ARTC

Melbourne-Brisbane
Inland Rail Alignment Study

Working Paper No. 12
Stage 2 Financial and Economic Analysis

PRICEWATERHOUSECOOPERS

ACIL Tasman

Economics Policy Strategy

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Glossary

ABS	Australian Bureau of Statistics
AC traction	Alternating Current traction motors; used in newer diesel-electric locomotives
ACCC	Australian Competition and Consumer Commission
ADO	Automotive Diesel Oil
alignment	The exact positioning of track; may be compared with 'route', which gives only a very general indication of the location of a railway
ARA	Australasian Railway Association
area route	For the purposes of the study, a route over an entire area, i.e. areas A, B, C or D
ARTC	Australian Rail Track Corporation
articulated wagons	Wagons comprising two or more units, with adjacent ends of individual units being supported on a common bogie and permanently coupled
AS 4292	Australian Standard for Railway Safety in six parts 1995-97
ATC	Australian Transport Council
ATEC	Australian Transport and Energy Corridor Ltd
ATMS	Advanced Train Management System; communication-based safeworking system currently being developed by ARTC
ATSB	Australian Transport Safety Bureau
axle load	The load transmitted to the track by two wheels of one axle of a bogie
backhaul	Returning wagons to a point where they can be used for their next assignment; freight moving in the opposite direction to the main flow
BAH	Booz Allen Hamilton (now Booz & Co)
bank engine	locomotive used to assist a train on part of its journey, typically to climb a steep grade; such grades are termed 'banks' in railway parlance
BAU	Business As Usual
BCR	Benefit Cost Ratio
BITRE	Bureau of Infrastructure, Transport and Regional Economics (formerly BTRE and BTE)
bogie	two axles and a sub-frame under each end of a wagon
BOOT	Build, Own, Operate, Transfer
bps	Basis points
break of gauge	Where a line of one track gauge meets a line of a different track gauge.
broad gauge	Railway track gauge of 1600 mm; used in Victoria except on interstate main lines and some other lines
BTE	Bureau of Transport Economics; now the BITRE
BTRE	Bureau of Transport and Regional Economics; now the BITRE
cant	Difference in the height of two rails comprising the railway track; cant may also be described as superelevation. It allows a train to travel through a curve at a speed higher than otherwise. Camber on the curve of a road has a similar function.

capex	capital expenditure
CBA	Cost benefit analysis
CCM	capital cost model
coastal route	The existing rail route from Melbourne to Brisbane via Sydney
corridor	A strip of land with a width measured in kilometres that is suitable for a railway. Study of a corridor leads to the identification of route options.
CountryLink	CountryLink is part of the Rail Corporation of New South Wales (RailCorp). It operates passenger trains from Sydney to Melbourne, Sydney to Brisbane and to NSW regional centres.
CPI	Consumer Price Index
CSO	Community Service Obligation
DBFM	Design, Build, Finance, Maintain
DC	Direct Current; form of electric traction
DIRN	Defined Interstate Rail Network
distributed locomotives	The practice of providing additional locomotive power within or at the rear of a train as well as in front.
DITRDLG	Australian Government Department of Infrastructure, Transport, Regional Development and Local Government
DMU	Diesel multiple-unit passenger train
DORC	Depreciated Optimised Replacement Cost
DoT	Department of Transport, Victorian Government
double stacking	Placement of one intermodal freight container on top of another in a specially designed well-wagon
EBITDA	Earnings before Interest, Tax, Depreciation and Amortisation
EIA	United States Energy Information Administration
EIRR	Economic Internal Rate of Return
energy efficiency	Ratio of the transport task to the energy input; a measure of energy efficiency is tonne/km per MegaJoule (MJ)
energy intensity	Ratio of energy input to transport task; the inverse of energy efficiency; a measure of energy intensity is MJ/net tonne/km
ESA	Equivalent Standard Axis
FBIRA	Food Bowl Inland Rail Alliance
FEC	Financial and Economic Consultant for the Melbourne-Brisbane Inland Rail Alignment Study, i.e. PricewaterhouseCoopers with ACIL Tasman and SAHA
five-pack wagon	Five wagons operated as one, either through being permanently coupled or the use of articulation
fuel consumption	Measured in litres per gross tonne kilometre (litres/gtk) or sometimes litres per 1,000 gross tonne kilometre (litres/1,000 gtk); sometimes net tonnes are used instead of gross tonnes
GATR	Great Australian Trunk Rail System
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GIS	Geographic Information System
gross	Total mass of a wagon and its payload

GST	Goods and Services Tax
gtk	Gross tonne kilometres; a standard measure of track usage; the gross weight of a train multiplied by kilometres travelled.
hr	hour
IA	Infrastructure Australia
IEA	International Energy Agency
IGA	Intergovernmental Agreement (1997) between the Commonwealth, NSW, Victoria, Queensland, Western Australia and South Australia which led to the establishment of ARTC
IPART	NSW Independent Pricing and Regulatory Tribunal
IRR	Internal Rate of Return
kg	kilogram(s)
kg/m	kilograms per metre
km	kilometre(s)
km/h	kilometres per hour
kW	kilowatt, a unit of power
L	Litre(s)
L/gtk*1000	Fuel consumption expressed in litres per gross tonne kilometre x 1000
land-bridging	Replacement of sea transport with land transport between two sea ports, e.g. between Brisbane and Melbourne.
LEP	Local Environmental Plan
Line sector	In the context of the study, a length of line connecting two nodal points.
loading gauge	the maximum permissible height and width dimensions for a rail vehicle and its load; see structure gauge
LTC	Lead Technical Consultant for the Melbourne-Brisbane Inland Rail Alignment Study, i.e. Parsons Brinckerhoff with Aurecon and Halcrow
mass	The mass of an object is measured in kilograms; mass and weight are used interchangeably in the study
M-B	Melbourne-Brisbane
MIMS	Maintenance Integrated Management System
MJ	MegaJoule: a unit of both energy and work
mm	millimetre(s)
MPM	Major Periodic Maintenance; planned maintenance on infrastructure assets at intervals of more than once a year.
mt	million tonnes
mt pa	million tonnes per annum
narrow gauge	Railway track gauge of 1067 mm; used in Queensland except on the interstate line from Sydney to Brisbane
NCOP	National Code of Practice
node	In the context of the study, a point at which alternative routes diverge.
NPV	Net Present Value
NPVI	Ratio of Net Present Value to Investment Costs (i.e. capital costs)
NSRCS	North-South Rail Corridor Study completed in 2006

NSW	New South Wales
ntk	net tonne kilometres; the payload of a train multiplied by kilometres travelled
OHW	Overhead wiring
opex	operating expenses
pa	per annum
payload	Weight of products and containers carried on wagons
PB	Parsons Brinckerhoff, Lead Technical Consultant
PwC	PricewaterhouseCoopers, Lead Financial and Economic Consultant
Qld	Queensland
QR	Queensland Rail, a corporation owned by the Queensland Government
RailCorp	RailCorp (Rail Corporation of NSW); owns rail track in the Greater Sydney region, operates passenger trains in that region and (under the name Countrylink) to Melbourne and Brisbane and regional NSW.
RAMS	Rail Access Management System; manages and records access to ARTC track; RAMS is licensed to other track owners.
RBA	Reserve Bank of Australia
RCRM	Routine Corrective and Reactive Maintenance; comprises maintenance, inspections and unplanned minor maintenance that is carried out annually or at more frequent cycles
Reference train	A notional train specification used in developing the Inland Rail Alignment
RIC	Rail Infrastructure Corporation, NSW, owner of NSW rail network other than metropolitan sections owned by RailCorp. Interstate track and certain other sections are leased to ARTC.
RL	Stands for reduced level in surveying terminology; elevation relative to a specific datum point
RoA	Return on Assets
route	In the context of the study, primary description of the path which a railway will follow.
RTA	Roads and Traffic Authority - various states
SA	South Australia
safeworking	Signalling system and associated rules that keep trains a safe distance apart
SKM	Sinclair Knight Mertz
Short North Project	Short North Project/Northern Sydney Freight Corridor Program; capacity increases for freight currently being planned for the railway between Strathfield and Broadmeadow; 'short north' refers to the railway between Sydney and Newcastle.
SPV	Special Purpose Vehicle established for the development and/or the operation of a project.
SSFL	Southern Sydney Freight Line; independent track for use by freight trains between Macarthur and Chullora, currently under construction
standard gauge	Railway track gauge of 1435 mm; used on the ARTC network and for the NSW railway system
structure gauge	Specification for the position of structures such as overhead bridges, tunnels, platform, etc, relative to a railway track, to allow adequate clearance for the passage of trains.

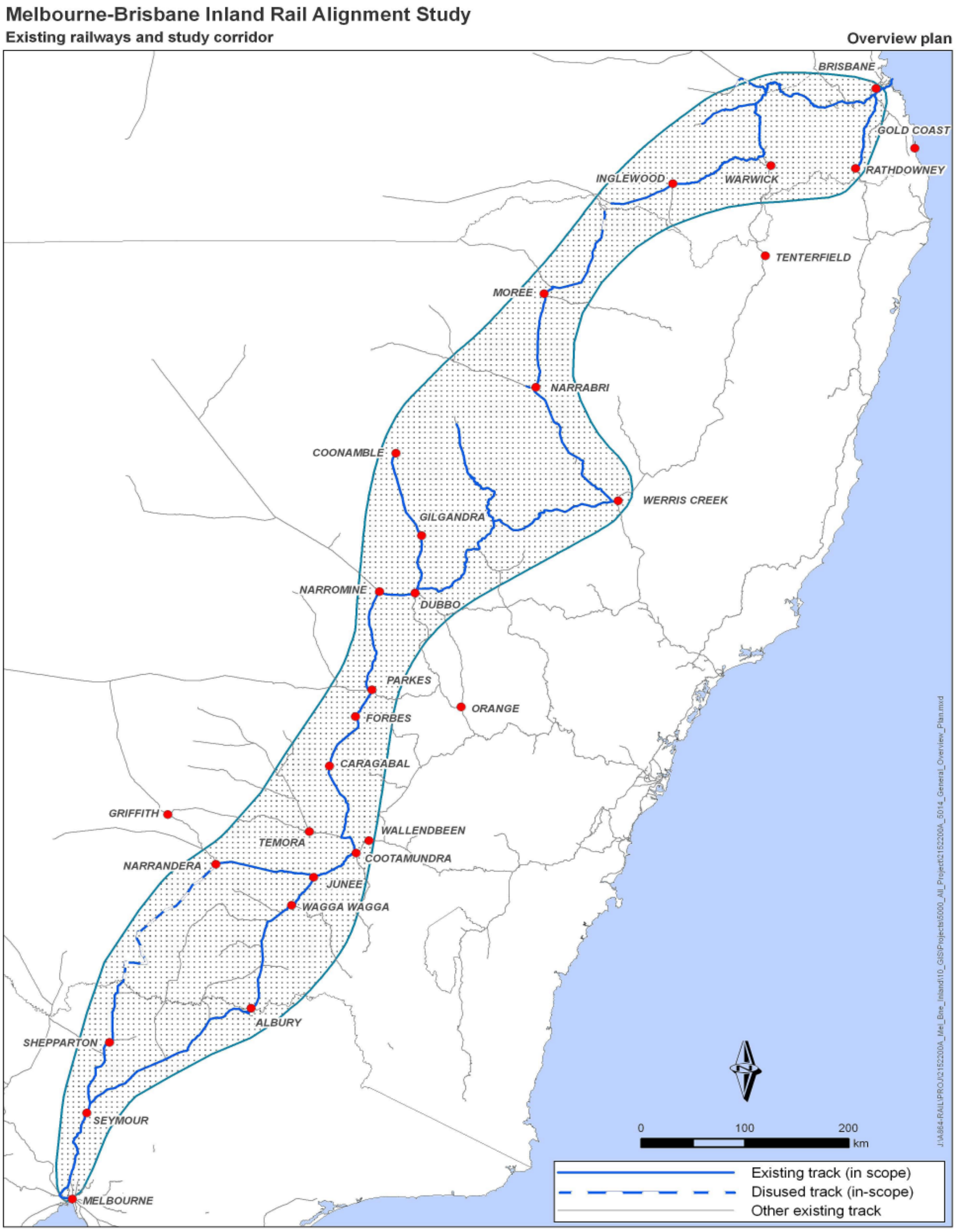
superfreighter	Term used to describe high-priority intermodal freight trains
t pa	tonnes per annum
tal	tonnes axle load
tare	Weight of an empty wagon
TCI	Track Condition Index; TCI is an indicator of the condition of track by compilation of a number of measures of its geometry
TOC manual	Train Operating Conditions manual
TEU	Twenty-foot Equivalent Unit, the standard unit measure of shipping container size
train kilometre	A standard measure of track usage; number of trains multiplied by the total kilometres travelled
TSR	Temporary Speed Restriction
TTM	Train Transit Manager
Vic	Victoria
VicTrack	VicTrack, owner of Victorian Government rail network; interstate track and certain other lines are leased to ARTC
VOC	Vehicle Operating Cost
WA	Western Australia
WACC	Weighted Average Cost of Capital
well-wagon	A wagon where the central loading deck is lower than the bogies at either end, to allow higher loads to be carried within the loading gauge
WP	Working Paper
WTT	Working Timetable

1. Introduction

In March 2008, the Australian Government announced that the Australian Rail Track Corporation (ARTC) had been asked to conduct the Melbourne-Brisbane Inland Rail Alignment Study.

The announcement stated that in developing a detailed route alignment, the ARTC would generally follow the far western sub-corridor identified by the previous North-South Rail Corridor Study and shown on the map. That study, completed in June 2006, established the broad parameters for a potential future inland rail corridor between Melbourne and Brisbane.

Figure 1 Map of the far western sub-corridor



Source: LTC

1.1 Background to Melbourne-Brisbane Inland Rail

The railways of NSW, Victoria and Queensland date from the 19th century. They were constructed using different gauges and developed primarily to link each state's hinterland to its ports. At present, the only north-south rail corridor in eastern Australia runs through Sydney. North of Sydney the railway runs fairly close to the coast. For that reason, the existing Melbourne-Brisbane line is referred to as the coastal railway throughout this working paper.

In September 2005, the Australian Government commissioned the North-South Rail Corridor Study, which undertook a high level analysis of the various corridors and routes which had been proposed for an inland railway to provide an additional line to move freight from Melbourne to Brisbane by rail.[1] The Lead Technical Consultant and Financial and Economic Consultant (LTC and FEC) have had the benefit of reviewing this and a range of prior studies on inland railway proposals and these are listed in a bibliography in Chapter 8.

In announcing the Melbourne-Brisbane Inland Rail Alignment Study, the Minister for Infrastructure, Transport, Regional Development and Local Government requested a customer-focused and consultative study involving discussions with state governments, industry, local government and major rail customers.[2]

1.2 Study objectives, stages and working papers

The objectives of the Melbourne-Brisbane Inland Rail Alignment Study (the study) are to determine:

- the optimum alignment of the inland railway, taking into account user requirements and the economic, engineering, statutory planning and environmental constraints. The alignment will be sufficiently proven up so it can be quickly taken through the statutory planning and approval process and into the detailed engineering design and construction, should a decision be taken to proceed;
- the likely order of construction costs +/-20%;
- the likely order of below rail (infrastructure) operating and maintenance costs;
- above rail operational benefits;
- the level and degree of certainty of market take up of the alignment;
- a project development and delivery timetable; and
- a basis for evaluating the level of private sector support for the project.

The study is being carried out in three stages, as follows:

- *Stage 1* – Identification of the Route for Further Analysis;
- *Stage 2* – Engineering, Environmental and Land Base Analysis; and
- *Stage 3* – Development of the Preferred Route.

Most of the Study's activities are being undertaken by two consultants, a Lead Technical Consultant and a Financial and Economic Consultant, whose activities are coordinated by

[1] Ernst & Young 2006, *North–South Rail Corridor Study, Executive Report*, Commissioned by the Department of Transport and Regional Services, p 9

[2] Albanese, A. (Minister for Infrastructure, Transport, Regional Development and Local Government) 2008, *Media Release: Inland rail Alignment Study Underway*, 28 March 2008

ARTC. These consultants have responsibility for specific working papers, which are produced at each stage of the study to document progress.

A series of working papers is being produced within each stage. A list of the planned working papers follows.

Table 1 Working papers

Stage	Working Paper		Lead Responsibility
Stage 1	WP1	Demand and Volume Analysis	FEC
	WP2	Review of Route Options	LTC
	WP3	Stage 1 Capital Works Costings	LTC
	WP4	Preliminary Operating and Maintenance Cost Analysis	LTC
	WP5	Stage 1 Economic and Financial Assessment and Identification of the Route for Further Analysis	FEC
Stage 2	WP6	Design Standards	LTC
	WP7	Preliminary Environmental Assessment	LTC
	WP8	Preliminary Land Assessment	LTC
	WP10	Development of Route	LTC
	WP11	Stage 2 Capital Works Costings	LTC
	WP12	Stage 2 Economic and Financial Analysis	FEC
Stage 3	WP9	Engineering Data Collection	LTC
	WP13	Preferred Alignments Environmental Assessment	LTC
	WP14	Preferred Alignments Land Assessment	LTC
	WP15	Refinement of Preferred Alignments	LTC
	WP16	Stage 3 Capital Works Costing	LTC
	WP17	Delivery Program	LTC
	WP18	Economic and Financial Assessment	FEC
	WP19	Policy Issues, Options and Delivery Strategies	FEC

Note: FEC and LTC relate to the Financial and Economic Consultant and Lead Technical Consultant respectively.

Note that the list of working papers has been revised since the completion of Stage 1 of the study. Some working papers have been re-titled and/or re-scheduled. In addition, the working papers listed as outputs of Stage 3 will appear as sections or appendices within an integrated final report of the study rather than being published as standalone documents.

1.2.1 Roles of the Lead Technical Consultant and Financial and Economic Consultant

The study's activities are headed by two lead consultants whose activities are coordinated by ARTC.

The LTC is responsible for engineering and environmental work and associated activities, including railway operational analysis. The FEC is responsible for financial and economic analysis. The two consultants work jointly and collaboratively with each other.

The LTC is Parsons Brinckerhoff (PB) and the FEC is PricewaterhouseCoopers (PwC). Each consultant acts independently and each has a lead responsibility for specific working papers. Whilst this occurs the other consultant plays a support role for that particular working paper.

