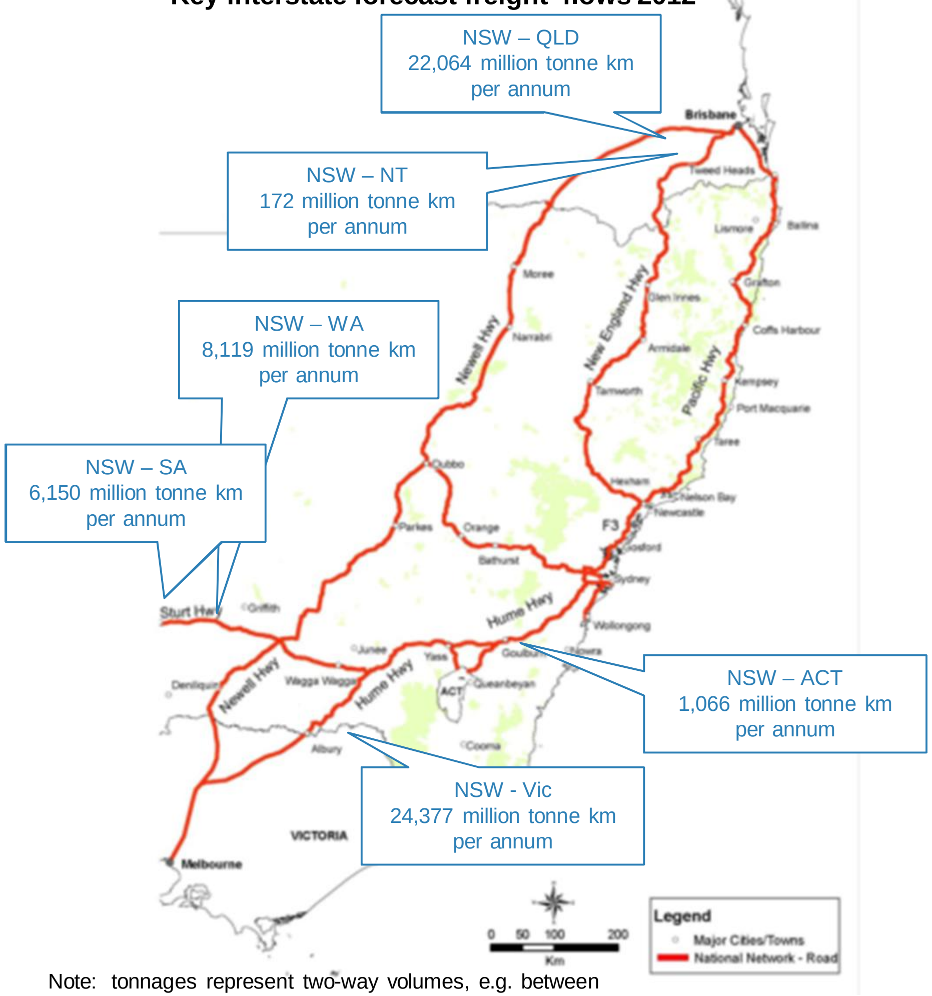
The interstate road freight task is forecast to grow by ~4% pa to 2029, while growth in the intrastate task is expected to moderate

Interstate and intrastate road freight task for NSW [1]



Road freight estimates and forecast growth gates (CAGR) [1]		
Freight routes	**Historical estimates (%)**	**Forecast (%)**
Interstate	7.4	3.8
Sydney	3.7	2.2
Rest of state	3.8	-0.4

Key interstate forecast freight flows 2012 [2 3]



Note: tonnages represent two-way volumes, e.g. between NSW and QLD, and QLD to NSW

[1] BITRE (2010) Report 121
[2] NSW Government (2011) Pacific Highway Submission to Infrastructure Australia
[3] BITRE (2010) Interstate Freight in Australia

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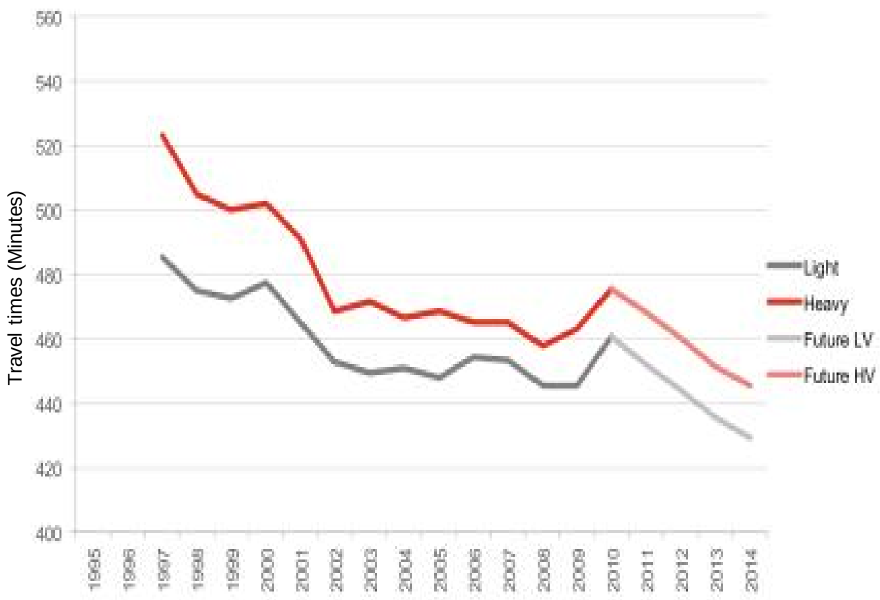
Infrastructure constraints on the interstate and local road networks impact freight reliability, however road upgrade programs are achieving some travel time savings at critical pinch points