PB has engaged Halcrow to support it in alignment development, operations and maintenance costing and Aurecon to support it in engineering and alignment development. Aurecon has in turn engaged Currie and Brown to assist in capital costing.

PwC has engaged ACIL Tasman to undertake volume and demand analysis and support it in economic review, and SAHA for peer review.

1.3 Stage 2 and role of Working Paper No. 12

Stage 1 focused on developing a preliminary assessment of the economic and financial position of the project as a mechanism to identify a preferred route for further analysis in later stages. In Stage 1 a route was identified for further analysis (the 'Low Capital Cost scenario), and Stage 2 of the study stage builds upon it to further analyse the railway based on consideration of possible alignments and more detailed financial and economic appraisal. In addition, one of the preliminary routes examined in Stage 1 (an adapted form of the 'High Capital Cost scenario) supplements the analysis in this paper as a result of operational analysis which has indicated transit time can be reduced for a relatively modest incremental rise in capital cost.

The role of Working Paper No. 12 (WP12) in Stage 2 is to further develop the financial and economic analysis of the route identified in Stage 2. WP12 draws on capital cost and operating costs prepared in WP2-4, and also incorporates further Stage 2 analysis of demand forecasts.

1.4 Structure of this working paper

This paper presents a description of the route identified for further analysis in Stage 1 (referred to as the 'Low Capital Cost scenario' in Stage 1 working papers). It then presents updated demand estimates, then presents the implications for financial and economic viability of Inland Rail. This paper is presented in the following chapters:

- *Chapter 2* – presents a summary of the inland route analysed in Stage 2;
- *Chapter 3* – incorporates ACIL Tasman's current and projected demand estimates;
- *Chapter 4* – identifies cost, time, revenue and other assumptions and estimates used in the economic and financial analysis;
- *Chapter 5* – includes the methodology and results of the financial assessment;
- *Chapter 6* – presents a rail freight user economic appraisal and discusses employment and wider economic benefits;
- *Chapter 7* – indicates key findings and results; and
- *Chapter 8* – contains the bibliography and reference list

The paper is supported by the following appendices:

- *Appendix A* – Stakeholders consulted;
- *Appendix B* – Case studies of recent rail freight projects; and
- *Appendix C* – Additional information on demand results and assumptions;
- *Appendix D* – Additional information on economic parameters; and
- *Appendix E* – Terms of reference for the study.

2. The inland routes assessed in Stage 2

2.1 Inland routes assessed in Stage 2

This paper presents a description and analysis of two Inland Rail scenarios:

- *route identified for further analysis in Stage 1* – this is the route with a distance of 1,880 km and transit time of 27.5 hours, which was identified for further analysis in Stage 1 (referred to as the 'Low Capital Cost scenario' in Stage 1 working papers); and
- *Stage 2 optimised route* – this relates to the 'High Capital Cost scenario' that was assessed in Stage 1, which has been further refined to produce a faster transit time in the order of 22 hours.

The key characteristics of each route are provided in the table below.

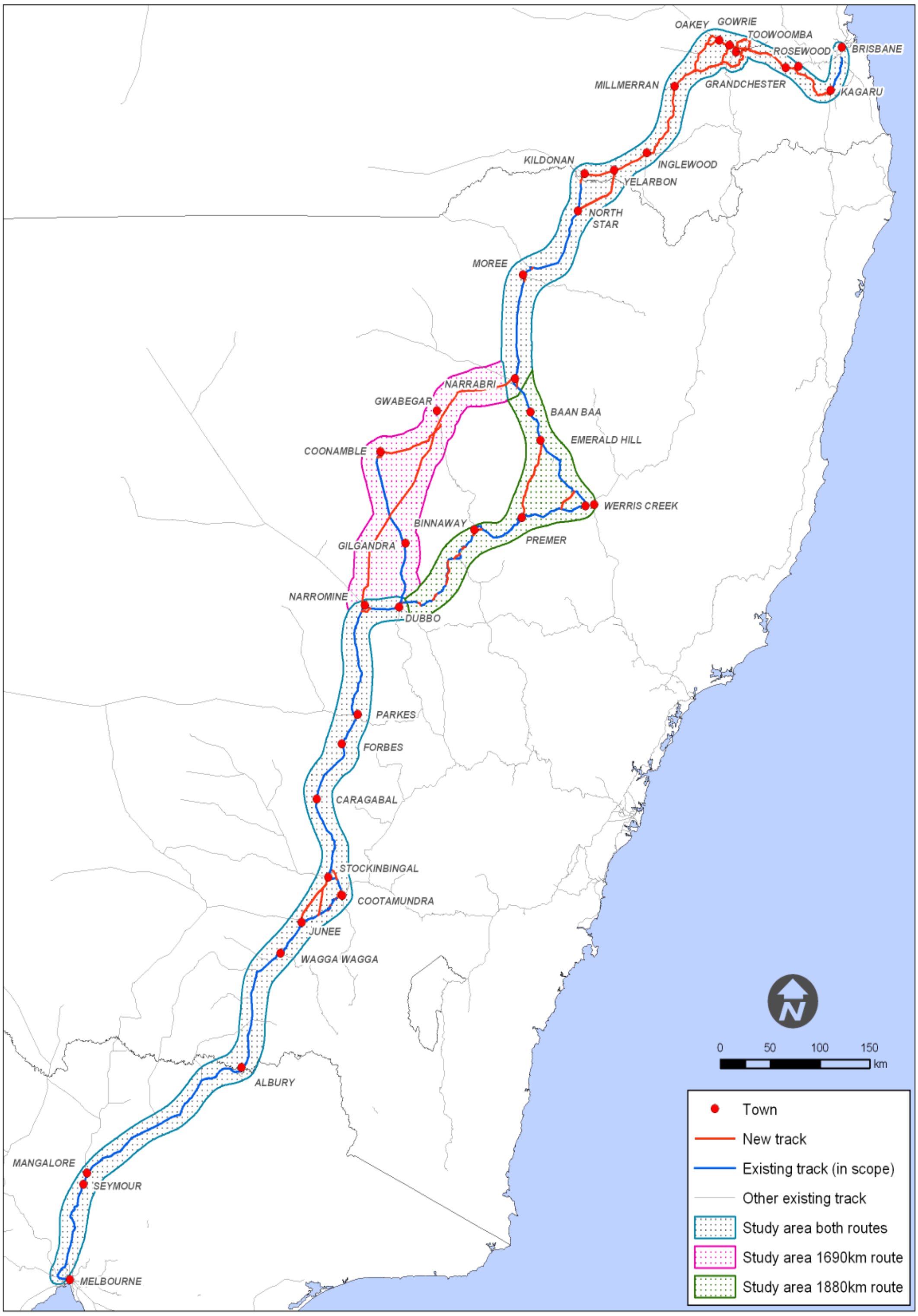
Table 2 Melbourne to Brisbane inland railway routes analysed in Stage 2

Route analysed	Corridor	Route distance (km)	Transit time (terminal-terminal)	Capital cost ($ billion, including 20% contingency)
1,880 km scenario	Existing corridor from Melbourne to North Star, upgraded and with by-passes of Binnaway and Werris Creek. Route into Brisbane via Toowoomba.	1,880	27.5	2.82
1,690 km scenario	Existing corridor from Melbourne to Narromine, new route from Narromine to Narrabri. Route into Brisbane via Toowoomba	1,690	22	3.75

The map below depicts the routes analysed in Stage 2.

Further detail on these two Inland Rail routes is provided in the remainder of this chapter.

Figure 2 Inland rail routes analysed in Stage 2



Source: LTC

2.2 Stage 1 route identified for further analysis

Stage 1 involved development and analysis of three scenarios:

1. low capital cost scenario;
2. central capital cost scenario; and
3. high capital cost scenario.

These scenarios were assessed against a Base Case (existing road and rail with no inland railway) in terms of cost and transit time results, and also in terms of financial and economic outcomes, to identify one route for further analysis in Stage 2. This involved the following:

- demand analysis;
- technical analysis;
- identification of optimal route segments; and
- financial and economic analysis.

The preliminary Stage 1 findings for each of these are presented below.

2.2.1 Demand and volume analysis

ACIL Tasman conducted demand and volume analysis from assessment of the current freight market in the corridor, consultation with key freight/logistics companies and customers, and development of a logit model to estimate future mode shares with and without Inland Rail.

Key findings of the preliminary demand analysis undertaken in Stage 1 include:

- *rail mode share is expected to increase as a result of the Inland Rail* – rail market share (combined for the inland railway, coastal railway and other existing rail lines in the corridor) is expected to increase. As a proportion of total Melbourne-Brisbane road and rail freight in the corridor, the rail share is expected to increase from the current 29% (by tonnes), to 45% once the inland railway commences operations in 2020, rising slowly to 57% by 2050 for the 1,880 km scenario and 60% for the 1,690 km scenario. In contrast, if there is no inland railway the rail mode share of intercapital freight is projected to be 44% in 2020 and 54% in 2050;
- *Inland Rail's market share is relatively stable (but with demand/freight volumes growing by 3-4% per annum)* – Inland Rail's share of total road and rail intercapital freight is estimated at 49% by 2050 (for the 1,880 km scenario, by tonnes) and 59% (for the 1,690 km scenario). This does not vary significantly if operation commencement is delayed; and
- *an inland railway was found to induce/divert other freight* – including substantial quantities of coal freight over short distances. It would also divert grain from other rail routes and road onto parts of the inland railway, and attract regional freight and freight from outside the corridor.

The demand volumes have been updated in Stage 2, as presented in this working paper.

2.2.2 Technical analysis

Performance specifications. The technical analysis in Stage 1 developed performance specifications for the inland railway, and determined above rail operating costs, and track maintenance costs for each route option to assist in alignment analysis and as an input to the economic and financial analysis.

Key performance specifications for the inland railway include:

- a freight train transit time driven by customer preferences which to date are mainly seeking a terminal-to-terminal transit time within a range of 23 to 28 hours;
- equivalent or better reliability of journey time than that provided by the coastal route;
- equivalent or lower operational costs (fuel and crew) than the coastal route;
- allow for a maximum train length of 1,800 m;
- a desirable maximum freight operating speed of 115 km/h;
- a maximum gradient of 1 in 67 and a target gradient of 1 in 80; and
- a standard gauge of 1,435 mm between rails.

Minimum upgrade inland railway. In establishing performance specifications for Inland Rail, the idea of a minimum upgrade inland railway was considered by the FEC and LTC. As it was considered that demand for such a railway will be low unless Inland Rail achieves performance criteria that are equivalent or superior to the coastal railway, it was not considered sufficient to make a railway with such specifications viable. The LTC estimates that with a series of minor upgrades and a limited amount of new track (e.g. Boggabilla-Goondiwindi) a basic inland rail alignment could be established between Melbourne and south-east Queensland at a lower capital cost. Based on this, the LTC estimates that the likely transit time for a least capital cost inland alignment is about 31½ hours for $2.46 billion.

In summary, a minimum upgrade inland alignment is unlikely to be able to attract significant tonnage from the existing coastal rail alignment or from road. Hence the economic and financial analysis has focused on options that provide a transit time broadly similar to the future coastal route transit time and the very basic option has not yet been evaluated.

Cost and time estimates. As part of the technical analysis in Stage 1, the following elements were also estimated by the LTC to assist in determining an optimal alignment, and also as cost inputs to the financial and economic analysis:

- *capital costs* – were estimated based on benchmarking against comparable, completed projects. A detailed cost model will be developed for use in Stage 3;
- *journey times* – were analysed based on benchmarking against comparable sections of the coastal routes. A detailed operational model is being developed during Stage 3; and
- *operating and maintenance costs* – initial estimates were developed, to be refined in Stage 3.

2.2.3 Identification of optimal route segments

In Stage 1 a large number of route options and segments, which in combination amounted to over 50,000 options, were identified as possible alternatives for the route between Melbourne and Brisbane. These were reduced to three key options to be subjected to financial and economic analysis based on consideration of the key route segments:

- *key route decision in the south* – assessing a route either via Albury or Shepparton through northern Victoria and southern NSW, Albury was identified as the preferred route due to lower capital costs, possibly lower transit time, capacity not being an issue, and extra demand via Shepparton not being considered sufficient to offset higher capital costs;

- *key route decision in the north* – assessing routes either via Warwick or Toowoomba on the approach to Brisbane, Toowoomba was identified as the preferred route due to lower capital costs, and access to additional regional freight (mainly coal).
- *upgrade options in the mid-section of the corridor* – in order to assess the impact of Melbourne to Brisbane routes in the mid-section of the corridor, low cost, high cost and mid/central cost upgrade scenarios were developed for sections within NSW. These three scenarios were developed by the LTC from a review of over 50 route options using a capital cost versus transit time analysis.

Table 7 includes a summary of the key features of the three options selected in Stage 1.

Table 3 Melbourne to Brisbane routes for economic and financial analysis

Route selected	Corridor	Route distance (km)	Loop spacing (km)	Transit time (terminal-terminal)	Capital cost ($ billion, including 20% contingency)
Low capital cost	Existing corridor from Melbourne to North Star, upgraded and with bypasses of Binnaway and Werris Creek. Route into Brisbane via Toowoomba.	1,880	45	27.5	2.82
Central capital cost	Existing corridor from Melbourne to Premer, upgraded and with bypass of Binnaway. New route from Premer to Emerald Hill. Route into Brisbane via Toowoomba.	1,773	45	25.5	3.10
High capital cost	Existing corridor from Melbourne to Narromine, new route from Narromine to Narrabri. Route into Brisbane via Toowoomba.	1,690	20	23.5	3.62

The route identified for more detailed analysis is via Albury in the south, and via Toowoomba in the north for all scenarios.

2.2.4 Financial and economic analysis

Preliminary financial and economic assessments were undertaken on the three scenarios identified in the optimal alignment analysis. The result of the preliminary Stage 1 financial assessment was that Inland Rail does not appear financially viable on a standalone basis. The economic results indicated that the Low and Central Capital Cases were broadly equivalent and unviable. The financial results showed that the Low Capital Case had a stronger performance, identifying this route for further analysis in Stage 2. The additional economic benefits in the other cases were not sufficient to justify their higher capital costs.

2.2.5 Route identified for further analysis

The key finding of Stage 1 was that the Low Capital Cost scenario was identified as the optimal alignment for further analysis. This route is:

> *From Melbourne via Albury to Cootamundra, Parkes, Narromine, Dubbo, towards Binnaway and Werris Creek (both with bypasses), Moree to Inglewood, Millmerran, Gowrie, Grandchester, Rosewood, Kagaru and Brisbane.*

2.3 Stage 2 optimised route

Given the iterative nature of the study the 'High Capital Cost scenario' assessed in Stage 1 has been assessed further in this working paper (alongside the 1,880 km scenario identified for further analysis in Stage 1). This route has a faster transit time and a shorter route length, as well as higher capital costs in order to achieve this higher level of performance. While in this working paper this route is referred to as the '1,690 km scenario', it is not the fastest of rail proposals that have been submitted for the inland railway corridor, nor does it have the highest capital cost (see discussion in section 2.5).

This inland railway scenario has been assessed further in the Stage 2 economic and financial appraisal because:

- *Stage 2 technical engineering analysis indicates transit time reductions can be achieved for a relatively modest rise in capital cost* – through reductions in crossing delays and operational analysis undertaken during in Stage 2, it has been indicated that transit time can be reduced for a relatively modest incremental rise in capital; and
- *signals that economic results are more favourable* – there were some signals from Stage 1 economic results that a faster transit time could result in more favourable economic outcomes. This is mainly because there is greater scope to achieve train operating cost savings and generate economic value from faster transit times. However, the variation between transit times considered in that stage (27.5, 25.5 and 23.5) did not indicate significant variation and also suggested financial results worsen.

During Stages 1 and 2, consistent with the terms of reference for the study requiring consultation 'with key interested parties', some stakeholder views supported consideration of a lower transit time route to be more competitive with road. Hence, the further analysis of two route scenarios within Stage 2 had potential merit.

The 1,690 km scenario also partly reflects a strategy of 'future proofing' to provide more of a 'step change' in transit time to compete with road as competing modes will continue to make productivity gains into the future.

The 1,690 km Inland Rail scenario analysed in Stage 2 is that of the 'High Capital Cost scenario' assessed in Stage 1. The route does not vary significantly from the 1,880 km scenario (with the main differences occurring between Narromine and Narrabri). This route is:

> *Existing corridor from Melbourne to Junee, Stockinbingal, Caragabal, Narromine and new route from Narromine to Narrabri. From Toowoomba, the route would pass through Rosewood and Kagaru to reach Brisbane.*

The LTC is currently assessing if all rail paths available on the inland railway will be 22 hours, or if some will be slower, and this will be tested further in Stage 3.

2.4 Stage 2 alignment options analysis

This section of WP12 refers to alignment option analysis undertaken by the LTC in Stage 2. The alignment analysis focuses on the 1,880 km Inland Rail scenario identified in Stage 1, as it was only toward the end of Stage 2 that the 1,690 km scenario was determined to offer a better economic result. As a result, analysis of the alignment options for the section of route between Narromine and Narrabri will be superseded by further work in Stage 3, which will assess a more direct route between these two centres involving substantial new construction.

2.4.1 Alignment options for the 1,880 km route

Stage 1 established a refined study corridor to be taken forward to Stage 2. The route generally comprises existing track from Melbourne to Parkes via Junee, and then to Narromine, Werris Creek, Moree and North Star, greenfield railway to Inglewood, Millmerran, Gowrie, Grandchester/Rosewood and Kagaru, and then existing track to Acacia Ridge. Within the study area there are opportunities to improve the journey time by upgrading existing track, bypassing towns and building deviations.

In Stage 2, the 1,880 km route was subject to more detailed analysis of possible alignments and deviations along sub-sections of the route. The chief purpose of this was to understand which deviations may achieve the target transit time of 27 hours, and based on this to identify an alignment for further cost, financial and economic analysis in Stage 3. In order to do this, and as presented in Working Paper No. 10 (WP10), a set of alignment options were identified by the LTC based on capital cost, journey time saved, and critical environmental aspects.

The deviations will be formally included and/or excluded from the final route as part of Stage 3, and based on this will be costed for inclusion in the Stage 3 financial and economic appraisal. The implication of this is that the capital costs of the railway as applied in the Stage 2 appraisal are subject to change based on the deviations selected. However the impact of this on total costs will not be understood until Stage 3.

Approach to analyse alignment options

Firstly, the LTC defined a 'reference case' to allow potential journey time savings of upgrades and deviations to be compared. The reference case is the alignment identified in Stage 1 as having the minimum capital expenditure required to operate Inland Rail from Melbourne to Brisbane effectively. The reference case is made up of the sections listed in WP10 in Tables 3-1, 3-2, 3-3 and 3-4. Modelling during Stage 2 has estimated the total journey time between Melbourne and Brisbane for the reference train to travel along the reference case alignment to be 29 hours, 2 minutes (23 hours, 2 minutes journey time with added time for crossing trains and other operational requirements, totalling between 4 and 6 hours).

Following definition of a reference case, alignment options along the Stage 2 study corridor were considered by the LTC in broad terms and a short-list of deviation options was selected. The deviations are all between Junee and Brisbane, with none required between Melbourne and Junee as the existing Class 1 Main South line is considered adequate.

Evaluation was then undertaken on the short-listed options based on the following three criteria and in comparison with the reference case:

- *environmental* – deviations with potential negative environmental impacts and land use constraints were excluded from the analysis;

- *cost* – capital works cost estimates were prepared for each reference case, upgrade and deviation option; and
- *journey time saving* – the alignment options being considered were modelled using RailSys computer software to provide an estimate of journey times.

Having excluded deviations with potential negative environmental impacts and land use constraints, the options were differentiated based on capital cost and journey time. Comparison of the reference case with possible deviations and upgrades was done by estimating the 'incremental cost' relative to the reference case for each minute of journey time saved, as presented in Table 8. The options with the lowest capital cost per minute saved were considered the most economic options.

Table 4 Cost per minute saved relative to the reference case – 1,880 km route

Deviation/upgrade section that achieves a journey time improvement	Journey time saving (minutes)	Incremental cost [*1] ($ millions)	Cost per minute saved ($ millions)	Shortlisted section
Oakey bypass	2.75	(89.80)	(32.70)	✓
North Star to Yelarbon	9.75	(18.30)	(1.90)	✓
Narrabri bypass	12.75	26.90	2.10	✓
Narromine bypass	9.25	24.00	2.60	✓
Narrabri (north) to Moree (south)	36.50	112.00	3.10	✓
Stockinbingal bypass	9.00	31.30	3.50	✗[*2]
Moree (south) to Moree (east)	1.50	5.60	3.70	✓
Spring Ridge to Breeza	24.50	92.20	3.80	✓
Junee to Stockinbingal	39.25	150.40	3.80	✗[*2]
Piambra to Ulinda deviation	5.75	22.40	3.90	✓
Illabo to Stockinbingal	33.5	139.70	4.20	✓
Merrygoen deviation	8.00	34.30	4.30	✓
Dubbo bypass	7.50	32.20	4.30	✓
Camurra deviation	3.75	19.40	5.20	✓
Premer to Emerald Hill	62.25	374.30	6.00	✗
Parkes bypass	2.75	18.50	6.7	✓
Cecilvale to Gowrie via Wyreema West	3.00	21.70	7.20	✗
Dubbo (north east) to Barbigal deviation (west)	2.50	19.00	7.60	✗
Parkes deviation (north) to Narromine (south)	19.25	149.80	7.80	✓
Oakey Creek to Premer deviation	8.75	77.30	8.80	✗
Boomley deviation	6.75	60.00	8.90	✗
Premer (west) to Premer (central)	0.25	2.50	9.80	✗
Narromine (east) to Dubbo (west)	3.75	38.50	10.30	✗

Source: LTC, Working Paper No. 10, Table 5-1
Notes: *1 incremental cost is used in the analysis: capital cost of the deviation/upgrade, minus cost of the reference case). Figures in brackets are negative; Sections that are highlighted green have been excluded for environmental reasons described in WP10; *2 These deviations are not shortlisted as they are conflicting with deviation B14a, which offers a better journey time saving than B17 and was assessed to provide a better environmental/social outcome than B14. Refer to WP10 for further details

The options highlighted yellow in the table above give a journey time reduction of 2 hours and 57.5 minutes, which reduces the total journey time to the 27 hours in the performance specification. The negative incremental costs for Oakey bypass and North Star to Yelarbon indicate that the capital cost of the deviation is estimated to be less than the cost of the reference case. This analysis showed many of the options to be less favourable due to:

- significant capital expenditure,
- the upgrading of track did not give significant journey time improvement due to curves and grades still constraining the speed of the train, or
- options to remove speed constraints were costly for little time saving.

2.4.2 Alignment options for the 1,690 km route

A similar approach as that described above was adopted for the analysis of the 1,690 km route. In this instance, the analysis only applied to the section between Narromine and Narrabri, as the sections of route to the south and north of this area are common to both routes under consideration.

A base case was adopted, following the existing corridors as far as possible, with the necessary upgrading works.

As with the above, alternatives to the base case were differentiated based on capital cost and journey time. The options with the lowest capital cost per minute saved were considered the most economic options, as presented in Table 9.

Table 5 Cost per minute saved – 1,690 km route

Deviation/upgrade section that achieves a journey time improvement	Journey time saving (minutes)	Incremental cost [*1] ($ millions)	Cost per minute saved ($ millions)	Shortlisted section
Curban/Gilgandra to Merebene	15.25	-62.40	-4.10	✓
Narrabri bypass	12.50	-4.00	-0.32	✓
Narromine to Curban/Gilgandra	41.75	91.30	2.20	✓
Dubbo bypass	7.50	32.20	4.30	×

Source: LTC

2.4.3 Identifying alignment options for Stage 3 analysis

Based on the analysis presented above, the LTC identified the following options for journey time improvement would be taken forward to Stage 3 of the study for further development depending on the decision between the 1,880 and 1,690 km options in this working paper:

Common to both the 1,880 and 1,690 km routes:

- Illabo to Stockinbingal – as it shortens the route;
- Parkes bypass – as it shortens the route;
- Upgrade from Class 2 to Class 1 between Parkes (north) and Narromine (south);
- Narromine bypass – as it shortens the route;

1,880 km route only:

- Dubbo bypass – as it avoids bridge replacement in the reference case;
- Merrygoen deviation – as it shortens the route;
- Piambra to Ulinda deviation – as it avoids triangle construction on the reference case and shortens the route;
- Spring Ridge to Breeza – as it shortens the route; and
- Narrabri bypass – as it avoids bridge replacement on the reference case.

1,690 km route only:

- Narromine to Curban/Gilgandra – more cost effective than an upgraded route via Dubbo;
- Curban/Gilgandra to Merebene – requires less capital expenditure than the reference case; and
- Narrabri bypass – requires less capital expenditure than the reference case.

Common to both the 1,880 and 1,690 km routes:

- Upgrade between Narrabri (north) and Moree (south) and Moree (south) to Moree (east) – as it reduces transit time through enabling a speed increase;
- Camurra deviation – as it shortens the route;
- North Star to Yelarbon – as there is high cost associated with the reference case; and
- Oakey bypass – requires less capital expenditure than the reference case.

2.5 Other rail proposals for the inland railway corridor

2.5.1 Great Australian Trunk Rail System inland rail network

A proposal for an inland rail network is being developed by the Great Australian Trunk Rail (GATR) System Pty Ltd, which has publicly released its business plan to generate support for the concept.[3] GATR is proposing a 'steel tollway' open to all rail freight users, with a 14 hour courier train transit time, 18.2 hour superfreighter transit time, route length of 1,583 km route, and capital cost, as estimated by GATR, of $4.8 billion excluding rollingstock (or $5.2 billion including rollingstock).[4]

The track specification proposed by GATR has been revised from that understood by the LTC at Stage 1, meaning that the current GATR specification is quite comparable with that defined by the LTC in WP6. This means that GATR's construction costs should now be broadly in line with LTC track unit costs in Working Paper No. 3. However the total capital cost as stated by GATR has not been reviewed in detail by the LTC. GATR's preferred route is comparable to the 1,690 km route as identified by the LTC, with the following key differences:

- GATR proposes the use of a route via Shepparton, arguing that this would be shorter and faster. The rationale for this study not adopting the Shepparton route is given above, with a key reason being an additional $0.8-1.0 billion in capital costs; and
- GATR's proposed deviation between Narromine and Narrabri connects to the existing corridor to the south of Narromine, around Peak Hill, whereas the LTC's deviation connects at Narromine. This results in a longer section of new track in the GATR proposal.

GATR's proposed higher speed (120-160 km/h) version of a Melbourne-Brisbane inland railway is designed to cater for:

- *XFT Courier Freight trains* – 14 hour transit time – serving the time sensitive freight market (e.g. less than container load: mail, parcels, express pallets, 'just-in-time' manufactured parts). High speed trains require greater grade separation at road crossings and more advanced signalling and safety equipment, and they may consume a

[3] GATR 2007, *Business Plan*, [Online, accessed 29 January 2009], URL: http://gatr.com.au/index.php?option=com_content&task=view&id=5&Itemid=6

[4] GATR 2009, *Response to Working Papers 1 to 5*, 'Coastal route 2011-2024 capex impact of an inland route', 25 May 2009, p 4

larger number of train paths than slower train services on the same track if the standard environment is considered to be the slower trains; and

- *superfreighters* – 18.2 hour transit time – the GATR proposal also aims to accommodate lower speed (80-120 km/h) general freight trains. This train would service a slightly higher volume to that identified by ACIL Tasman for the 1,690 km scenario forecast in section 7.4 of this working paper.

Overall, the additional capital costs to achieve a 14 hour transit time does provide a substantial element of future proofing and opens the potential to service the express freight market. However, given the additional $2 billion in capital expenditure to achieve a 18.2 hour transit time compared to 27.5 hours for the 1,880 km scenario (or $1 billion compared to the 1,690 km route), the courier and other trains expected to use this rail network would need to earn significantly higher revenue to underwrite this extra cost.

The GATR Group is yet to develop a demand forecast for the Courier Freight Train concept. A courier train concept would appear to be mainly competing with air freight and express road freight. WP5 provided some information on the Melbourne-Brisbane airfreight market, which was approximately 200,000 tonnes in 2007.[5,6] Air freight schedules indicate that Melbourne-Brisbane represents about 5-10% of the Australian domestic airfreight market or 10,000-20,000 tonnes per annum (t pa). The size of the express road freight market is larger but its quantum is relatively unknown, combined with being difficult to estimate.

Overall, the high capability/courier train concept is innovative and it would represent a significant step change in rail and supply chain performance. However, the demand for the railway would need to be significant enough to support a 28-70% increase in capital costs from the 1,690 km and 1,880 km scenarios respectively. The 1,690 km scenario explored in the financial and economic appraisal in this working paper has some similarities with the GATR proposal, but without the Courier Freight Train concept.

Further information about the GATR proposal is available at: http://gatr.com.au/

2.5.2 Border railway

Australian Transport and Energy Corridor Pty Ltd (ATEC) has long been a proponent and advocate for establishing a Melbourne-Brisbane inland railway and a number of other proposals for new rail freight lines. The company has commissioned several studies, and its recommendations for the Melbourne-Brisbane corridor were provided to the North-South Rail Corridor Study.

ATEC has proposed construction of a 310 km 'Border Railway' from Moree to Toowoomba which would provide a standard gauge connection from the NSW rail network (and via, existing tracks, from Melbourne) to a proposed freight terminal at Toowoomba.

ATEC estimates the capital cost of the Border Railway at approximately $1 billion (equivalent to $3.22 million per kilometre in 2009 dollars). The Border Railway would connect (via existing narrow gauge lines) to another railway involving ATEC being the 210 km Surat Basin Railway (SBR) linking Wandoan, north-west of Toowoomba, to Banana where it would

[5] The international air freight market for Australia for export and imports is approximately four times the size of the domestic market, but the international air freight market would not compete with a Melbourne-Brisbane courier train.

[6] DITRDLG 2007, *Fact Sheet 5 - Air Cargo Security - the background*, current as at 20 December 2007, available at: http://ww w.infrastructure.gov.au/transport/security/aviation/factsheet/factsheet5.aspx

connect with Queensland Rail line to Port of Gladstone. The estimated construction cost of the SBR is $1 billion[7] (or $4.7 million per kilometre, excluding rollingstock).

ATEC also has a related entity (Australian Freight Terminals or AFT) which is focused on the long-term development of intermodal freight terminals at key strategic sites throughout Australia. AFT has acquired land at Charlton, near Toowoomba, Queensland (the most advanced project) and between Parkes and Dubbo, NSW. Other sites are under consideration. Physically, the 'border railway' would be part of the inland railway that is the subject of this study. Demand and viability impacts on Inland Rail if this railway is separately constructed is discussed later in this working paper (see Section 7.4).

Further information about the various ATEC proposals is available at: www.ateclimited.com.au.

2.6 Case studies of recent rail freight projects

To provide a comparative point for the inland railway project with some recent rail developments in Australia, three case studies have been discussed below (and in greater detail in Appendix B):

- *Case study 1 – Alice Springs-Darwin railway* – the Adelaide-Darwin railway is a north-south transcontinental railway operating across South Australia (SA) and the Northern Territory (NT). The line from Tarcoola was extended from Alice Springs to Darwin by the AustralAsia Rail Corporation in 2000. The total cost of the extension comprising 1,420 km of new track, is estimated to have been $1.3 billion including rollingstock (equivalent to $0.9 million per kilometre in 2009 dollars).[8] The extension was funded jointly by the Australian Government, the SA and NT governments and the private sector.[9]
- *Case study 2 – Bauhinia Regional Rail Project* – this project relates to a new 110 km line constructed as a branch off the Kinrola spur line to the Rolleston coal mine in central Queensland. The line provides rail infrastructure to haul coal from the Rolleston mine to the Port of Gladstone for export, as well as to domestic power users such as Stanwell and Gladstone power stations. QR financed and managed the Bauhinia rail project, securing in May 2004 a take or pay contract with Swiss-based mine owner Xstrata to underwrite the building of the rail line.[10]
- *Case study 3 – Pilbara rail projects* – the Pilbara region is located in the North-West area of Western Australia (WA). The freight lines in the region service heavy-haul iron ore to the Port Hedland, Wickham and Dampier. Rio Tinto, BHP Billiton and Fortescue Metals Group (FMG) are the three largest companies operating in the region, making use of the private freight lines to link their iron ore mines to the port terminals. The efficiency of the private Pilbara railways has meant government intervention has not been required to date for infrastructure development/investment.

Considering these case studies, some potential lessons for Inland Rail are:

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[7] Surat Basin Rail, *Environmental Impact Statement* [Online, accessed 23 June 2009], URL: http://www.suratbasinrail.com.au/files/EIS/eisSummary.pdf

8 Department of Infrastructure, Transport, Regional Development and Local Government 2009, Transport Infrastructure Programs: Alice Springs – Darwin Railway, <www.infrastructure.gov.au/transport/programs/rail/alice.aspx>

9 Department of Infrastructure, Transport, Regional Development and Local Government 2009, Transport Infrastructure Programs: Alice Springs – Darwin Railway, <www.infrastructure.gov.au/transport/programs/rail/alice.aspx>

10 QR Network Access, Blackwater System Enhancement Program, Newsletter 2: November 2005

- *funding approaches* – while the majority of new coal and iron ore railways are funded by industry often without a government contribution, new long distance highways and general freight railways have required a significant capital contribution or service payment in order for the infrastructure to be developed and commissioned.
- *approaches to encourage private sector involvement*– in the case of the Alice Springs-Darwin extension, a vertically integrated operation and access regime reduced risk for private sector involvement. Take or pay contracts, as achieved for the Bauhinia Regional Rail, also reduce revenue/demand risks for track owners.

3. Demand

3.1 Introduction

This chapter is an update and extension of parts of Working Papers Nos. 1 and 5, and provides an assessment of demand and potential rail volumes. It further investigates the potential responses of railway users and customers, updates assumptions for recent events and incorporates more detailed investigation of induced coal and grain movements. The main new material incorporated in the Stage 2 demand analysis is:

- adjusted forecasts in the light of additional industry interviews and analysis;
- additional material on potential coal freight; and
- more extensive treatment of alternative modelling by the ARTC and reconciliation with ACIL Tasman analysis (in Section 7.3 and Appendix C, the ACIL Tasman demand projections are compared alongside demand more sensitive to service and price characteristics following ARTC and industry feedback).

Interviews have been held with additional freight forwarding/logistics companies and freight customers, grain exporters and coal companies. The analysis has also been fine tuned in the light of the more detailed work that has now been done by the technical consultants. Further discussions with the ARTC have clarified the assumptions behind their demand analysis and the reasons for differences between their rail demand forecasts and ACIL Tasman's.

The new work has not led to major changes to the earlier results, except for changes to likely coal volumes.

The methodology behind this chapter comprises:

- an assessment of the current freight market (total, all modes) by origin, destination and commodity, and forecasts of external drivers of demand such as GDP growth, fuel prices and labour prices;
- a questionnaire and interviews with key freight companies and customers to understand how modal choices are made;
- input on expected future journey time, reliability and capacity of the current coastal railway and potential inland railway;
- a logit model to estimate future mode shares;
- analysis of other freight that is additional to these estimates, e.g. diversion of grain from other routes and generation of new coal freight; and
- prediction of estimated future rail tonnages with and without Inland Rail.

The study concentrates largely on freight between Melbourne and Brisbane and vice versa, freight between points along the route, and freight between points outside the route and points on it (e.g. Perth-Brisbane). There is other transport in the area that moves across the north-south flow (e .g. Hunter Valley coal) but this is not covered in this study except for indirect effects.

3.2 Freight in the inland railway corridor (all modes)

The main categories of freight in the corridor are manufactured (non-bulk) products (86% of tonnes) and bulk steel, paper, coal and grain. There are different drivers of growth:

- *non-bulk and paper* – in the past this freight has grown faster than real GDP (i.e. GDP net of inflation), but it is moving towards the GDP growth rate. There is also a price effect, due to a long-term downward trend in real freight rates (with the recent exception of 2005-2008). However the price effect has less impact on total freight than the GDP effect;
- *agricultural products* – freight tonnages depend on production, which has shown a long-term growth trend of 2.2% pa;
- *steel* – freight has grown at 1.5 times the real GDP growth rate;
- *coal and minerals* – freight tonnages depend on overseas markets, with a long-term growth trend also of 2.2% pa.

Real GDP growth has averaged 3.3% pa since 1977 but there is debate about the future. Our central forecast of GDP in this analysis of Inland Rail is a mix of consensus forecasts: low in the next two years and moving up to 3.1% pa from 2013. Recent forecasts of short-term GDP have been incorporated in this Stage 2 analysis, including the economic forecasts accompanying the Australian Government's 2009-10 Budget.