Constraints [1]

- There are a number of pinch-points on key freight routes and planning is underway to improve travel times
- **Pacific Highway** – The Commonwealth and State Governments have been jointly upgrading the Pacific Highway between Hexham and the QLD border to a 4 lane divided highway since 1996. The target for the completion of the upgrades is 2016. Travel times, as a result, will continue to improve
- **Great Western Highway** – Proposed future upgrades to the GWH at Kelso will widen the road to four lanes, improve intersections and separate opposing directions of traffic
- **Hume Highway** – The Commonwealth and State governments committed to upgrading the entire length of the Hume Highway to a four lane divided carriageway. Some works are completed and many are in the planning pipeline
- **New England Highway** – The Tenterfield by-pass, currently in the planning stage, will alleviate congestion issues and safety concerns for long distance traffic currently travelling through the town centre

Travel Times, Actual and Forecast – Hexham to QLD border [2]



[1] RTA (2012) http://www.rta.nsw.gov.au/roadprojects/projects/index.html
[2] NSW Government (2011) Pacific Highway Upgrade Submission to Infrastructure Australia

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Regulatory requirements limit freight access to parts of the road network, however long term road reform programs are underway to improve freight productivity

Regulatory Requirements and Constraints

To access NSW roads freight operators must comply with statutory mass, dimension and configuration conditions as follows: [1]

Mass Limits

- Vehicles must comply with the mass limit provisions set out in the regulation for standard vehicles, conforming axle groups, and axle spacing. Under the mass limits, vehicle combinations may operate to a maximum loaded mass of 42.5 tonnes

Dimension Limits

- Height All Vehicles 4.3 metres
- Width All Vehicles 2.5 metres
- Gross Mass Maximum 42.5 tonnes

Vehicle Size Restrictions

- "General access" vehicles are those that do not exceed the following limits:
  - Truck Length -12.5 metres
  - Bus - 12.5 metres
  - Truck & trailer - 19.0 metres
  - Articulated vehicle - 19.0 metres
- Any vehicle outside "general access" requirements is classified as a "restricted access" vehicle and operates under specific arrangements in NSW, such as "Concessional" or "Higher" Mass Limits

Road Reform Programs

COAG Road Reforms [2]

- Currently investigating options for creating a more efficient and sustainable road transport system nationally
- A range of alternative charging models are being considered to align road charges with actual costs imposed by heavy vehicles on the roads

National Heavy Vehicle Regulator [3]

- COAG agreed that a single National Heavy Vehicle Regulator (NHVR) will be established by 2013
- The NHVR aims to modernise the heavy vehicle regulatory system to support the safe, efficient and sustainable growth of freight as part of a national economy
- The reform aims to establish a national approach to compliance and enforcement, safety, access, registration and licensing
- The expected benefits are:
  - Less time and resource needed for business to manage regulatory differences
  - Improved consistency and quality of administering heavy vehicle regulations
  - Operational synergies through a uniform system and set of processes

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[1] RTA, National Heavy Vehicle Reform – Vehicle Operations: Heavy Vehicle Mass, Loading and Access.
[2] COAG Road Reform Plan (2011) Funding and Implementation Issues Paper
[3] National Heavy Vehicle Regulator website. Accessed 2012.

5

The movement of rail freight is particularly constrained when it shares the network or interfaces with passenger services in metropolitan areas

Constraints [1]	Discussion
• The anticipated growth in the volume of containerised freight moved by rail will place more pressure on existing rail arrangements • In the Metropolitan network, freight is prohibited on the network during peak commuting periods and where freight trains share the network, priority is given to passenger services. This represents a significant constraint to rail freight efficiency, particularly during the peak commuter hours with curfews preventing any activities by freight trains on the metropolitan network • As a consequence of these constraints, reliability decreases from 80% to 30% between Newcastle and Sydney and 60% to 40% between Macarthur and Sydney • The majority of Sydney's existing intermodal terminals are located on the shared passenger rail network rather than on dedicated freight lines • The NSW Government has highlighted the need to shift freight transport from road to rail, which puts further stresses onto the already limited capacity • On the ARTC leased network, speed limitations are imposed to most of the freight operations	• The expansion of the intermodal freight terminal network in Sydney at locations such as Enfield and the proposed new developments planned for Moorebank, for example, will increase pressures on the overall rail network (and adjoining roads) unless capacity elsewhere in the supply chain is provided • Growth in regional freight and the lower availability of train paths due to increased metro rail demand is likely to put more pressure on regional freight to utilise road, which is a more expensive mode of transport for long haul services • Capacity constraints will limit access to low cost rail freight solution, thereby increasing storage time for commodities to enter the rail network (particularly time dependent harvested products). These increased storage times will increase utilisation of these facilities, potentially to the point, where the need to invest in additional storage capacity is required. As a result, the cost of transport related services may increase – especially for low production years • The volatile market and seasonality of some commodities means underutilised storage and transport capacity already exist during some parts of the year, and with the pressure to build additional storage capacity to manage peaks, or spikes in demand, the cost of transport will be higher, or a higher cost transport mode will be used