Freight rates (the total cost to customers of using freight services) have an influence on total freight tonnages and are a key determinant of mode choice. Road freight is more sensitive than rail freight to labour and fuel costs. Labour accounts for around 33% of road freight costs and 20% of rail freight costs. An increasing driver shortage, although eased at present by the economic slowdown, has pushed up driver costs. A trend of rising fuel prices, notwithstanding the current downturn, has also pushed road freight rates up faster than rail freight rates. Our modelling assumes the driver shortage will continue for several years, and allows for a wide range of possible oil prices (based on recent US Energy Information Administration and International Energy Agency forecasts) – US$45 per barrel, US$70 per barrel, and US$125 per barrel in 2030.[11] The range of oil prices between May 2008 and May 2009 was $32 to $142 in nominal terms, with prices in May and June 2009 in a tighter range of $50-$65 per barrel.

The total freight forecasts (for both road and rail in the corridor) are generated by forecasting the freight for each of five different categories as follows:

Intercapital freight

This freight mostly comprises containerised non bulk freight between Melbourne and Brisbane. The amount of Melbourne-Brisbane land freight is currently 5.2 mt pa including backhaul. This is forecast to decline in the near term and then grow by 2.8% pa, reaching 7.4 mt by 2020 and 13.9 mt by 2040. Approximately 66% of the Melbourne-Brisbane freight is currently estimated to flow north from Melbourne to Brisbane.

Freight to and from regions within the corridor

This consists of freight between areas along the inland railway corridor. Data regarding this freight are poor but available information, including submissions from stakeholders, indicates relatively modest total freight volumes: currently 1 mt, growing to 1.9 mt in 2020 and 2.9 mt in 2040. These are ballpark estimates; due to data limitations it is difficult to identify the amount of contestable freight – that is: (i) freight with origins and destinations at a distance

[11] In 2008 US dollars.

that enable rail to compete with road and that would primarily travel along the inland railway corridor where rail is currently unavailable; and (ii) in commodities for which rail is a feasible mode of transport (for example livestock is unlikely to travel by rail).

Freight to and from points outside the corridor

This consists of freight to or from points outside the corridor, such as Perth, and points within, such as Brisbane. From discussions with rail operators, supermarket operators and freight forwarders, ACIL Tasman estimates the total contestable market for goods from North Queensland to Melbourne is currently 1.3 mt pa. Currently, 1 mt of freight moves between Brisbane and Adelaide (mostly via Melbourne, traversing the current coastal railway) and 0.6 mt between Brisbane and Perth.[12]

Total freight to and from points outside the corridor is therefore estimated to be 3 mt currently. The total is forecast to grow to 4.4 mt in 2020 and 7.5 mt in 2040.

Diverted freight

This category consists of freight that would move to an inland railway from other existing road and railways – mainly grain. The total grain freight task is determined by climate and is partly determined by local shortfalls (domestic consumption is first satisfied with export taking the residual).

Induced freight

Induced freight refers to freight that would not take place in the absence of Inland Rail - mainly coal. It is considered that freight is only considered induced if it would not be produced or transported (by road or other mode) unless the Inland Rail is constructed. As a result, the volume of induced freight is modest and chiefly relates to coal.

3.3 Modal analysis methodology

Different methods were used for contestable freight (mainly Melbourne-Brisbane non-bulk), freight from outside the corridor (Adelaide and Perth to Brisbane and Northern Queensland to Melbourne), contestable regional freight and rail-only freight (grain and coal).

For the first category of contestable freight, freight firms and customers were surveyed, with a questionnaire and interview, to understand how modal choices are made. Relative price, reliability, availability, transit time and other factors were explored.

- *Price* – reflects total door-to-door costs, including local pickup and delivery for rail and sea freight.
- *Reliability* – is the percentage of goods delivered on time by road freight, or available to be picked up at the rail terminal or port when promised.
- *Availability* – refers to services available with departure and arrival times that are convenient for customers, which depends on cut-off and transit times. For the Melbourne-Brisbane route the ARTC's track upgrading program on the existing route via Sydney has increased the number of available train paths, so that rail availability is no longer the problem it was at the time of the previous North-South Rail Corridor study.
- *Transit time* – is measured as the door-to-door transit time experienced by customers, and is assumed at 27 and 32.5 hours for an inland railway trip under the two scenarios analysed. This includes an estimated 5 hours of pickup and delivery time for Melbourne-

[12] The inland rail corridor as proposed will include the section from Stockinbingal to Parkes, which also forms part of the east-west corridor between Sydney and Perth.

Brisbane rail trips. Road trips are assumed to have a 22-24 hour door-to-door transit time dependent on whether road movements are via terminals, an average time of 23.5 hours is used in the following analysis. In other parts of this document transit time can refer to the terminal-to-terminal transit time (also referred to as line haul transit time).

The survey showed that the importance of the above factors varies by the type of freight, though price was usually the most important. For express and other just-in-time type freight (e.g. postal, retail chains), minimum transit time and high reliability were essential, so little use was made of rail freight. Such customers would consider rail only if performance improved and there was a large difference in price. At the other end, bulk commodities (e.g. paper, steel) were less sensitive to journey time and more sensitive to price, and tended to use rail or sea freight (on the domestic legs of international shipping services). The bulk of the market, mainly container freight, is between these extremes and is contestable between road and rail. Land-bridging of containers, in which rail dominated, has declined in this corridor as the use of shipping has increased over time, due to recent increases in spare capacity and declines in shipping rates.

The survey results were used in a logit model (as recommended in ATC Guidelines) to forecast mode shares, and hence rail tonnes, under different assumptions about the modes' relative price, reliability and other factors, and different assumptions about external drivers such as GDP, fuel prices and labour costs.

The logit model uses elasticities obtained from ACIL Tasman's surveys of customers, potential customers and freight forwarders, calibrating the model coefficients to the observed market shares for road and rail. This allows the interaction between prices and different aspects of service to be modelled and estimates of market share to be made for Inland Rail, coastal railway and road alternatives. Working Paper No. 1 contains details about the logit model and its operation.

A feature of the Stage 1 analysis was that, within limits, a generally low sensitivity to transit time was identified through customer interviews and surveys. Despatch at the end of the day, and arrival early the second day afterwards (i.e. two nights and a day) was seen as adequate. A much faster time, e.g. 15 hours, would be needed to get significantly more rail freight, and even then the additional quantities would not be large. Some anecdotal evidence from freight forwarders suggested that many users of rail used the mode as a form of secure inventory storage, and did not pick their goods up immediately after the promised delivery time. In one case the average pickup was 1.8 days after delivery, when the maximum permitted storage at the terminal was 2 days.

Most rail operators expressed a preference for a faster transit time to enable faster turnaround of their train assets and resulting operating efficiencies. This could result in lower freight rates which would affect demand, though part of the efficiency gain would be taken as increased profits. The analysis in Stage 2 included consolidating 'availability sensitive' and 'non availability sensitive' non-bulk freight, on the basis that rail availability is no longer a problem. This had the effect of slightly altering the elasticities of non bulk freight, increasing the elasticities to service whilst leaving the price elasticity relatively unchanged.

ACIL Tasman conducted further interviews with customers, and obtained further demand information concerning the intentions of coal companies, the possible reactions of grain companies, regional concerns, and the views of QR and Pacific National (PN) on possible route configurations.

As a result of these investigations other freight in the corridor was added to the logit results:

- *Grain freight* – has a long-term growth trend, would divert from other routes onto parts of Inland Rail. Grain from northern and central NSW would divert from the Hunter Valley line to Newcastle, to the inland railway via Cootamundra to Port Kembla. In addition, some grain from northern NSW would divert to the Port of Brisbane using Inland Rail. Grain from the Darling Downs, some if which is now trucked to Brisbane because of inadequate rail capacity, would use the northern part of the inland railway.
- *Coal freight* – an inland railway is expected to induce extra thermal coal from Toowoomba and South East Queensland areas. Current coal freight moved by rail from these areas uses low-capacity wagons and a relatively short train length (or less than 2,000 net tonnes per train). For Stage 2, given constraints on train paths around the Brisbane metropolitan area, we have assumed the number of coal train paths per day remains constant but that over the next decade it becomes possible to utilise a higher productivity train consist through upgrades to passing loops and junctions. Additionally, if the inland railway proceeds, a small deposit of more valuable coking coal near Ashford in northern NSW may use the line to connect with the Hunter Valley line and the Port of Newcastle. ACIL Tasman does not support suggestions that Toowoomba thermal coal would also move south to Newcastle via the inland railway as the value of that coal is too low to cover both the considerable mining costs and the longer rail distances. One million tonnes of thermal coal are also expected to divert from road to rail between Toowoomba and Swanbank power station near Ipswich along the most expensive to build part of the inland railway.
- *Network benefit driven demand* – a benefit the inland railway provides the broader rail network is that it enables bypassing of the capital cities Sydney and Melbourne, to better connect other capital cities and increase mode shift from road. As a result of this benefit there is additional freight demand estimated on Inland Rail from:
  - *Brisbane to Perth freight* – is included on Inland Rail. All of this freight is assumed to use the inland railway when it is available, irrespective of the characteristics of the route. This is because the service characteristics of Inland Rail from Parkes to Brisbane are expected to be always superior to the route via Sydney, not least being the shortening of the route. This adds tonnage to Inland Rail that is insensitive to transit time. it is therefore assumed that 100% of the Perth-related rail freight travels on the inland railway irrespective of changes to the transit time and other characteristics;
  - *Freight from Adelaide and from northern Queensland* – is mostly freighted along the current Melbourne to Brisbane intercapital route via Sydney. This freight is therefore treated in the same was as Melbourne-Brisbane intercapital non-bulk freight and is subject to the same logit calculation of market shares as the intercapital freight; and
  - *Freight from Sydney to Perth and from Whyalla to Newcastle* – for revenue purposes freight from Sydney to Perth and from Whyalla to Newcastle is also included between Parkes and Cootamundra, although this freight is unaffected by Inland Rail. It is included for financial assessment rather than the economic assessment.
  - There may be some freight from the NSW Riverina horticultural production areas that would use the Inland Rail to Brisbane and Queensland. Although ACIL Tasman analysed this freight, it determined that it was not significant enough to warrant separate analysis.

3.3.1 Scenarios considered

The demand analysis has been conducted in consideration of three scenarios: a base case, a 1,880 km scenario, and a 1,690 km scenario. These scenarios were incorporated into the demand analysis by using the logit model of market shares. The model enables an estimate to be made of the market share for Inland Rail given the price and level of service being offered by Inland Rail and its competitors. Parameters to this estimate were derived from survey results and calibrated to current market shares.

The scenarios are discussed in further detail in Chapter 4.

3.3.2 Price and service attributes assumed

The table below presents the expected price and service attributes of the intercapital freight market that form the basis of the demand analysis. These attributes have been determined in line with the corresponding capital expenditure forecasts and included in the financial and economic analyses.

Table 6 Characteristics of Melbourne-Brisbane Intercapital market

	Relative Price* (vis-à-vis road)	Reliability	Transit time (door to door)	Availability
Road	100%	98%	23.5 hours	98% (declining to 95%)
Coastal railway	61.9% (declining to 57.6%)	70%	33 hours	93%
Inland railway (1,880 km scenario)	61.6% (declining to 57.2%)	85%	32.5 hours	95%
Inland railway (1,690 km scenario)	58.6% (declining to 54.6%)	87.5%	27 hours	95%

Note: Price varies by commodity. This relativity includes pick up and delivery costs for rail freight and is the relative price estimated for non-bulk goods in 2020. Relative rail price in 2008 is approximately 72% of road, and this declines by 2020 because of increased fuel and labour costs which affect road more strongly than rail.
Note: SKM survey indicates there are different front haul and back haul prices, with rail backhaul are approx. half front haul (55%). However, for road backhaul prices are also about half (49%), reducing road/rail backhaul price relativities.

The price and service attributes are discussed further below.

Price

Although there have been modifications to most of the demand forecast numbers in Stage 2, the follow up and additional surveys conducted for this stage generally confirm the findings of Stage 1. The importance of relative price remains high. Although road freight rates have risen more than other modes because of fuel and labour costs, rail operators have been adjusting pricing structures and rail mode shares have declined; rail's market share also reflects a lagged response to past service levels. Recent falls in the price of diesel and recent spare capacity in freight modes have put downward pressure on prices. Coastal shipping (by international ships) has established a regular service on the east coast which competes for the most price sensitive freight. Some companies have become more conscious of carbon emissions, but still make little use of rail and less of sea because of their tight logistics arrangements. Also excise arrangements relating to the Carbon Pollution Reduction Scheme (CPRS) currently favour road freight over rail freight.

Relative door-to-door rail prices have been sourced from an SKM survey commissioned by the ARTC, starting at 67-79% of the road price depending on the commodity and declining by 2020 to around 60%. Some freight firms said that in practice freight rates are much closer because of the structure of rail tariffs. As a starting point in Working Paper No. 1 it was assumed there is no difference between inland and coastal rail prices (per tonne), for Stage 2 it has been assumed that improved operating characteristics reduce the above rail operating costs by 2% for a 1,880 km scenario and by 18% for a 1,690 km scenario. In Section 3.4.1 looking at the revenue maximising access price, the extent to which the improved service of the inland railway (for a constant road price) could lead to a profitable increase in price (and access revenues) is assessed.

Availability and transit time

The ACIL Tasman survey confirmed that, other than for express-freight customers, delivery between Melbourne and Brisbane, or vice versa, between early evening one day and early morning 2 days later, is satisfactory. The FEC's research suggests that a door-to-door transit time of 35 hours would allow rail to compete for 95% of the availability sensitive market which is assumed to be rail's maximum achievable performance in this area due to infrequency of train departures compared to road. Deducting assumed pickup and delivery time of 5 hours would allow a terminal-to-terminal time of 30 hours to compete for 95% of the market with faster transit times failing to capture any more of the availability sensitive freight. This 30 hour terminal-to-terminal transit time requirement, together with work by the technical consultants is the basis for a minimum service requirement of a 27.5 hour rail terminal-to-terminal journey time, with 2.5 hours of timetable slack built into the schedule to help achieve reliability.

The ARTC aims to achieve much the same time (26½ hours) terminal-to-terminal on the upgraded coastal railway. However discussions with the technical consultants conclude that it will be challenging to achieve a much shorter journey time and much better reliability, and 28 hours terminal-to-terminal has been assumed for the coastal railway in both the base case and the Route Study. With 5 hours for pick-up and delivery, this gives a total transit time of 33 hours, which meets the required transit time of 93% of availability sensitive freight. In the base case this 'availability' preference is mostly satisfied by the coastal railway with a 28 hour terminal-to-terminal time, and little additional availability sensitive freight is contested by the inland railway with its faster terminal-to-terminal transit time of 22 or 27.5 hours.

Very little freight was identified which was transit time sensitive on its own. Most customers would prefer faster transit times to enable availability preferences to be met, or to provide additional slack to improve reliability, such preferences are captured in the parameters for these attributes. The types of commodities which require fast transit are usually perishable in nature, such as agricultural products, and for these goods there was an inherent preference for road freight because of its reduction in double handling as well as its faster transit time.

Reliability

In the past rail reliability has been poor. In 2004 only 45% of trains arrived within 15 minutes of scheduled arrival, but the ARTC aims to achieve 75% when current track upgrading is completed in 2010. On this basis, and after discussion with the technical consultants, 70% reliability has been assumed as achievable for the coastal railway, alongside a reduction in transit time to 28 hours. It has been assumed that an inland railway, being less congested and avoiding Sydney, would achieve 85% considering the 1,880 km scenario, and 87.5% considering the 1,690 km scenario (and reliability of 95% could be achieved if up to 3 hours' slack was built into the timetable). The increased reliability of 87.5% for the lower transit time scenario is linked to a reduction in crossing delays relative to the 1,880 km scenario.

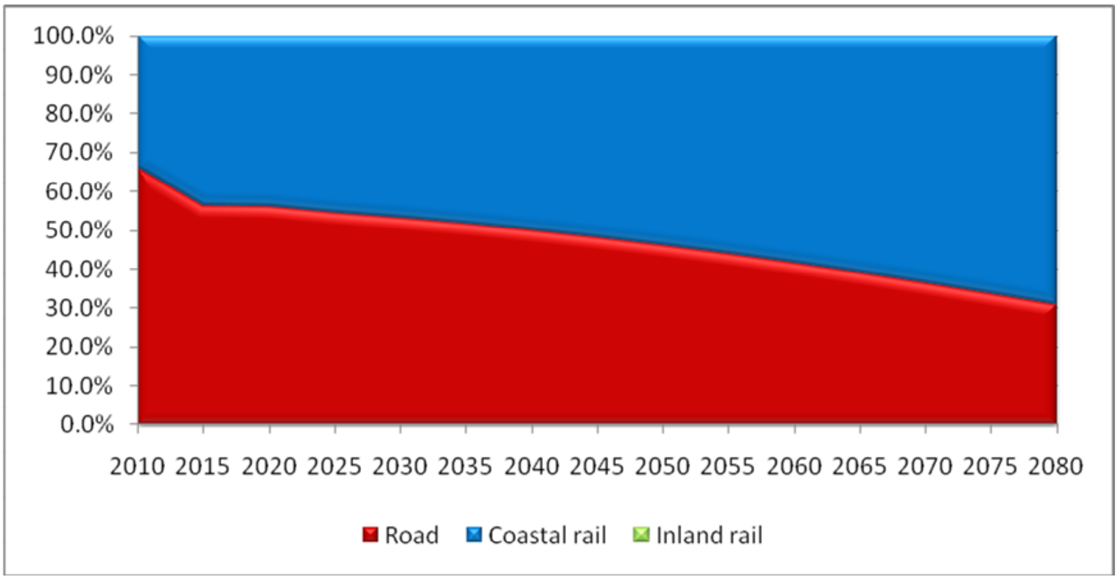
Rail operators and customers say the reliability has already improved although the recent history is not yet reflected in observed market shares because of hysteresis. Trucks are extremely reliable at around 95-98%. The availability of service when required, already excellent with trucks, is assumed to improve for rail freight from 65% to 95% as infrastructure capacity and transit time are improved over the next few years.

3.4 Demand results

Intercapital freight

The present intercapital rail mode share between Melbourne and Brisbane (averaging the two directions) varies between approximately 22-27% for non-bulk, to 60-90% for the various bulk commodities, and is estimated at about 27% overall, by tonnes. The forecast for mode share in the base case scenario (that is, without Inland Rail) predicts steady gains to the coastal railway mostly stemming from movements in the real cost of fuel and labour which increase the relative price differential between road and rail. By 2050 the coastal railway is expected to have 54% of the intermodal market if there is no inland railway. These forecasts are shown in Figure 4.