[1] Sydney Ports Corporation (2010) Annual Report 2009/10; Sydney Ports Corp – Port Freight Logistics Plan

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There are a number of rail infrastructure upgrades underway that aim to improve rail freight reliability and productivity in the metropolitan region

South Sydney infrastructure upgrades

Southern Sydney Freight Line (SSFL)

- Currently in the final stage of construction by ARTC this 36 kilometre dedicated freight line is located in the existing rail corridor between Macarthur and Sefton
- The project provides a third line adjacent to the existing passenger lines - allowing passenger and freight services to run independently
- The SSFL is expected to increase the efficiency of the whole eastern seaboard rail freight network and is critical in facilitating increases in; rail capacity to Port Botany and the competiveness of railing freight

Port Botany to Enfield Freight Line [2]

- Dedicated freight line running 18 km between Port Botany and Enfield/Chullora where the Enfield Intermodal Terminal (Owned by Sydney Ports) is location (expected to be fully operational in 2013)

North Sydney infrastructure upgrades

Northern Freight Line

- The Corridor (North Strathfield to Broadmeadow in Newcastle) experiences junction delays at critical locations, and restricted train paths due to passenger service priority, Some freight trains spend up to 40% of their journey time waiting for an available pathway through the Sydney network [3]
- Set of initiatives to increase the capacity and reliability of passenger and freight train services on the Main North Line between Sydney and Newcastle. It is expected to reduce the delays resulted from freight and passenger trains competing for the track between Sydney and Newcastle.
- The program looks to include grade separation, track amplification, and passing loops to increase capacity

Newcastle Rail Corridor Upgrade [4]

- The project, now completed, included platform extensions and re-signalling allowing more efficient passenger services to run between Newcastle and Sydney – this would result in efficiency gains for freight trains using the network

[1] Infrastructure Partnerships Australia (2009) Meeting the 2050 Freight Challenge
[2] Sydney Ports (2012), http://www.sydneyports.com.au/trade_services/logistics
[3] IPA (2011) Agreement Clears the Way for $1 Billion Freight Link Through Sydney
[4] TfNSW (2012), http://www.transport.nsw.gov.au/Projects-Completed-Projects/Newcastle-Rail-Corridor-Upgrade

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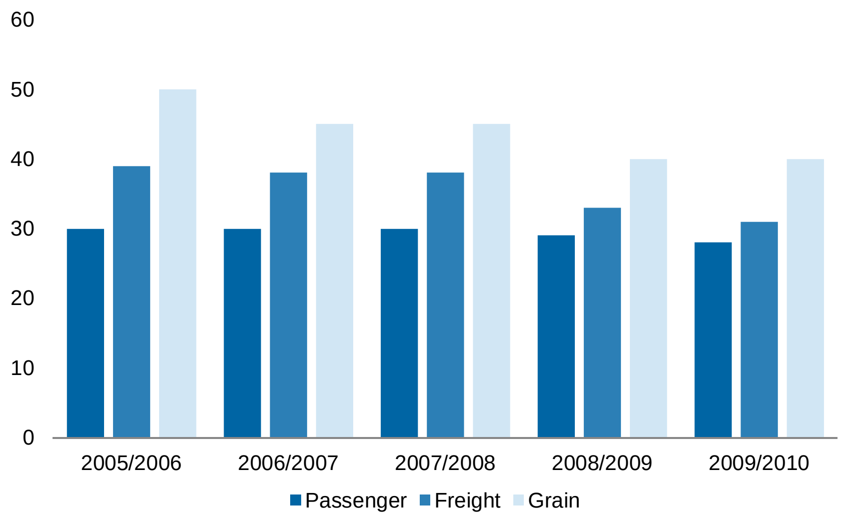
The Country Rail network (in particular, the grain network) has severe speed limit restrictions and low axle load limits impacting transit times and gross train sizes (weight)

Estimated track quality index Country Rail network [1]



Notes: Track Quality Index excludes lines operated and/or leased by ARTC

NSW grain rail network speed restrictions	
Class 5 Track	Class 3 Track
55%	45%
40 km/h speed limit	70 km/h speed limit
19 tonne axle load	19 tonne axle load

Passengers, freight and grain rail

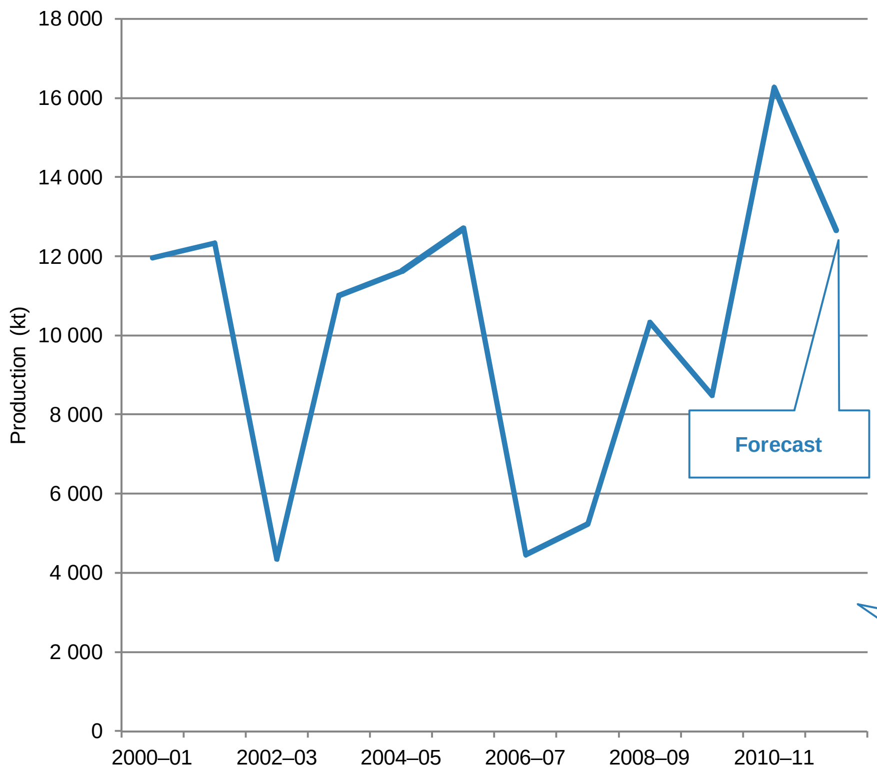
- The condition of the Country Rail network is significantly worse than the metropolitan network. The network was constructed in the late 1800's and now has severe operating speed limits and axle load limits
- 55% of the grain rail network is Class 5 Track, which is limited to 40kmh speeds and 19 tonne axle load limits. Many of these lines are further restricted to 20km/h because of timber sleepers and bridges
- Temporary speed restrictions (TSRs) on the grain network are stable but remain high [1]
- Where axle loads are low, train sizes can "max" on weight before length (subject to passing loop lengths)
- Train length is 'typically' dictated by length of passing loops where the smallest loop length decides train length on a particular route
- Passenger trains operate on higher quality sections of the network meaning travel times are faster and more reliable than general freight and substantially more reliable than the grain rail network

[1] Rail Infrastructure Corporation (2010) *Annual Report 2009/10*

5

Over half the Country Rail network is not operational due to asset condition and commercial factors associated with volatile grain volumes

NSW Grain and Oilseed Production 2000 – 2012 [1]



Key issues

- Over half the Country Rail network is not operational (3,139 kms)
- However, this is not entirely due to the condition of the asset
- Due to volatile annual grain volumes and geographically dispersed assets, the grain network is costly to maintain and service provision is not always commercially viable
- Given the seasonality and volatility of grain production, there is a high risk of low utilisation of rail infrastructure and rolling stock and hence poor returns on investment
- The grain rail network moves an average of 1.6 million tonnes per annum
- 38% of NSW produced grain is consumed domestically, within NSW, increasing the demand for road transport
- Estimates of grain transport costs (NSW – Japan) in 2011 total $133.91/t, 70.3% of which is allocated to transport within Australia which accounts for approximately 49% of farm-gate value [4]

Grain's and Oilseed include:

- Wheat, Barley, Lupins, Canola, Sorghum, Cottonseed, Field Peas, Maize, Chickpeas, Sunflower, Faba Beans and Lentils

[1] ABARES (2012) Australian Crop Report February 2012
[2] IPART (2011) Operational costs for transporting grain from silos on the NSW country Rail Network to ports at Newcastle or Port Kembla by rail and road
[3] ABARE (2011) Australian Crop Report No 157, 15 Feb 2011
[4] Australian Farm Institute (2011) Transport Costs for Australian Agriculture

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Without long term planning and investment, the regional rail freight infrastructure (in particular, the grain network) will continue to be highly inefficient

Grain Freight Review Findings

- The NSW Grain Freight Review concluded that: [1]
- There is an economic case for keeping the majority of the grain branch lines open (with the exception of the Cowra branch lines)
- A one off capital injection and an ongoing maintenance agreement are required to keep the lines open and operating at the minimum level of service (Class 5)
- The cost of stabilising the branch lines should be met by the NSW through a non recoverable grant. If industry deems that these lines should be improved beyond a class 5, then they should fund the additional improvement
- Ongoing maintenance costs should be met by access charges/ user contributions
- The grain rail network should remain in public hands (Given the multi user environment, privatisation is unlikely to have a positive impact on supply chain performance)
- Long term grain freight network planning is required to ensure access and capacity constraints are managed on rail, roads and at ports

ARTC Infrastructure Upgrade Projects [2]

New alignment of the Liverpool Ranges (Hunter Valley)

- Under investigation – will remove a particularly steep section of track that currently limits train length and imposes inefficient operating practices

Hunter Valley Capacity Increases [3]

- Decreasing and harmonising train headways by increasing speed limits for trains approaching grades, re-signalling and deviating tracks to avoid steep grades

Gap to Narrabri Improvements [4]

- Capacity improvements to the regional network for freight service to the north west of the state

General Capital Maintenance 2011 – 12 [5]

- General upgrades to the regional country rail network, now provided under contract by John Holland for items such as steel re-sleepering and bridge renewals to improve the safety, reliability and efficiency