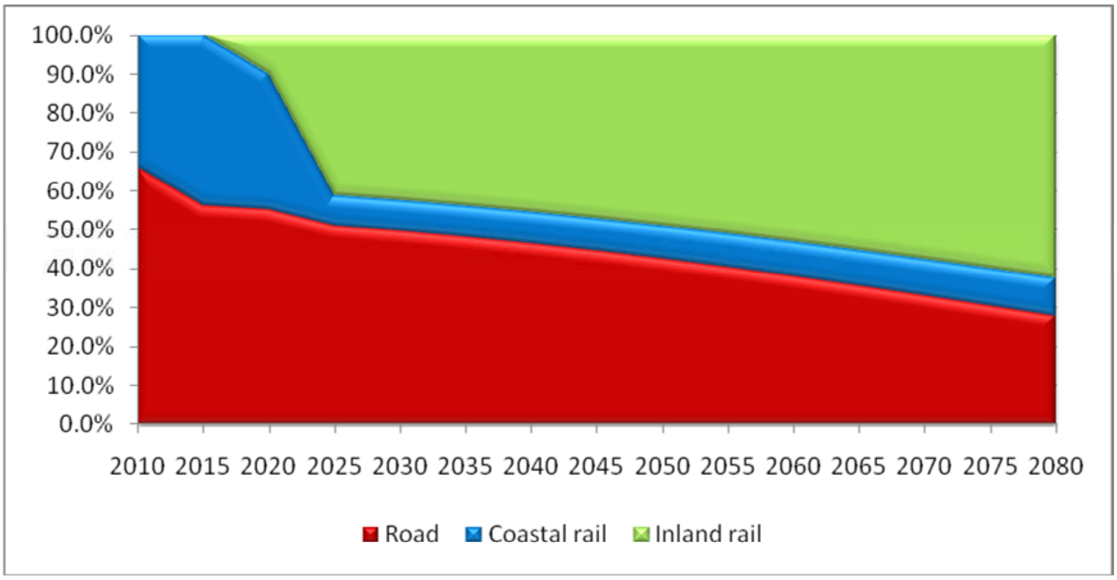
Figure 3 Aggregate market shares using survey elasticities (no inland railway)



As indicated in Figure 4, even without an inland railway, there is a gradual increase in rail market share. This comes about as fuel, labour and other assumptions continue to exert influence, and in particular as fuel and labour costs are forecast to increase in cost over time putting pressure on prices. As road is more fuel and labour intensive relative to rail, and is competitively priced, this is expected to have a greater impact on the cost of road freight, thus impacting on road/rail competitiveness. Track improvements currently under way along the coastal route will also have an impact over the next few years as timetables and behaviour adjust to reflect the better service which will soon be offered on this route.

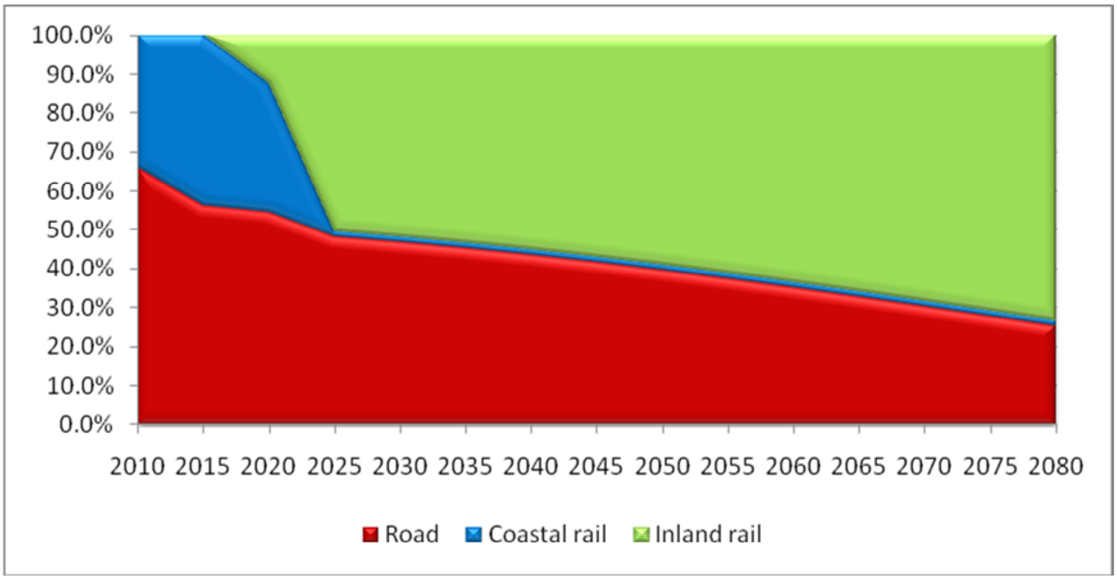
With the 1,880 km scenario, rail's market share is forecast to reach 45% in 2020 once the railway is operating, 49% once it has been operating for five years, and rising slowly to 57% by 2050 then 72% in 2080 as the fuel, labour and other assumptions continue to exert influence. Inland Rail would capture the majority of this freight, with 10% on inception in 2020 rising to 41% in 2025, 49% in 2050 and 62% in 2080. The intercapital market share (for total tonnes) across all commodities for the 1,880 km scenario is shown in Figure 5.

Figure 4 Aggregate market shares using survey elasticities (2020 inland railway commencement, 1,880 km scenario)



Considering the 1,690 km scenario, rail's market share is forecast to reach 46% in 2020 once the railway is operating, 52% once it has been operating for five years, and rising slowly to 60% by 2050 then 75% in 2080. Inland Rail would capture the majority of this freight, and slightly more than the 1,880 km scenario, with 12% on inception in 2020 rising to 50% in 2025, 59% in 2050, and then 73% in 2080. The intercapital market share (for total tonnes) across all commodities under the 1,690 km scenario assumptions is shown in Figure 6.

Figure 5 Aggregate market shares using survey elasticities (2020 inland railway commencement, 1,690 km scenario)



The inland and the coastal rail routes are close substitutes for each other, so gains in market share for one route come predominantly from the other rail route. This is shown in the figure above. Because Inland Rail offers better operating costs, transit time and reliability than the coastal railway, there is a very large shift of freight away from the coastal railway for Melbourne-Brisbane freight. However, as most freight on the coastal route is not Melbourne-Brisbane freight (but includes freight such as Sydney-NSW central coast, Sydney-Brisbane, Melbourne-Sydney, coal, etc.), the inland railway is not simply a substitute for the coastal route and the majority of current freight is expected to remain on this existing railway.

Rail operational policy will be important to the viability of Inland Rail. Rail operators expressed a desire to bypass Sydney and given the option, would always ship goods via the inland railway provided that the cost was not prohibitive. Some Melbourne-Brisbane freight might continue to go via Sydney (and perhaps Adelaide-Sydney-Brisbane freight also) to generate better utilised trains, in particular as there is a likelihood operators will load balance and fill both coastal and inland trains before increasing frequency. However Inland Rail would capture most of the Melbourne-Brisbane freight from the coastal railway from an early stage of operations, because of its superior reliability and reduced operating costs. The journey times are markedly different for the 1,690 km scenario, but not for the 1,880 km scenario, and the better reliability and lower operating costs on Inland Rail mean that operators would use it.

Induced freight

By creating the inland railway, some freight is induced because the lack of transport is stopping a commercial activity from being undertaken. Typically heavy commodities, or products in remote locations, would suffer from such a constraint.

Coal freight is one commodity which may be induced from the creation of a railway which links a mine to a market. The creation of an inland railway would allow exports from some mines or potential mines that at present do not have an economically viable means of getting coal to port.

ACIL Tasman has investigated the potential coal resources in proximity to the proposed inland railway routes including the potential for coal freight to be induced by establishing an inland railway. From discussions with industry participants and state minerals departments, ACIL Tasman estimates that an inland railway would stimulate extra coal tonnages from the East Surat basin near Toowoomba to the Port of Brisbane above the present 5.5.mt per annum. However, as train paths around the Brisbane metropolitan area are constrained, we have assumed the number of coal train paths per day remains constant but, that over the next decade, it becomes possible to utilise a higher productivity train consist through upgrades to passing loops and junctions. East Surat–Brisbane coal freight is an attractive source of access revenue as it pays a higher access charges and hence provides an improvement to the viability of Inland Rail.

Freight diverted from road or existing rail

Much of the freight that would use Inland Rail would be diverted from road or some other existing rail route – for example much of the intercapital freight using Inland Rail would have been diverted from the coastal railway. One commodity in particular that could see significant diversion of tonnages onto the inland railway is grain. An inland railway would reduce transit time and costs involved in moving grain, leading to greater movement to address seasonal imbalances for different grain types within the corridor, and the diversion of exports from Newcastle to Brisbane and Port Kembla. Discussions with key industry participants suggest that 0.5-1 mt of grain could be diverted onto part of the route by 2010. Appendix C contains further detail on diverted grain freight.

ACIL estimates that coal from the Gunnedah basin (rising to 75 mt pa) would use part of the 1,880 km Inland Rail option on its way to Newcastle, but the 1,690 km option bypasses this section of track and foregoes this. This is a significant source of freight expected to be carried by existing railways even if there is no Inland Rail. Appendix C details further results.

Further traffic on an inland railway expected to divert from existing rail would come from or to points outside the corridor, e.g. Brisbane-Perth, Brisbane-Adelaide, north Queensland-Melbourne (totalling 1.1 mt in 2020).

The resulting tonnages of diverted freight are added to those that were obtained from the intercapital logit analysis. With both coal and grain, the door-to-door cost estimates reflect the fact that only parts of the inland railway are used.

Total inland railway tonnages

Total inland railway tonnages in the route analysis would be 51.9 mt in 2020 and 101.8 mt in 2040, although the freight excluding coal and grain is 2.0mt in 2020 and 8.2mt in 2040. Coal and grain would travel on only part of the route, but coal in particular pays higher access charges than grain or non-bulk. The map below gives an indication of the freight that would flow along the inland rail corridor (note that Melbourne-Sydney freight that would travel between Melbourne and Cootamundra has been excluded because this is irrelevant to the business case for Inland Rail).

Figure 6 Freight flows along the corridor

Note: some freight is excluded in the map above, e.g. Melbourne-Sydney as far as Cootamundra. Griffith to Parkes between Narrandera and Cootamundra are excluded, but Gunnedah basin coal is included north of Werris Creek.

Summary tonnage on the inland railway (1,880 km scenario)

The Inland Rail scenario with a route length of 1,880 km generates reliability of 85% and above the rail cost savings of 2% compared to the coastal route (50% of which are assumed to be passed on to consumers in the form of lower prices).

The amount of tonnes expected to be carried by the inland railway under this scenario are shown below:

Table 7 Forecast tonnes and net tonne kilometres carried on the 1,880 km scenario (assuming commencement in 2020)

'000 tonnes	2020	2030	2040	2050	2060	2070	2080
Intercapital	721	4,095	5,868	8,429	12,113	17,374	24,802
Induced	10,000	10,250	9,500	9,500	9,500	9,500	9,500
Diverted from Road	1,720	2,369	2,701	3,115	3,629	4,268	5,063
Diverted from Rail (e.g. Branch line, not coastal)	38,142	81,226	81,354	81,513	81,711	81,957	82,263
Outside	1,066	1,630	2,184	2,943	3,984	5,415	7,439
Regional	228	284	353	439	546	678	843
Total	**51,878**	**99,854**	**101,960**	**105,939**	**111,483**	**119,192**	**129,910**
Million ntk	2020	2030	2040	2050	2060	2070	2080
Intercapital	1,356	7,702	11,037	15,854	22,784	32,680	46,653
Induced freight (mostly coal)	1,220	1,242	1,178	1,178	1,178	1,178	1,178
Diverted from Road	328	750	895	1,077	1,302	1,582	1,930
Diverted from Rail	5,752	12,029	12,132	12,259	12,417	12,614	12,858
Outside	1,365	2,242	3,039	4,143	5,672	7,793	10,845
Regional	158	196	244	303	377	468	582
Total	**10,179**	**24,161**	**28,525**	**34,814**	**43,730**	**56,316**	**74,047**

On the assumption of a fully loaded reference train with a capacity of 2,920 tonnes (container weight and payload), the number of trains per day is determined by the amount of traffic in the most heavily utilised direction (Northbound). On this basis the number of trains per day is estimated in Table 12.

Table 8 Number of northbound trains per day on the 1,880 km scenario (assuming commencement in 2020)

Number of trains per day	2020	2030	2040	2050	2060	2070	2080
Intercapital (M-B full length)	0.8	4.3	6.1	8.8	12.6	18.2	25.9
Induced freight (mostly coal)	19.8	37.4	37.2	37.5	37.8	38.1	38.5
Extra-corridor (M-B full length)	0.2	0.3	0.4	0.6	0.9	1.2	1.8
Extra-corridor (Parkes-B length)	0.5	0.7	0.9	1.2	1.5	2.0	2.6
Regional (various lengths)	0.2	0.2	0.3	0.3	0.4	0.5	0.6
Total	**21.5**	**42.8**	**44.9**	**48.4**	**53.2**	**60.0**	**69.5**

Note: Induced and diverted freight is based on a coal train carrying 7,178 tonnes payload. Also, the operating year is assumed to be 350 days long.

Summary tonnage on the inland railway (1,690 km scenario)

An alternative scenario was modelled with fewer kilometres (1,690 km) and a faster transit time terminal-to-terminal. This option would also generate additional reliability relative to the 1,880 km scenario because of a reduction in crossing delays and this has been modelled as 87.5% reliability (compared to 85% for the 1,880 km option).

In addition to the improved transit time and reliability, the faster transit time is expected to allow improved cycle times and other operating efficiencies. Considering this, the LTC and FEC have estimated an approximate reduction in train operating costs on a per tonne basis of 18% relative to Coastal Rail. Assuming that 50% of these costs are passed through to final consumers, and in line with ACIL Tasman's assumption that 83% of door-to-door transport prices are determined by above rail operations would mean a 7.47% reduction in freight rates as a result of the 1,690 km scenario. The resulting demand estimates for this scenario are shown below:

Table 9 Forecast tonnes and net tonne kilometres carried on the 1,690 km scenario (assuming commencement in 2020)

'000 tonnes	2020	2030	2040	2050	2060	2070	2080
Intercapital	888	5,054	7,206	10,299	14,725	21,003	29,807
Induced	10,000	10,250	9,500	9,500	9,500	9,500	9,500
Diverted from road	1,720	2,369	2,701	3,115	3,629	4,268	5,063
Diverted from Rail (e.g. Branch line, not coastal)	5,542	6,026	6,154	6,313	6,511	6,757	7,063
Outside	1,076	1,689	2,270	3,068	4,167	5,680	7,803
Regional	228	284	353	439	546	678	843
Total	19,455	25,671	28,184	32,735	39,077	47,887	60,078
Million ntk	2020	2030	2040	2050	2060	2070	2080
Intercapital	1,506	8,571	12,221	17,468	24,973	35,621	50,552
Induced freight (mostly coal)	1,220	1,242	1,178	1,178	1,178	1,178	1,178
Diverted from Road	328	750	895	1,077	1,302	1,582	1,930
Diverted from Rail	1,244	1,631	1,733	1,861	2,019	2,216	2,460
Outside	1,280	2,162	2,939	4,016	5,513	7,595	10,551
Regional	158	196	244	303	377	468	582
Total	**5,735**	**14,551**	**19,210**	**25,903**	**35,362**	**48,659**	**67,253**

The number of trains per day is estimated to be:

Table 10 Number of northbound trains per day on the 1,690 km scenario (assuming commencement in 2020)

Number of trains per day	2020	2030	2040	2050	2060	2070	2080
Intercapital (M-B full length)	0.9	5.3	7.6	10.8	15.5	22.0	31.3
Induced freight (mostly coal)	6.9	7.4	7.3	7.5	7.8	8.2	8.6
Extra-corridor (M-B full length)	0.2	0.3	0.5	0.7	1.0	1.4	1.9
Extra-corridor (Parkes-B length)	0.5	0.7	0.9	1.2	1.5	2.0	2.6
Regional (various lengths)	0.2	0.2	0.3	0.3	0.4	0.5	0.6
Total	**8.7**	**14.0**	**16.5**	**20.5**	**26.2**	**34.1**	**45.1**

Note: Induced and diverted freight is based on a coal train carrying 7,178 tonnes payload. Also, the operating year is assumed to be 350 days long.

The table below presents intercapital freight forecasts under the three scenarios: the Base Case, the 1,880 km scenario and the 1,690 km scenario.

Table 11 Melbourne-Brisbane (and backhaul) forecast tonnes (intercapital freight, Base Case and inland railway scenarios, assuming Inland Rail commencement in 2020)

		Thousand tonnes / million ntk							
Scenario	Year	2015	2020	2030	2040	2050	2060	2070	2080
Base case (no Inland Rail)	Grand Total (000 tonnes)	**6,135**	**7,133**	**9,612**	**12,860**	**17,120**	**22,692**	**29,975**	**39,493**
	Inland	-	-	-	-	-	-	-	-
	Coastal	2,684	3,136	4,506	6,435	9,231	13,269	19,067	27,309
	Road	3,450	3,997	5,106	6,425	7,889	9,423	10,908	12,184
	Grand Total (million ntk)	**10,804**	**12,565**	**17,004**	**22,854**	**30,592**	**40,812**	**54,302**	**72,100**
	Inland	-	-	-	-	-	-	-	-
	Coastal	5,111	5,971	8,579	12,253	17,575	25,264	36,304	51,996
	Road	5,693	6,594	8,425	10,601	13,017	15,548	17,999	20,104
1,880 km scenario	Grand Total (000 tonnes)	**6,135**	**7,141**	**9,666**	**12,945**	**17,250**	**22,888**	**30,263**	**39,901**
	Inland	-	721	4,095	5,868	8,429	12,113	17,374	24,802
	Coastal	2,684	2,478	764	1,054	1,463	2,036	2,838	3,946
	Road	3,450	3,942	4,807	6,023	7,358	8,738	10,052	11,152
	Grand Total (million ntk)	**10,804**	**12,579**	**17,090**	**22,982**	**30,780**	**41,080**	**54,668**	**72,568**
	Inland	-	1,356	7,702	11,037	15,854	22,784	32,680	46,653
	Coastal	5,111	4,718	1,455	2,007	2,785	3,877	5,403	7,513
	Road	5,693	6,505	7,932	9,938	12,141	14,418	16,585	18,401
1,690 km scenario	Grand Total (000 tonnes)	**6,135**	**7,157**	**9,762**	**13,092**	**17,476**	**23,233**	**30,782**	**40,668**
	Inland	-	888	5,054	7,206	10,299	14,725	21,003	29,807
	Coastal	2,684	2,367	130	175	235	315	417	549
	Road	3,450	3,902	4,578	5,711	6,941	8,193	9,362	10,313
	Grand Total (million ntk)	**10,804**	**12,452**	**16,373**	**21,978**	**29,368**	**39,091**	**51,863**	**68,613**
	Inland	-	1,506	8,571	12,221	17,468	24,973	35,621	50,552
	Coastal	5,111	4,507	248	334	448	599	795	1,045
	Road	5,693	6,438	7,554	9,423	11,452	13,519	15,447	17,016

Source: ACIL Tasman modal share model
Note: there are intercapital tonnage variations between scenarios as the existence of the inland railway puts a greater percentage of freight onto rail in total (coastal + inland). Because rail is cheaper than road this means that the weighted average price of freight has decreased. This has a small effect on the demand for freight, subsequently 'price inducing' additional freight. This effect is minor (e.g. 0.3 million tonnes in 2080, which is negligible in percentage terms).

3.4.1 Results – revenue maximising access price

ACIL Tasman undertook an analysis to determine the revenue maximising access price for the track operator to attempt to improve viability.

In the core appraisal, it has been assumed that Inland Rail access prices are similar to those charged on the coastal railway. However there may be some scope to increase Inland Rail prices as up to a point, higher prices can be charged because Inland Rail offers reliability and transit times that are superior to the coastal railway. Above that maximising point, however, the revenue gains from the higher price are more than offset by loss of tonnage demand to the cheaper coastal railway, or to road.

Determining the access price that delivers the greatest revenue (allowing for demand responses) involves running multiple demand scenarios through the logit model to show consumers' response to changes in the retail price of freight. This analysis has been carried out for Melbourne to Brisbane (and vice versa) *intercapital non-bulk freight* carried on the reference train. Other commodities were not considered because of the complexity of the analysis and the number of specific factors relevant to commodities such as coal and grain.

It is difficult to specify the extent to which increases in access prices paid by train operators would be passed on to freight customers. If prices are set competitively then price would reflect marginal cost and when the marginal (access) costs to both operators increase then we could expect this to be fully passed on to customers. However with a more complex market we might expect a less than full pass through of costs – particularly if access charges were to decrease – since operators may take the opportunity to increase their profit margins. To cover this range of possible behaviours, ACIL Tasman has modelled three cost scenarios – 100% pass through, 75% pass through and 50% pass through, this is a much wider range covering much lower levels of pass through than those considered in Working Paper No. 1.

The analysis also assumes that the prices of road and coastal rail alternatives do not adjust in response to changes in the price of Inland Rail.

Based on this approach and the assumptions above (which are detailed further in Appendix C), key findings of this analysis are:

- *intercapital non-bulk access revenue in the core appraisal is $43.1 million per annum* – ACIL Tasman estimates the intercapital Melbourne-Brisbane non-bulk access revenue to be approximately $43 million per annum under in the core appraisal presented throughout this paper (including per gross tonne kilometre and per kilometre access charges).[13] Similarly, the assumed average access charge for a reference train running at 78% of capacity is calculated as $2.98 per thousand gross tonne kilometres on the coastal railway (in 2008 dollars, includes access charges and flagfall). This is based on elasticities derived during ACIL Tasman's survey of key freight companies and customers, indicating price elasticities varying from -1.37 to -0.25 dependent on the freight type (see Table C.2 in Appendix C for further detail on elasticity assumptions);
- *improved Inland Rail services are expected to compensate for a higher access price* – if Inland Rail prices are at parity with the coastal railway and there is some pass through of access cost increases from train operators to freight customers, then the revenue maximising access price for Inland Rail is:

[13] In the demand forecast and financial analysis, it has been assumed that Inland Rail access charges are the same as current coastal railway access charges, and for simplicity ARTC prices have been applied to the full Melbourne-Brisbane journey. But it is noted that QR and RailCorp access prices currently apply for parts of this route.

    - a 13% premium over current coastal access charges if there is 100% pass through of cost increases to freight customers;
    - a 26% premium if the cost pass through is 75%; and
    - a 56% increase in access prices if the cost pass through is 50%.
- *annual non-bulk, intercapital revenue per annum at the revenue maximising access price is estimated as:*
    - $44.2 million per annum at 100% pass through – at a 100% pass through, this reflects a 2.6% increase above the current annual revenues of $43.1 million;
    - $46.3 million per annum at 75% pass through; and
    - $51.9 million per annum at 50% pass through.
- *the revenue maximising access price is greatly impacted by elasticity assumptions* – undertaking this analysis using higher elasticities results in higher access revenue to the track operator because the service characteristics are valued much more highly (see Appendix C for further detail).
- *the revenue maximising access price would increase under the 1,690 km scenario* – undertaking this analysis with better service characteristics for Inland Rail would increase the revenue achieved at all access prices because of greater volumes. Complementing this is the assumption of only 50% pass through of changes to costs, and the decrease in train operating costs would partly offset any increases in access price.

In the financial appraisal presented later in this paper, the intercapital freight access charges used are in line with that assumed in the core demand (i.e. charges are assumed to be the same as current coastal railway access charges).

4. Cost estimates, transit time and other key assumptions

4.1 Introduction

During Stage 1, performance assumptions were developed for Inland Rail, and cost and journey time estimates were produced for the Low Capital Cost scenario. These and other key assumptions have formed the basis of the inland routes now analysed in Stage 2. The following section reproduces the assumptions and estimates that were first estimated in Stage 1, in order to provide clarity about the assumptions incorporated in the financial and economic appraisals.

This chapter also incorporates a discussion of the Base Case and Inland Rail scenario as it pertains to not only the demand analysis but also the financial and economic analysis presented in this paper.

4.2 Performance assumptions

From consultation with the Study Steering Committee and ARTC, a range of performance specifications were developed in Stage 1 for Inland Rail that impact on cost and revenue items to operate the railway.

Given the existence of the coastal route between Melbourne and Brisbane via Sydney, it was concluded that to be viable an Inland Rail corridor must, as a baseline, provide a superior service to Melbourne–Brisbane freight than that offered by the coastal route.

The parameters that define ‘a superior service’ will be further developed throughout the study, but at this stage include:

- journey time below the threshold demanded by customers, and not at any disadvantage when compared to the coastal route;
- equivalent or better reliability of journey time than that provided by the coastal route;
- equivalent or lower operational costs (fuel and crew) than the coastal route; and
- equivalent or lower access charges when compared to the coastal route.

Individual performance specifications are presented in the table below.

Table 12 Inland railway performance specifications

Attribute	Performance
Requirements	
Maximum freight train transit time (terminal-terminal including crossing loop delays)	Target driven by a range of customer preferences between 23 and 28 hours
Gauge	Standard (1,435 mm) (with potential for dual gauge in some sections e.g. Queensland).
Desirable max freight operating speed	115 km/h (@ 21 tonnes axle load (tal) (passenger trains, if any, could be 130-160 km/h)
Maximum axle loads	21 tonnes at 115 km/h (for containers) (sensitivity tests at 23 and 25tal) (higher axle load would be permitted at lower speeds e.g. 80 km/h coal trains)
Reliability	Not less than coastal route
Maintainability	To provide marginal access charges equivalent or lower than coastal route
Operating costs	End-to-end, lower than coastal route
Minimum vertical clearance above top of rail (to allow for double stacking)	7.1 m for new structures, any amendment to existing structures to be dependent on economic benefit
Assumed maximum train length	1,800 m
Factors to be optimised	
Inland rail route distance (Melbourne-Brisbane)	To be optimised in the course of the study; within the range of 1,650-1,950 km
Maximum target & allowable gradient and desirable ruling grade	To be optimised in the course of the study
Minimum horizontal geometry (curvative) radius for 115 km/h	To be optimised in the course of the study
Minimum horizontal geometry radius for 100 km/h	To be optimised in the course of the study
Crossing loops	To be optimised in the course of the study
Corridor width	To be optimised in the course of the study

Source: LTC and Study Steering Committee, Stage 1

4.3 Journey time

The Melbourne-Brisbane journey times below were developed by the LTC as key inputs into the demand analysis, and into the economic and financial appraisals. As Table 17 indicates, the 1,880 km scenario has a transit time comparable with the coastal rail, and the 1,690 km scenario is more competitive with road.

Table 13 Melbourne-Brisbane journey time

Mode & rail line	transit time (hours)	
Coastal railway	28 (terminal-to-terminal)	33 (door-to-door)
1,880 km Inland railway scenario	27.5 (terminal-to-terminal)	32.5 (door-to-door)
1,690 km Inland railway scenario	22 (terminal-to-terminal)	27 (door-to-door)
Road		23.5 (door-to-door)

Source: LTC, WP5: Appendix E & ACIL Tasman
Note: door-to-door time comprises pick up and delivery time of 5 hours for rail (2.5 hours at each end). 'Terminal-to-terminal' is not a relevant measure for road, as some road will drop at a terminal and some will go straight to a customer. Where further transit is required from a terminal, ACIL Tasman suggests that approximately 3 hours pick up and delivery (at each end) could potentially be added. This may be considered further in the demand and economic appraisal as the current approach is likely to be conservative.
Note: 26.5 hours is being targeted for the coastal railway, but this study assumes a more conservative 28 hours

4.4 Capital costs

In Stage 1, the LTC used benchmarked data as the basis to develop capital cost estimates for Inland Rail. The financial and economic appraisals presented in this paper continue assuming the Stage 1 capital estimates as a revised capital cost figure was not developed for the whole railway in Stage 2. Further analysis of the capital expenditure required for Inland Rail will be undertaken in Stage 3, when the set of upgrades and deviations shortlisted by the LTC in Stage 2 will be incorporated into a fully developed operational model for the route that can be costed.

The capital costs for Inland Rail as incorporated in Stage 2 analysis are presented in the table below. Further information on capital costs assumed for the coastal route in the base case is discussed later in this chapter.

Table 14 Indicative Inland railway capital costs ($ millions, undiscounted, 2008 dollars)

Appraisal	1,880 km scenario $ millions	1,690 km scenario $ millions
Indicative Capital cost	$2,815	$3,750

Source: LTC, WP5: Appendix E and LTC estimates for a 1,690 km scenario
Note: economic capital costs that are 'incremental' to the base case will capture savings relating to deferred ARTC coastal route capital costs; the above financial costs incorporate an 8% profit margin that was removed for the economic appraisal.

The basis for the capital costs for each inland railway scenario is:

- *1,880 km scenario* – based on Stage 1 estimates for the Low Capital Cost scenario; and
- *1,690 km scenario* – in Stage 1, the LTC estimated a cost of $3,620 million for the High Capital Cost scenario, which was expected to achieve a transit time of 23.75 hours. Having done some more work on journey times in Stage 2, the LTC has estimated that with some double tracking and optimising of loops this scenario could achieve 22 hours, at an estimated capital cost of $3,750 million at this stage.

Table 19 presents the asset types that are assumed to comprise the capital costs discussed above.

Table 15 Asset allocation of inland railway capital costs (excluding contingency)

Asset type	Allocation
Land acquisition costs	5%
Planning & approvals costs	4%
Earthworks	35%
Trackwork	35%
Bridges	3%
Culverts	3%
Viaducts	3%
Tunnels	10%
Approach Roadworks	1%
Fencing	1%
Total	**100%**

Source: LTC Stage 1 estimates

The capital costs, and also subsequent maintenance costs are based on the proportions of existing track, track that will require upgrade, and new track presented in Table 20. As indicated in the table below the 1,690 km scenario has a greater proportion of new track and lower proportion of track requiring upgrading compared to the 1,880 km scenario.

Table 16 Asset allocation of inland railway capital costs (excluding contingency)

Asset type	1,880 km scenario	1,690 km scenario
Existing Track	54%	51%
Upgrade	30%	12%
New Track	16%	37%
Total	**100%**	**100%**

Source: LTC Stage 1 estimates

4.5 Operating and maintenance costs

In Working Paper No. 4, the LTC presented preliminary operating and maintenance costs for Inland Rail. These will be updated during Stage 3; hence the costs described below are based on Stage 1 analysis.

4.5.1 Above rail costs

Above rail operating costs consist mainly of rollingstock maintenance, crewing, fuel and access charges.

Rollingstock maintenance and crewing costs are derived from information about existing practice.

Fuel costs are highly dependent on the alignment of each section, and vary according to terrain. Fuel costs are also highly dependent on the price of oil, which is expected to be volatile and may not follow previous trends. Fuel consumption was estimated by the LTC for each section in litres and the FEC has incorporated a fuel price assumption based on Austroads' published resource prices for diesel (excluding GST and excise).[14]

Above rail operating costs relating to train operation on the inland railway are presented in the table below. These costs are based on LTC analysis of the 27.5hour scenario in Stage 1.

[14] Austroads 2008, *Guide to Project Evaluation, Part 4: Project Evaluation Data*, Table 2.4, p 6

Table 17 Train operating costs (2008 dollars)

Cost item	1,880 km scenario	1,690 km scenario	Coastal railway	Unit and basis assumptions
Fuel consumption	16.4 litres per km	13.1 litres per km	16.7 litres per km	*1,880 km scenario* – based on Tables 4.1-4.4 in WP4 and track sections of the inland scenario as presented in WP5. Applying Austroads' Sydney resource price for diesel produces a fuel cost of $13.60 per km. This is relatively conservative as it incorporates lumpiness of shifts. *1,690 km scenario* – based on savings in comparison to the 1,880 km scenario 16.4 L assumption, related to shorter time. As a result, consumption was reduced by the factor 22/27.5 *Coastal* – based on savings in comparison to the 1,880 km scenario 16.7 L assumption. In line with higher transit time, consumption was increased by the factor 28/27.5
Train crew costs	$6,090 per single trip between Melbourne & Brisbane	$4,872 per single trip between Melbourne & Brisbane	$6,201 per single trip between Melbourne & Brisbane	*1,880 km scenario* – assumes two people per crew, and that three sets of crew are required per single trip. *1,690 km scenario* – based on time savings in comparison to the 1,880 km scenario $6,090 per trip estimate, reduced by a factor of 22/27.5 *Coastal* – based on higher transit time in comparison to the 1,880 km scenario, increased by a factor of 28/27.5
Rollingstock maintenance - locomotive costs	$1.50 per km	$1.20 per km	$1.53 per km	*1,880 km scenario* – based on the life of a 3,400 kW AC locomotive in service on Interstate Intermodal traffic, covering 250,000 Km per year. There are three such locomotives on each reference train. *1,690 km scenario* – considering transit time savings in comparison to the 1,880 km scenario estimate of $1.50 per km, reduced by a factor of 22/27.5 *Coastal* – considering transit time in comparison to the 1,880 km scenario estimate, increased by a factor of 28/27.5
Rollingstock maintenance - container wagon costs	$0.05 per km	$0.04 per km	$0.05 per km	*1,880 km scenario* – for the life of a typical container carrying bogie wagon in service on Interstate Intermodal traffic, covering 125,000 Km per year. There are 73 such wagons on each reference train *1,690 km scenario* – based on savings in comparison to the 1,880 km scenario estimate of $0.05 per km, reduced by a factor of 27/32.5 *Coastal* – based on savings in comparison to the 1,880 km scenario estimate, increased by a factor of 33/32.5

Source: LTC in WP4, pp 15 & 16
Note: total train operating costs per ntk as used in the economic appraisal is presented in Appendix D.
Note: average load assumed in these costs is 1,886 tonnes per train based on the LTC reference train established in Stage 1. Because coastal railway rollingstock is single stacked (compared to double stacked on the inland railway), it is estimated to have longer trains/ more wagons than the inland railway and will also achieve higher utilisation, resulting in a similar total tonnes per train despite these two operational differences.

The train operating costs above are real and have been assumed to incorporate a profit margin of 10%. In the economic appraisal the profit margin was removed from financial costs.

A further assumption relating to the train operating costs above is that the demand analysis conducted by ACIL Tasman assumes that of the approximate 10% cost reduction in the train operating costs between the 1,880 and 1,690 km scenarios, 50% of this will be passed through from train operators to freight customers.[15] This has been assumed as in addition to improved transit time and reliability, the faster transit time is expected to allow a reduced cycle time for locomotives and wagons, considering that a 24 hour threshold is generally

[15] Given a 10% above the rail (ATR) cost reduction, and access charges are 23% of costs/price then the pass through is accommodated by a (77%*10%*50%) adjustment to freight transport price. This has been incorporated into the 1,690 km Inland Rail scenario demand.

significant in maximising locomotive and wagon cycle efficiency. (This will be explored further in Stage 3 as the LTC undertakes further analysis of both operating costs and the achievability a 22 hour transit time for all rail paths). This has a slightly positive impact on demand, as the 1,690 km scenario increases its price competitiveness with the coastal railway and road freight.

4.5.2 Below rail costs

Below rail costs consist mainly of track maintenance. There are also some infrastructure operating costs. The costs were derived by the LTC from information about existing practices. On existing alignments track maintenance cost will vary with the chosen treatment of the existing track structure, and as the assets age. Where new track is provided, costs vary as the assets age.

(i) Below rail maintenance costs

The estimates of preliminary maintenance costs for various track categories are presented in the following table.

Table 18 Inland railway below rail maintenance costs (2006 dollars)

Track category	Preliminary Maintenance cost estimate($/km)	Adjustment for greater than average of 0.3 structures per km	Adjustment for difficult operational terrain track (Steep grades and tight curves)
Existing track	$22,507	$22,681	$24,484
Upgraded track – Class 1 or equivalent	$11,063	$11,237	$12,626
Upgraded track – Class 2 or equivalent	$15,867	$15,995	$17,431
New track (during 0 – 8 years of service)	$5,375	$5,462	$5,776
New track (during year 8 to 15 of service)	$7,074	$7,161	$7,855
New track (during years 15 plus of service)	$11,325	$11,413	$12,466

Source: LTC in WP4, p 29
Note: for inclusion in the financial and economic appraisal these costs were inflated to 2008 dollars

Considering the costs in the table above, maintenance costs for newly constructed alignments (which capture maintenance costs for new construction in its initial period of use) include:

- track inspection;
- inspection of bridges and structures;
- post construction intervention to correct defects;
- routine and reactive maintenance and major periodic maintenance (MPM); and
- reactive maintenance undertaken on the new railway to rectify faults.