[1] NSW Government (2009) NSW Grain Freight Review
[2] ARTC (2012) http://www.artc.com.au/Search/SearchResults.aspx?p=3&s=projects
[3] ARTC (2007) Hunter Valley Corridor Improvement Strategy
[4] NSW Auditor General (2011) Volume 8, 2011 Country Rail Infrastructure Authority
[5] NSW Government (2011) Infrastructure Budget Paper

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Anecdotal evidence suggests there is a maintenance backlog, however more detailed analysis of ‘levels of service’ data is required to ascertain whether the maintenance backlog is as significant as claimed

Road Maintenance Issues [1 2]

- The RTA/ RMS has claimed a significant maintenance backlog for a number of years (Asset Management Plans)
- As part of the Auditor General’s review of road maintenance in 2006, the perceived gap between the actual and appropriate conditions of NSW roads was tested but not confirmed because appropriate condition standards had not been set
- Analysis of levels of service information and RMS’ strategic asset management plan would be required in order to ascertain the extent of the maintenance backlog

Rail Maintenance Issues

- RailCorp's maintenance expenditure is increasing which appears to reflect its ‘good’ track condition rating, however maintenance plans highlight a potential maintenance backlog
- Under investment in the renewal of assets between 1996 and 2002 resulted in a considerable maintenance backlog
- RailCorp has been addressing it year on year by allocating a proportion of the maintenance funding to address the backlog
- Without significant investment, RailCorp claims the backlog could increase to $500 million over the next 5 years (under a ‘worst case’ scenario)

[1] Auditor General (2006) Condition of State Roads: Roads and Traffic Authority of NSW
[2] RTA (2007) Safeguarding Our Roads

6

A range of factors continue to drive up standards which may result in some increases in road maintenance expenditure

Factors Influencing Construction and Maintenance Standards

- Increasing community expectations to increase safety requirements
- Increasing environmental standards
- Increasing engineering specifications
- Expanding asset base
- Ageing network
- Old ITS systems (technology have short life cycles)
- Rapidly increasing freight task (The NSW road freight task has increased by 112 % over the previous 17 years) [1]
- Increases in axel loadings
- Increases in travel demand
- Increasing mix of modes
- Increases in material costs i.e. bitumen/steel
- Decreasing access to roads in order to maintain them i.e. requires night work
- Ageing Population
- Unprecedented weather conditions (can redirect funds away from routine maintenance)

Examples of Evolving Standards

Example	Requirements in 1992	Requirements in 2012	Impact on Maintenance
Construction (D&C R44 Earthworks)	Minimum pavement thicknesses specified	Additional pavement requirements (up to 20mm thicker).	Likely to extend asset life and durability and reduce maintenance requirements
Pavement (E6/R2 Granular Base and sub-base Materials for Surfaced Road Pavements)	Mix of 'low cost' granular pavements and heavy duty pavements	Greater use of 'heavy duty' pavements	Likely to extend asset life and durability and reduce maintenance requirements
Environmental (G34M Environmental Protection: Management Plan)	Minimal environmental requirements	Environmental protection requirements are significantly greater eg –wildlife crossing	These environmental measures will need to be maintained – increasing maintenance costs
Safety (Carriageway Separation R132 Safety Barrier Systems)	Concrete barriers were standard - they have a long life and require little or no maintenance	Wire rope barriers have been introduced to improve safety and aesthetics	More costly to maintain
Rural/Urban Design (R158 Road Tunnel and Underpass Lighting)	-	Growing tendency to use consistent standards between urban and rural areas	This could possibly be unnecessary given lower traffic volumes More costly to maintain

[1] BITRE (2011) The Australian Infrastructure Yearbook
GHD analysis

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- Hypothesis 5 – Rural and Regional Freight
- Hypothesis 6 – Asset Maintenance
- **Hypothesis 7 – Road Safety**

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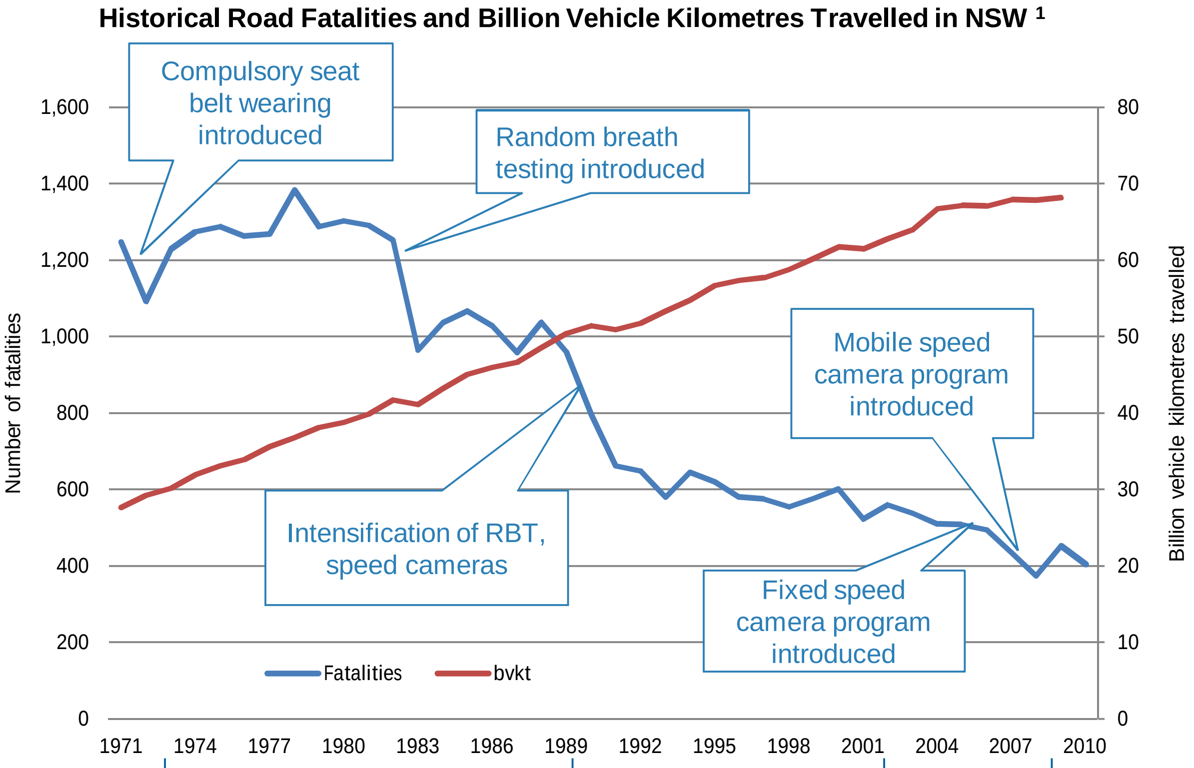
Road safety performance in NSW has improved over the last few decades despite a significant increase in vehicle kilometres travelled