In addition, maintenance costs for upgraded/existing alignments in the table above include:

- inspection of track, bridges and structures;
- routine and reactive maintenance and MPM; and
- reactive maintenance to rectify faults.

The rail maintenance costs above do not incorporate a profit margin. A profit margin of 10% has been incorporated for financial appraisal costs. These costs have been inflated to 2008 dollars for incorporation in the financial and economic appraisals. These cost parameters are not assumed to vary between the 1,880 and 1,690 km scenarios as they are per kilometre estimates that allow variation in total annual costs for a shorter route length.

(ii) Below rail operating costs

These costs include infrastructure operators' costs (on a standalone basis) that are incurred while planning, controlling and managing trains (but exclude track maintenance activities). These costs cover such activities as train planning, train control, incident response, administration and safety inspections.

Table 19 Inland railway below rail operating costs (2008 dollars)

Track category	Below rail operating costs (per annum)
Operations planning	$425,000
Train control	$1,250,000
Transit management and administration	$5,700,000
Total	**$7,375,000**

Source: LTC in WP4, pp 30-31

The below rail operating costs above seek to be reasonable estimates for the economic appraisal, and it is assumed they do not incorporate any profit margin. A profit margin of 10% has been incorporated for financial appraisal costs. These costs are not assumed to vary between the 1,880 and 1,690 km scenarios for the Stage 2 analysis.

It is also noted that if Inland Rail were to be operated by ARTC, then a lower incremental operating cost is possible through leveraging existing staff and equipment.

4.6 Access revenue

As the financial appraisal is undertaken on a below rail basis, the analysis incorporates access revenue assumptions that are linked to ACIL Tasman's freight demand projections. The access revenues included in the appraisal are based on an assumption that access charges for Inland Rail are set at broadly the same reference tariff levels that ARTC applies for the existing main south and coastal railway and that QR applies for coal. For simplicity ARTC prices have been applied to the full Melbourne-Brisbane journey (with the exception of QR prices for coal freight), but it is noted that QR and RailCorp access prices currently apply for parts of this route. The ARTC charge levels for superfreighters are set to be road competitive which results in revenues generally being well below the potential ceiling or maximum charge levels for specific corridors.

The table below summarises the Inland Rail access revenue assumptions incorporated into the financial appraisal.

Table 20 Inland Rail access revenue assumptions (2008 dollars)

Revenue item	Inland rail revenue		Unit and basis assumptions
	1,880 km scenario	1,690 km scenario	
General freight			
Access rates (applied to all general freight excluding Melbourne-Junee)	$2,880 per million gtk	$3,194 per million gtk	Based on current coastal rail approximation of $2,845 per million GTK, reduced by factor of (1,904/1,881) and (1,904/1,696) based on an assumption Inland Rail will be competitive with coastal railway per Melbourne-Brisbane trip, regardless of trip kilometres.
Fixed charge per train km ('flagfall') (applied to all general freight excluding Melbourne-Junee)	$0.59 per train kilometre	$0.65 per train kilometre	Based on current coastal rail approximation of $0.58 per train km, reduced by factor of (1,904/1,881) and (1,904/1,696) based on an assumption Inland Rail will be competitive with coastal railway per Melbourne-Brisbane trip, regardless of trip kilometres.
Coal			
Fixed charge per net tonne ('flagfall')	*$1/tonne* – Moree-Narrabri, NSW/Qld border-Narrabri and Werris Creek-Narrabri *$2/tonne* – Toowoomba-Brisbane, southeast Queensland-Brisbane and Toowoomba-Ipswich	*$1/tonne* – Moree-Narrabri, NSW/Qld border-Narrabri *$2/tonne* – Toowoomba-Brisbane, southeast Queensland-Brisbane and Toowoomba-Ipswich	In addition a revenue cap of $40 million per annum is assumed for Narrabri-Werris Creek coal revenue, reflecting an approximation of the impact of regulated maximum prices on revenues generated on this part of the corridor. Coal volumes on other lines are not expected to be significant enough to require a cap. No Werris Creek – Narrabri coal would be carried on the 1,690 km scenario.

Source: based on average of current ARTC North-South access charges, *ARTC 2008 Pricing Schedule*

It is important to note that access revenue and below-rail maintenance costs from Junee to Melbourne accrue to ARTC and therefore are not allocated to Inland Rail under either transit time scenario. This is approximately 30% of realised revenues accrued from Melbourne-Brisbane traffic (superfreighter) on Inland Rail. Similarly, for freight that originates or terminates outside the corridor (e.g. Brisbane to Perth) only access revenue obtained from using Inland Rail is recognised in the analysis.

In addition, some coal access revenue between Werris Creek-Narrabri has been allocated to the 1,880 km Inland Rail project as this scenario uses existing line in the central NSW region with proximity to coal mines likely to freight coal between Werris Creek and Narrabri. It is noted that this coal currently uses existing track and this revenue is likely to be captured with or without Inland Rail proceeding. However, it has been assumed that this coal access revenue is allocated to the project to part-fund capital outlays on other parts of the inland railway, and thereby improves its viability. A further consideration for the Werris Creek-Narrabri line is that there may be a need for an inland railway operator to purchase these lines from the NSW Government. This track is currently not included within the ARTC lease with the NSW Government, but it is covered by a management agreement and ARTC has an option to include it in a lease in the future. As a result, there may be a need to incorporate this line into the lease, which could require payment. Given that part of the track requires an upgrade[16] and the original lease for the NSW interstate and Hunter Valley lines was agreed on for an amount of $1, this same approach has been assumed in Stage 2. An alternative method to consider this line could be to add an amount (e.g. $10 million at start of construction period) as a notional consideration. If a cost estimate for purchase of this section of the railway was incorporated in the financial and economic appraisals, it is expected that the viability of 1,880 km scenario will reduce. This will be considered further in Stage 3.

As the 1,690 km scenario is located further to the west, all Gunnedah Basin coal volumes are assumed to use the existing railway and not an inland railway under this scenario.

Road and rail access prices

The assumptions concerning road and rail access prices used in the appraisal are summarised in Table 26 later in this chapter. The issue of road and rail freight access pricing to achieve cost recovery and competitive neutrality has been a topic of debate and several public enquiries. In Stage 3, the FEC will review this body of previous analysis and assess potential for reform of road and rail access process and how this may impact on financial and economic viability of the Inland Rail.

ACCC regulation of maximum access prices

It has been assumed that the track owner establishes an access undertaking with the ACCC akin to the regulatory framework utilised by ARTC. The table below provides an indicative illustration of how a maximum revenue limit per annum could be set for Inland Rail. The regulatory ceiling test revenue is calculated on a section by section basis, as some sections of the track where coal tonnage is projected have a greater prospect of being at the ceiling than others. Werris Creek-Narrabri is likely to be at the ceiling whereas sections such as Moree-Narrabri and Toowoomba-Ipswich are not expected to generate volumes that warrant a revenue limit.

Table 21 Inland rail indicative maximum regulated revenue limits ($ millions, 2008 dollars)

Assumption	1,880 km scenario	1,690 km scenario
Indicative Depreciated Optimised Replacement Cost (DORC value), 2008 dollars	2,727[17]	2,459
Regulatory WACC (@11.67% post-tax nominal)[18]	318	287
Depreciation (@3.33% straight-line)	91	82
Efficient operating and maintenance Costs (2020 estimate)	43	39
Indicative maximum revenue pa	452	408

These rates are less than what the market would bear, and higher rates would be justified given the cost of establishing the inland railway, and the presence of competition from the coastal railway and from road freight. In addition, revenue per annum for Inland Rail is typically only 10% to 20% of the potential maximum limit. Consequently, there is some scope to apply higher access charges (as explored above in Section 3.4.1). However this is fairly limited as most general freight is open to road competition.

16 Werris Creek-Gunnedah has recently been re-sleepered in concrete, but is likely to need duplication in the future, as planned by the ARTC.

17 Based on: (i) new track (16% of total 1,881 km route distance) at a value of $2.5 million per km assuming no accumulated depreciation; and (ii) upgraded/existing track (84%) at $2.5 million per km, and assuming 50% accumulated depreciated.

18 ACCC 2008, *Final Decision, Australian Rail Track Corporation Access Undertaking – Interstate Rail Network*, July 2008

4.7 Scenarios considered in the demand, economic and financial appraisals

The demand projections, and the economic and financial appraisals presented in this working paper consider the following scenarios:

- *Base Case scenario* – assumes there is no Inland Rail and freight travels by road or existing rail lines; also assumes currently planned upgrades to the existing coastal railway proceed that will achieve a terminal-to-terminal transit time of 28 hours;[19]
- *1,880 km Inland Rail project scenario* – assumes development of Inland Rail based on a target of 27.5 hours transit requiring low-level capital costs, and upgrades to the coastal railway in line with the Base Case; and
- *1,690 km Inland Rail project scenario* – assumes development of Inland Rail based on a target of 22 hours transit requiring high-level capital costs, and upgrades to the coastal railway in line with the Base Case.

As indicated above, the Base Case or 'without project' case assumes that no inland railway project proceeds. Investment in the coastal railway, which forms the Base Case, is also assumed under the Inland Rail scenario. The table below summarises the route distances, capital costs and other assumptions of the Inland Rail scenario compared to the Base Case.

[19] ACIL suggests that the 28 hour transit time may be difficult to achieve as this would require three locomotives, which operators may not otherwise choose for haulage of a 1500m train. As such, this may be a conservative estimate for Inland Rail viability.

Table 22 Summary of assumptions for specific scenarios

Assumption	Mode/route	Base Case (no Inland Rail)	1,880 km scenario	1,690 km scenario
Indicative capital costs (Stage 1 estimates, $2008 millions incl. 20% contingency, undiscounted) [(2)]	Inland railway	n/a	$2,815m	$3,750m
	Other rail in corridor	$2,701m	$2,101m [(1)]	$2,101m [(1)]
	Road in corridor	Assumed as equal under the three scenarios		
Distance (M-B terminal-terminal), km	Inland railway	n/a	1,881	1,696
	Coastal railway	1,904	1,904	1,904
	Road	1,650 (door-to-door)	1,650 (door-to-door)	1,650 (door-to-door)
Transit time (M-B terminal-terminal), hours	Inland railway	n/a	27.5 hrs	22 hrs
	Coastal railway	28 hrs	28 hrs	28 hrs
	Road	n/a	n/a	n/a
Transit time (M-B door-door), hours [(3)]	Inland railway	n/a	32.5 hrs	27 hrs
	Coastal railway	33 hrs	33 hrs	33 hrs
	Road	23.5 hrs	23.5 hrs	23.5 hrs
Reliability (M-B)	Inland railway	n/a	85%	87.5%
	Coastal railway	70% in 2010	70% in 2010	70% in 2010
	Road	98%	98%	98%
Availability (M-B)	Inland railway	n/a	95%	95%
	Coastal railway	93%	93%	93%
	Road	98% (declining to 95%)	98% (declining to 95%)	98% (declining to 95%)
Door to door price (M-B, relative to road)	Inland railway	n/a	61.6% (declining to 57.2%)	58.6% (declining to 54.6%)
	Coastal railway	61.9% (declining to 57.6%)	61.9% (declining to 57.6%)	61.9% (declining to 57.6%)
	Road	100%	100%	100%

Source: LTC Stage 1 cost and time estimates, and ARTC Stage 1 estimates for other rail capital costs
Note: [(1)] source of difference is due to deferral of coastal railway passing lanes (see Table 27 for further detail); [(2)] capital costs include profit margin, which is excluded from costs in the economic appraisal; [(3)] the economic appraisal is undertaken on a 'door-to-door' basis; [(4)] 23.5 hours door-to-door transit time for road is based on assumption that 70% of trips have a transit time of 22 hours, and 30% will consolidate freight via an intermodal terminal (i.e. 22 hours plus 5 hour consolidation time). This results in a weighted average road transit time of 23.5 hours door-to-door. This was confirmed by industry estimates provided to ACIL Tasman. Slower road services might attract a price discount, which are not incorporated in the demand model resulting in optimistic road demand.

The Base Case and Inland Rail scenarios are discussed further below.

4.7.1 Base case

In the Base Case, it is assumed that there is no Inland Rail. Hence in the Base Case, Melbourne-Brisbane freight continues to use existing road and coastal rail infrastructure.

The Base Case also assumes business as usual upgrading of capacity and improving transit times of the existing rail routes from Melbourne-Sydney and Sydney-Brisbane to cover growth in freight demand. The combination of these routes is captured by ARTC, defined as the north-south corridor, and referred to throughout this document as the coastal route.

Further analysis is required to refine the Base Case for the Inland Rail study in Stage 3, as this affects the economic viability of the project. For example, there may be additional coastal railway capital costs that can be avoided if an inland railway is constructed, considering that capacity requirements for Melbourne-Brisbane freight are projected to decrease on the route in the event the Inland Rail is established.

Coastal railway upgrades

Under the Base Case, it is assumed that ARTC's planned upgrades on the coastal railway will take place, including the committed Stage 1 of the proposed Northern Sydney Freight Corridor works ($840 million), in order to accommodate future capacity needs.

ARTC assisted in developing the assumptions for upgrading the north-south rail corridor. Table 27 summarises forecast capital expenditure on the coastal railway and presents assumptions about the amount of corridor expenditure in the Base Case as well as the effect of an inland railway commencing operations in 2020 (the Inland Rail scenario).

Table 23 ARTC proposed capital spend on the north-south corridor assumed in demand and appraisals ($ millions, undiscounted)

Year	Section	Base Case	Inland Rail (2020 commencement)
2010-2015	Brisbane-Sydney, Northern Sydney Freight Corridor Program (Stage 1) *	$840	$840
2011	Brisbane-Sydney 22 loop extensions & 4 new loops	$260	$260
2013	Junee-Melbourne duplication, section Seymour-Tottenham	$300	$300
2015	Junee-Melbourne duplication, section Albury to Junee	$300	$300
2025	Brisbane-Sydney 17 passing lanes of 14 km each	$481	-
2028	Brisbane-Sydney 16 passing lanes of 14 km each	$480	-
2029	SSFL enhancement	$50	-
2039	SSFL enhancement	-	$50
2045	Brisbane-Sydney 17 passing lanes of 14 km each	-	$481
2048	Brisbane-Sydney 16 passing lanes of 14 km each	-	$480
Total (undiscounted, 2008 dollars)		**$2,711**	**$2,711**
Total (PV, discounted, 2008 dollars)		**$1,746**	**$1,505**
Marketable capacity (exc. paths at undesirable times of day)		**30 paths/day**	**30 paths/day**

Source: ARTC 2008, *2008-2024 Interstate and Hunter Valley Rail Infrastructure Strategy* and consultation; and NSW Government 2009, *Budget 2009/10 – Transport*, 16 June 2009, available at: http://www.transport.nsw.gov.au/news/releases/090616-Transport-Budget.pdf

Note: without the Northern Sydney Freight Corridor Program, the base case marketable capacity is estimated at 14 paths/day, and the maximum capacity 64 paths a day; '*' denotes Short North upgrade to the Sydney- Newcastle segment.

Table 27 indicates that expenditure would be required to upgrade the coastal railway and undertake Northern Sydney Freight Corridor works if future capacity needs are to be met. ARTC assumes that these developments will take place regardless of whether the inland railway proceeds.

ARTC planned upgrades on the coastal railway

ARTC considers it may be possible to delay some coastal railway expenditure if Inland Rail commences in 2020, as some passing lanes north of Maitland can be deferred if freight is diverted to Inland Rail. This results in a saving in present value costs of $241 million under the 2020 Inland Rail scenario. For later commencement of operations, it has been assumed that 50% of the expenditure required for the construction of passing lanes would be deferred if Inland Rail commences in 2030 However all of the capital expenditure would be required if Inland Rail commences in 2040. This is because ARTC expects expenditure on the construction of passing lanes on the coastal route to occur between 2025 and 2029. If Inland Rail is delayed until 2030 or 2040, this capacity expansion on the coastal route is still likely to be required. The same expenditure delay is assumed for both the 1,880 and 1,690 km scenarios, which is likely to be conservative for the 1,690 km scenario as this may allow further delay in coastal route expenditure.

It will be considered further in Stage 3, whether there may be additional coastal railway capital costs that can be avoided if an inland railway is constructed, considering that capacity requirements for Melbourne-Brisbane freight are projected to decrease on the route (as presented in Figures 5 and 6). GATR has suggested that, of coastal railway improvement works projected by ARTC in its 2008 submission to Infrastructure Australia, up to $3.3 billion of this could be avoided with the GATR proposed rail, and potentially $1.8 billion with the inland railway presented in this paper.[20] (It should be noted that the $4.8 billion proposed by ARTC in its submission was aiming to achieve higher transit time and reliability than has been assumed in this study for the coastal route. After discussion with the technical consultants, 70% reliability has been assumed as achievable for the coastal railway in this study.)[21] However, the majority of freight on this existing line via Sydney is not Melbourne-Brisbane freight as the coastal railway also has Sydney-NSW central coast, Sydney-Brisbane, Melbourne-Sydney, coal, etc. As such the inland railway is not simply a substitute for the coastal route.

Stage 1 of the Northern Sydney Freight Corridor works

The Northern Sydney Freight Corridor Program is an initiative of the Australian Government to remove operational impediments to rail freight traffic between North Strathfield and Broadmeadow, Newcastle.[22] There is a committed funding agreement in place between the NSW and Australian governments for Stage 1 of the Northern Sydney Freight corridor ($840 million).

Stage 1 is expected to provide for the North Strathfield dive (i.e. an underpass to take freight tracks under major passenger tracks), extra track between Epping and Hornsby, two refuges near Gosford and some extra signalling. In addition, it would provide four freight paths per hour 20 hours per day, but with only two reliable freight paths per hour (i.e. 30 per day compared with the present 24, of which 11 are used). This stage of works is estimated to be operational by 2016. The Northern Sydney Freight Corridor Program team has advised it would have adequate freight capacity until around 2020 (depending on the ramp up period).[23]

In Stage 2, it has been assumed that coastal capacity will not be reached within the timeframe of the economic and financial appraisal (if all capital spend on coastal railway is performed as per Table 27). In addition, in collaboration with the Northern Sydney Freight Corridor team, it has been assumed in Stage 2 that expenditure savings are not possible for either project as the result of the other. In Stage 3, however, it will be further considered whether the coastal works and Stage 1 Northern Sydney Freight Corridor works will deliver required capacity under the Base Case, or whether some demand/performance assumptions may be constrained on the coastal railway.