1972 – Commonwealth Government decided to take responsibility for funding of national highways

1989 – Substantial upgrade of national road network completed

2002 – AusLink national funding program introduced

2009 – AusLink replaced by Nation Building Program, which includes major upgrades on Hume Highway and Pacific Highway

Discussion

- Road safety performance has improved significantly since the early 1970's
- A number of safety initiatives (targeted toward reducing the road toll) have been implemented which are likely to have contributed to the improvements
- For example, after undertaking the mobile speed camera program in 2008, NSW had achieved 35% decrease in road fatalities rates per 100,000 population since 1999, compared to 25% decrease in Victoria, 12% decrease in Queensland, and 22% decrease Australia wide
- By 2011, road fatalities rates per 100,000 population in NSW had dropped by 46% since 1999

[1] Department of Infrastructure, Transport, Regional Development and Local Government, Monthly Road Death Series; BITRE, Australian Infrastructure Statistics Yearbook 2011
[2] Department of Infrastructure and Transport, 2006, History of Australian Road and Rail
[3] Nation Building Program, http://www.nationbuildingprogram.gov.au/

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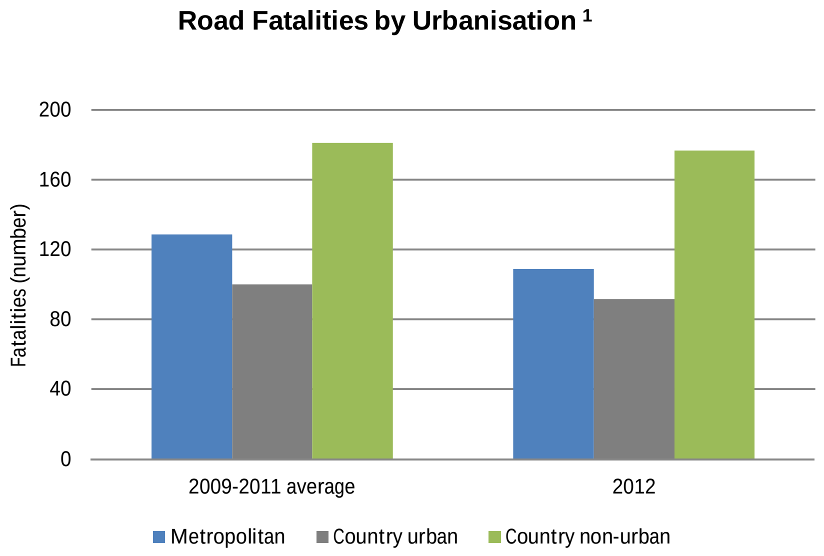
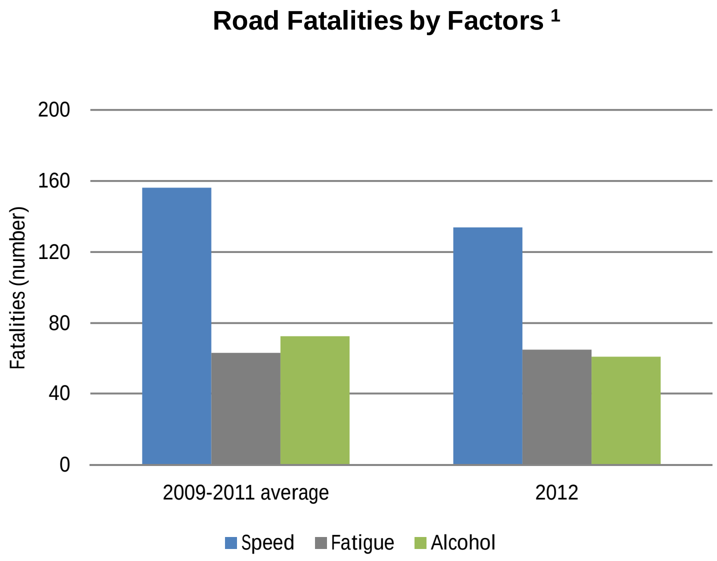
Road incidents in regional areas are more serious than those in urban areas and driver behaviour seems to be a key factor in fatalities





[1] Transport for NSW (2012) Crash Statistics

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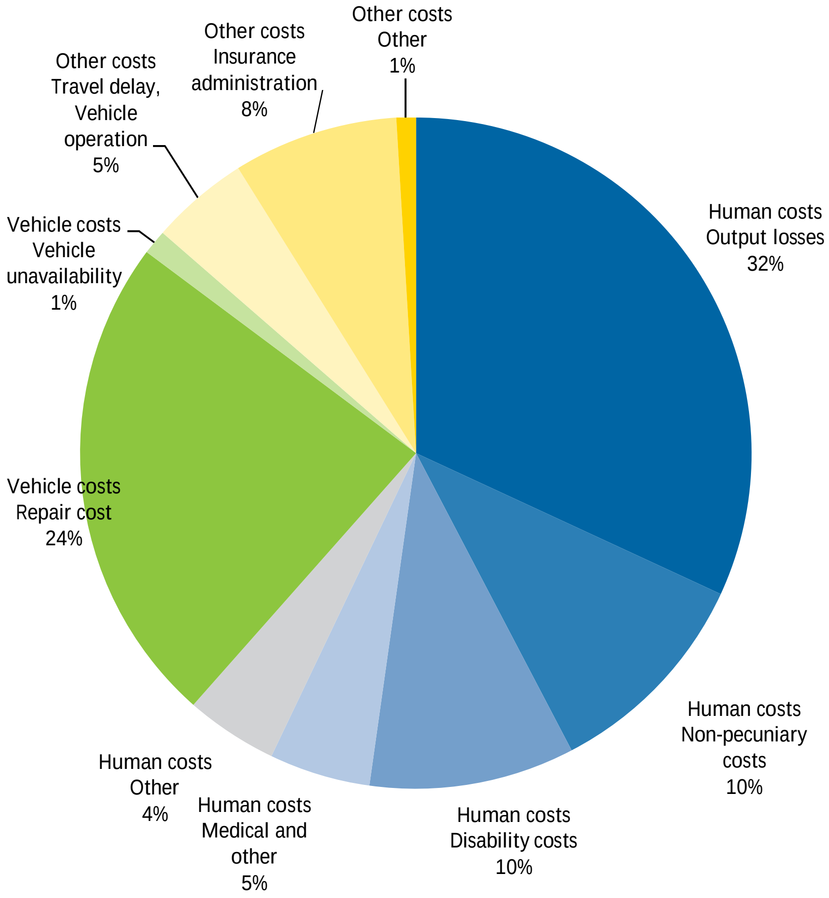
While the social cost of road crashes is substantial, the effectiveness of safety programs is difficult to evaluate

The Social Cost of Road Crashes in Australia 2006 [1]



Discussion

- Social cost of road crashes in Australia has been estimated at $18 billion per annum [1]
- The NRMA estimates that the cost of crashes on NSW roads is up to $2.8 billion per year [2]
- Measuring the effectiveness of safety programs is a complex task as it is a measure of a range of factors such as; driver behaviour, infrastructure condition, vehicle standards and technology
- It is hard to generalise the benefits of a specific road safety treatment or program since the effects tend to vary based on other factors such as the current road safety situation, road section and features, traffic condition, and other existing treatments or programs in place
- A study by Monash University in 1991 found that treatments and programs on rural roads in Victoria tend to have high benefit cost ratios, for example, rural road sealed shoulders (22:1), rural roadside hazard management program (18:1), rural roads skid resistance overlays (16:1), and improved delineation on rural highways (14:1) [3]
- A study by Curtin University found that Black Spot Programs in WA have been effective, seeing reductions in crash rates of 15% [4]

[1] BITRE (2006) Cost of Road Crashes in Australia 2006, Research Report 118
[2] NRMA (2012) Cost of Road Crashes in NSW
[3] Monash University Accident Research Centre (1991) Indicative Benefit/Cost Analysis of Road Trauma Countermeasures
[4] Curtin University of Technology (2008) Effectiveness of the Black Spot Programs in Western Australia

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However, road safety investments appear to be targeted to key risk areas and along with improvements in road construction and vehicle standards, have likely improved road safety outcomes

Selected Examples of NSW Road Safety Improvement Initiatives

Driver Behaviour Programs

Safer Speeds
- Point-to-point speed enforcement
- A concerted and integrated speed management program
- Speed zone mapping to support speed zone management system
- Fixed speed camera program and mobile speed camera program

Safer Road Users and Safer Behaviour [1]
- Enhanced Enforcement Program
- Drink/drug driving testing
- Road safety marketing campaign
- Safety cameras and speed camera programs

Fatigue and Distracted Driving
- Heavy vehicle rest areas
- Safe-T-Cam sites on major freight routes

Road Programs and Standards

Safer Roads and Road Sides [2]
- Newell Highway safety reviews
- Speed limits for high pedestrian activity areas
- Road Toll Response Package
- Australian and NSW black spot programs

Evolving Road Standards
- Standards for safety barriers on highways and major roads have been improved. Wire rope barriers have replaced concrete barriers to improve safety and reduce the risk of vehicles crossing into oncoming traffic [3]
- New NSW speed zoning guidelines (2011) now consider a rang e factors when setting road speeds (such as the road function, road characteristics (alignment, road access, lane width, adjacent speed zones), traffic characteristics (traffic patterns, road users))

Vehicle Standards

Safer Vehicles [4]
- Intelligent Speed Adaptation (ISA) trial to limit heavy vehicle speed
- Heavy Vehicle Inspection Programs and roadside compliance and enforcement programs
- Vehicle Safety Compliance Certification Scheme - new framework and competency criteria and new vehicle standards

Safety Rating Schemes/ Crash Testing
- Australasian New Car Assessment Program (ANCAP)
- Used Car Safety Rating - provide comparative assessment of the overall crash safety rating of used vehicles

[1] Australian Transport Council, National Road Safety Action Plan 2009 and 2010
[2] RTA Annual Reports
[3] Safety – carriageway separation R132 safety barrier systems
[4] GHD Industry Knowledge

Appendix A – Assumptions and Methodologies

Item	Slide Reference	Clarification

Definition of Economic Hubs	7, 8, 10, 14, 17	• The economic hubs identified in the report align with those identified in the 2003 GHD report "Macquarie to Airport Corridor - Strategic Review of Passenger Demand, Drivers and Forecasts' and have been updated in consultation with the Metropolitan Plan for Sydney 2036
		• Calculation of trip durations between/to/from economic hubs have been made using travel zones or groups of travel zones (depending on the size of the hub). Travel zones were chosen on their proximity to the commercial centre of the hub – typically where economic activity is located and it is assumed where business related travel either originates or finishes
		• This assumes the majority of the economic activity occurs within the non residential zones of the suburb
		• Economic hubs had a number of travel zones allocated to them due to size.
		• Travel zones chosen for each economic hubs:
		  • Chatswood 2387, 2388, 2392
		  • K-S Airport 404, 406, 411, 415, 420, 425, 581
		  • Liverpool 1091, 1096, 1101, 1111, 1120
		  • Macquarie Park 2469, 2470, 2474-2481, 2488
		  • North Sydney 2347, 2358-2360, 2364, 2368
		  • Parramatta 1693, 1697, 1701-1705, 1708-1711
		  • Penrith 1929, 1930, 1932
		  • Port Botany 426, 553, 556
		  • Randwick 520, 521, 527
		  • St Leonards 2407, 2408, 2411, 2412, 2435
		  • Sydney CBD 3-166

Estimation of average speeds	10, 15, 19, 21, 41	• Travel zones were identified at particular points on a route – normally to encompass road stretches of particular importance - average speeds or travel times, for a specific time period, were then identified from travel zone to travel zone (point to point) using the BTS STM model.

Appendix A – Assumptions and Methodologies

Item	Slide Reference	Clarification
BTS STM assumptions	7, 8, 9, 10, 11, 14, 15, 17, 19, 21, 36, 37, 41	• There are 4 periods of travel; AM Peak (7 – 9 am), Inter Peak (9 am – 3 pm), PM peak (3-6 pm) and Evening/night (rest of the 24 hour period) • STM data heavily relies on a large range of other models for example the Freight Movement Model and the Household Travel Survey (Source: BTS (2011) STM: Technical Documentation) • Further detailed information on the model assumptions, identified by BTS, can be found in BTS (2012) BTS InfoSheet : Strategic Travel Model Assumptions
Assumed upgrades to 2036	37	**Road:** • Lane Cove Tunnel • Inner West Busway (Iron Cove Bridge duplication) • F3 widening • Hume hwy widening • Hunter Motorway (F3-Branxton) • M2 widening • M5 widening • W-Syd.Emp.Hub • Gt.Western Hwy widening • M5 East Duplication • M4 Extension • M4 Widening • M2 to F3 Tunnel • SW Sydney population growth centre • F6 **Rail :** • Enhanced timetable • Cronulla duplication • ECRL • Consolidation works • South West Rail Link • LRT Dulwich Hill extension • North West Rail Link to Rouse Hill • LRT CBD Extension • Western Express • 3-tier Railway Plan • Parramatta-Epping RL **Bus:** • Integrated bus networks phase 1 • Integrated bus networks completed + 1,000 buses Increased frequencies • Northern Beaches Busway • Bus network extensions and frequency adjustments aligned with changes in Land Use and Rail Network assumptions (Source: BTS (2011) STM: Documentation of Key Assumptions)

Appendix A – Assumptions and Methodologies

Item	Slide Reference	Clarification
Estimation of average speeds – suburban/ exurban centres	11	• Multiple travel zones are allocated to the CBD and suburban/exurban centres due to their size • Estimation of average speeds between origin and destination has been undertaken by taking an average of every possible O-D combination from the suburban/exurban centre to the Sydney CBD.
Motorway average speeds and minuter/km	22	• Data is collected by the relevant state road authority • It is the state road authorities responsibility to ensure that the basket of roads selected is a true representative sample of routes and travel environments The travel time surveys are carried out on 5 week days (Monday to Friday), in three time periods (AM Peak, PM Peak, off Peak) in each direction. • Data is compiled by RMS in NSW and provided to Austroads Source: Austroads, Australian and New Zealand Road System and Road Authorities national performance Indicators Data Collection Procedures and Methodologies