A ‘full corridor’ option is also being considered by the Government as Stage 2 of the Northern Sydney Freight Corridor works, comprising developments such as four tracks north to Berowra, a third track on the Cowan bank, refuges north of there and re-signalling. As Melbourne-Brisbane freight is estimated to comprise around 30% of Short North traffic, Stage 2 of the full corridor works could potentially be delayed or reduced if the Inland Rail is

[20] GATR 2009, *Response to Working Papers 1 to 5*, ‘Coastal route 2011-2024 capex impact of an inland route’, 25 May 2009

[21] ARTC 2008, *Submission to Infrastructure Australia*, ‘2008-2024 Interstate and Hunter Valley Infrastructure Strategy 2008’, pp 28-33

[22] Transport Infrastructure Development Corporation (TIDC) 2009, *Project Profile - The Northern Sydney Freight Corridor Program*, available at: http://www.tidc.nsw.gov.au/SectionIndex.aspx?PageID=2066

[23] Meeting between the Northern Sydney Freight Corridor Program and Inland Rail Alignment Study teams, 3 September 2009

constructed. However, as this works has not been committed, it is not assumed in the Base Case for the inland railway study.

Stage 2 assumptions for reliability and capacity of the coastal railway

Based on the capital costs presented in Table 27, in Stage 2 coastal railway upgrades are assumed to increase coastal rail reliability, capacity and reduce transit times). For example, reliability is assumed to increase from past levels of 45% reliability in 2004 to 70% in 2010.

Although there may not be a ceiling or maximum level of rail traffic on the coastal railway, there may well be a time when to meet, the growing demand, considerable upgrade is needed to ensure adequate capacity. Demand analysis and forecast capital spend suggests coastal capacity will not be reached before 2080 (if all capital spend on coastal railway is performed), the limit of this study.

Road upgrades

The economic appraisal currently takes into consideration that road maintenance costs will reduce as a result of road freight diverting to Inland Rail (as discussed further in Chapter 6). However, a reduction in road capital costs has not been included, which may be understating economic results.

In particular, there may be opportunity to defer potential spend on the Newell Highway in the future if trucks assumed to use the highway in the Base Case are diverted to Inland Rail. The reduction in road freight tonnage for the 1,880 and 1,690 km scenarios is as follows:

- *1,880 km scenario* – while the majority of freight diverted to the inland railway is expected to be from the coastal railway, the 1,880 km scenario is estimated to result in diversion of 2.0 billion ntk of freight from road to the inland railway on average per annum, which represents around 5% of total ntk estimated to be freighted on the inland railway under this scenario; and
- *1,690 km scenario* – as with the 1,880 km scenario, while the majority of freight diverted to the inland railway is expected to be from the coastal railway, the 1,690 km scenario is estimated to result in diversion of 2.6 billion ntk of freight from road to the inland railway on average per annum, which represents around 9% of total ntk on the inland railway under this scenario.

As indicated by the volumes diverted, it is likely that this could result in a subsequent reduction in road upgrades and expansion, particularly on roads currently attracting Melbourne-Brisbane freight such as the Newell Highway.

In Stage 3 this issue will be discussed with the NSW Roads and Traffic Authority (RTA) and examined further for the Base Case and for inland route options. In addition this may also apply to other highways or roads in the inland railway corridor.

Intermodal terminal and port capacity

As work is currently underway at Parkes and Acacia Ridge to increase intermodal terminal efficiency and capacity, and there are plans for new terminals in Bromelton, Moorebank and Donnybrook/Beveridge, the approach in this appraisal is to not include terminal costs with Inland Rail costs. Capital and operating costs of intermodal terminals are assumed to be met by train operators.

Even without an inland railway, ACIL estimates that freight volumes in the Melbourne-Brisbane corridor (excluding Melbourne-Sydney and Sydney-Brisbane intercapital freight) will increase from 49 mt in 2020 to 135 mt in 2080, indicating an increase of 180% or 1.7% year-on-year growth. Given the volumes projected in the corridor even without an inland railway, upgrades to current terminal capacity will be important to service growth in demand. As a result terminal costs are not expected to vary significantly between the Base Case and Inland Rail scenarios.

Required increase in port capacity has been considered in similar terms as intermodal terminal capacity. As the majority of freight volumes are expected to occur regardless of the inland railway, increased port capacity is expected to be required even without Inland Rail and as such is not specific to the inland railway development. In addition, it has been assumed that increases in port capacity will be provided and funded by port operators – as such this is not included in Inland Rail costs. An exception to this is induced freight, as while the financial appraisal does not capture costs to increase port capacity for induced freight as it is a project-specific financial appraisal, the economic appraisal captures this in the estimate of producer surplus from induced demand. Further detail on this is provided in Appendix D.

4.7.2 Scenarios with Inland Rail

Two Inland Rail scenarios are analysed in the financial and economic appraisals:

- *1,880 km scenario* – The 1,880 km scenario assessed in this working paper assumes development of an inland railway based on a target around 27.5 hours terminal-to-terminal transit time, which is comparable with the coastal railway, and requiring capital costs of $2.81 billion over a five-year construction period; and
- *1,690 km scenario* – The 1,690 km scenario assumes development of an inland railway based on a target around 22 hours terminal-to-terminal transit time, which will be faster than what is considered to be achievable with the coastal railway, and requiring capital costs of $3.75 billion over a five-year construction period.

In addition these scenarios assume upgrades to the coastal railway in line with the Base Case. As a result, some Base Case capital costs are likely to be avoided on the coastal railway if the inland railway is constructed. Further analysis on the Base Case upgrades assumed on the coastal railway, combined with greater understanding of the avoided capital costs for these upgrades if Inland Rail proceeds, could reduce the capital costs incorporated in the economic appraisal, which are presented on an incremental basis to the Base Case.

Multiple years for commencement of operations have been analysed for these scenarios based on commencing Inland Rail services in 2020, 2030 and 2040.

5. Financial appraisal methodology

5.1 Introduction

The financial appraisal was conducted on the route identified for further analysis in Stage 1. The overall objective of the financial analysis is to evaluate the feasibility of the identified scenarios for the procurement of Inland Rail in terms of the net present value of project cashflows. At the core of the analysis is the development of a financial model which is used to translate raw cost and revenue data into estimates of the net present value.

The financial analysis was undertaken on a forecast cash flow basis, using annual periods and nominal dollar forecasts. The general analytical framework adopted focused on the Inland Rail project cash flows (financing cash flows are more relevant to examine specific private/public sector financing structures). A before tax and financing net cash flow profile was estimated for each of the options. This net cash flow profile was then for three Inland Rail commencement years: 2020, 2030 and 2040.

The terms of reference for the study, included at Appendix E, focus on a project-specific study of the Inland Rail. While it is acknowledged there are relationships between the coastal and inland railways (as has been captured in the demand analysis and economic appraisal), a detailed financial appraisal of both lines concurrently as options for freight capacity is beyond the scope of this engagement. As a result, the financial appraisal assesses the financial feasibility of Inland Rail as a standalone project and does not incorporate financial effects to ARTC of Inland Rail on the coastal route, such as revenue loss or coastal route capital cost savings.

In addition, the financial appraisal results do not include:

- project-specific risk adjustments; or
- allowances for potential value drivers such as more optimistic traffic forecasts which could be generated by the private sector or potential cost innovation / efficiencies.

Losses to the ARTC on the coastal railway have been explored further in Section 7.1.3. The latter two factors will be further examined in Stage 3.

Assumptions used in the analysis are separately discussed below.

5.1.1 Operator and ownership

South of the NSW/Queensland border, the inland route traverses track that is mostly leased long-term by ARTC. North of the border, part of it would traverse track, or a rail corridor, owned by Queensland Rail. As a result there is a spectrum of possible ownership, funding and operational control roles for the inland railway.

In commissioning this study the Australian Government indicated a preference to assess the scope for private sector participation, and it also suggested the analysis be conducted from a national interest perspective.

The following assumptions have been retained from Stage 1 in relation to delivery of Inland Rail:

- access revenue and below rail maintenance costs for track from Junee to Melbourne accrue to ARTC only and therefore are not allocated to the Inland Rail scenario;

- access revenue and below rail maintenance costs from the route using the Queensland Rail corridor on approach to Brisbane, have been included in the scenarios with no payment for the use of the corridor being included in the analysis; and
- revenue for coal on the Werris Creek–Narrabri existing track has been included as project revenues in the 1,880 km scenario. These coal volumes reflect the demand projections in ARTC's 2008-2024 Interstate and Hunter Valley rail Infrastructure Strategy.

As previously stated, this financial analysis does not incorporate financial effects on ARTC of Inland Rail, such as revenue loss or coastal route capital cost savings (see Section 7.1.3 for some analysis on this impact). Nor does this financial analysis quantify the benefits of risk transfer to the private sector under the private sector procurement models assessed.

Possible options for private sector participation are discussed in the box below.

Box 5.1 Possible funding options for consideration in Stage 3

Public sector

Public sector funding for Inland Rail may come from a number of options:

1. *Government contributions* – Government funding may be acquired through federal and/or state budget allocations where the government contributes to the cost of the project, where the contributions will not be repaid.
2. *Government equity contributions* – Government may provide assistance to the project through the provision of equity. In some instances this can improve the financial viability of a project if government has a lower equity return target than the private sector. Based on the tonnage forecasts and track access charges, below rail revenue is insufficient to recover the significant capital outlay required for the construction of the inland railway. A government equity contribution to the project will allow funding to the project where government would be expected to absorb the shortfall between returns from the project revenues and returns normally expected by equity investors. This lower rate of equity return is an additional issue that government will need to consider in providing such contributions.
3. *Government-sourced debt*: Government may provide assistance to the project by raising debt sourced at government rates which may include a guarantee to debt providers to reduce risk. Margins have assumed government guarantees will not be provided as it is considered credit conditions will revert to more normal conditions in contrast to the current situation and the global financial crisis. For the purposes of this analysis, it has been assumed that the cost of this funding is equivalent to privately sourced debt.

Private sector

Where the project is delivered partially or in whole by the private sector, possible sources of funding may include:

1. *Debt sources:* bank debt, mezzanine debt, and bonds.
2. *Equity sources:* project sponsors, superannuation funds, sovereign funds, private equity, and IPO.

In reference to the nature of this project, the likely project length, and expected timeframe of delivery, an equity IRR reflecting recent long-term infrastructure projects has been assumed. This included rail projects prior to the current financial crisis. Impacts to equity IRR caused by the current crisis have not been included because of the long time frame of analysis for this project.

Private sector participation options include:

1. *Government funded through government-owned corporation –* based on Inland Rail being wholly operated and financed via the public sector, through a government-owned corporation;
2. *privately financed with government supplementary funding through annual service payment* – structure assuming private financing and operation based on a service payment PPP structure, i.e. government pays an annual service payment during the operational period to top-up access revenues to allow the project to generate an acceptable level of equity return for private equity investment; and
3. *privately financed with upfront government contribution* – private financing and operation based on an upfront contribution from government to allow the project to generate an acceptable level of equity return for private equity investment.

5.2 Key assumptions

The table below summarises the generic assumptions that apply to the proposed Inland Rail project. These are applied across all scenarios in the financial appraisal.

Table 24 General financial appraisal assumptions

Assumption	Details	Notes
Analysis period	Through to 2080	40 years after the last scenario begins full operations, with base year in 2010
Construction Period	5 years	Period assumed for the construction of the inland railway track assets, with capital costs allocated on an s-curve basis
Real estimates escalation base date	2008	Based on same basis as economic analysis and assumptions provided by technical consultants.
Net Present Value Date	1 January 2010	Base date for the calculation of the NPV of cash flows of the project.
Capital cost, operating cost and revenue estimates	2008 dollars escalated by CPI	Key revenue and cost assumptions were estimated in 2008 dollars. For the purposes of the financial appraisal, these assumptions were escalated in the financial model through CPI where applicable.
Consumer Price Index (CPI)	3.0%	Upper end of RBA target range, as applied in Stage 1 of the analysis.
Basis of cash flows for financial analysis	Nominal	For the purposes of the financial appraisal, the cash flows in the financial model are in nominal terms.
Government Discount rate (Nominal, Post tax)	8.4%	In developing a discount rate, a range of recent WACC regulatory determinations were considered. This included the Queensland Competition Authority QR's 2005 Draft Access Undertaking Decision for freight train services, which had a rate of 8.43%. In addition the ACCC's determination for the ARTC's interstate network was 11.61% post tax, nominal was considered. As the ARTC rate determined by the ACCC was in a period with higher interest rates/cost of debt, a long-term, lower discount rate of 8.4% has been used in this appraisal.
Capital Costs ($ million real)	$2,815 *(1,880 km route)* $3,750 *(1,690 km route)*	Capital costs expressed in real dollars (2008) including 20% contingency
PV Capital Costs ($ million nominal)	*1,880 km / 1,690 km* 2020 - $2,006 / $2,673 2030 - $1,177 / $1,568 2040 - $693 / $923	The NPV of capital costs have been calculated using a discount rate of 8.43%, and a base date of 1 January 2010.
Demand inputs	Refer Chapter 3 & WP1	ACIL Tasman prepared demand projections with and without the inland railway, for use in the financial appraisal.
Track access pricing	Refer Chapter 4	Access charges are assumed to be in line with current coastal rail prices.
Construction & operating costs	Refer Chapter 4 & WP3-4	Costs were estimated for the inland route in Stage 1 by the LTC.

6. Economic appraisal methodology

6.1 Introduction to the approach and methodology

This appraisal has been undertaken in broad consistency with the relevant guidelines for cost benefit analysis (CBA) as provided by the Australian Transport Council (ATC) *2006 National Guidelines for Transport System Management in Australia*, jurisdiction-based guidelines,[24] and other mode-specific guidelines as required, e.g. Austroads.

The appraisal objective is to analyse the economic merit of the proposed Inland Rail in line with state and national guidelines for economic appraisal. According to Austroads, CBA:

> *…is a technique for assessing the economic efficiency of resource allocation. It allows us to compare alternative approaches to individual projects and to set priorities amongst competing projects. It uses as its framework the values of all costs and benefits to the community which can be quantified in money terms.*[25]

An economic appraisal of Inland Rail has been undertaken to assess the project's merits. This will aid future government and private sector evaluations and would help guide efficient resource allocation. This is done by determining whether Inland Rail is economically viable (i.e. the total discounted incremental benefits of the project exceed the total discounted incremental costs over a specified period).

The appraisal uses a rail freight CBA framework. This framework assesses the potential change in economic welfare with the scenario by considering the following parameters:

- project and Base Case capital costs;
- project and Base Case recurrent costs;
- rail operating costs;
- freight value of travel time;
- road and rail crash costs; and
- external costs (such as air pollution, noise, and greenhouse gases).

The appraisal builds on previous appraisals, including:

- *economic appraisal undertaken in the North-South Rail Corridor Study in June 2006* – this analysed four broad route alignments or 'sub-corridors' (far western, central inland, coastal and hybrid inland/coastal), combined with two alternative routes via Shepparton or via Albury. The study found that, based on the alignments and likely timeframes and costs, none of the scenarios resulted in positive net economic benefit, with a BCR of 0.4 for the unconstrained case of $3.1 billion capital expenditure;[26] and
- *economic analysis undertaken by the Bureau of Transport Economics (BTE now BITRE), in October 2000* – the Australian Government commissioned the BTE to undertake an economic benefit-cost analysis of the ATEC proposal (as at October 2000) for a new rail corridor linking Melbourne and Brisbane, and all associated ATEC assumptions. The BITRE analysis found that, based on the ATEC demand forecast and ATEC estimated

[24] Jurisdiction-based guidelines include the Queensland Treasury 2006 *Cost-Benefit Analysis Guidelines*, Victorian Department of Transport (DoT) 2007, *Guidelines for Cost-Benefit Analysis*, the NSW Treasury 2007, *NSW Government Guidelines for Economic Appraisal*

[25] Austroads 1996, *Benefit Cost Analysis Manual*, Sydney, 1996

[26] The NSRCS included access revenue and externalities as the project's economic benefits whilst the appraisal approach in WP 5 and WP 12 excludes access revenue from the economic analysis as this is a financial transfer.

capital costs, the rail corridor resulted in a benefit-cost ratio (BCR) between 3.6 and 5.1 (noting that the demand forecasts used assumed a significant shift in road freight, and the capital costs assumed were significantly lower than assumed in this study, ranging from $1.2-1.68 billion (2000 dollars). Adjusting the BCRs with the higher capital cost range of $2.8-3.6 billion developed in this study would see these BCRs fall by around half. The BTE suggested caution in interpreting the results because of the assumptions it had been asked to use. It is also noted that an earlier BTE report analysing the inland railway found the project to be economically unviable.

This study builds on these previous studies with a focus on analysing and refining a route for further analysis within the far western sub-corridor.

Key inputs to economic appraisal

In addition it draws upon the following key inputs:

- capital and operating cost assumptions based on LTC estimates as described in Chapter 4, Working Paper No. 3 and Working Paper No. 4, and based on Stage 2 estimates for a 1,690 km scenario;
- ACIL Tasman freight forecasts as discussed in Chapter 3; and
- Base Case and Inland Rail scenario definitions presented in Chapter 4.

Updates in Stage 2 approach

The economic assessment presented in this working paper incorporates the following key updates and amendments since the Stage 1 appraisal (described in Working Paper No. 5):

- incorporates demand updated by ACIL Tasman;
- includes refinement of the LTC's Stage 1 capital and operating costs ensuring profit margins are removed and all costs are in the same base year;
- presents additional economic indicators (Stage 1 only presented NPV);
- accounts for pick up and delivery transport of rail freight (i.e. it incorporates road transport time and related costs to convert transit time from terminal-to-terminal to door-to-door). This has been applied to freight, that would experience a change in pick up and delivery time as a result of Inland Rail, when compared to the Base Case;
- has a base year of 2010 (in Stage 1 the base year was 2008);
- incorporates updated Base Case analysis in relation to savings in coastal rail costs if Inland Rail commences operations in 2020, resulting in lower capital cost savings; and
- includes a revised (more conservative, but also more reliable) road maintenance parameter value sourced from Booz Allen Hamilton (BAH).

Measures of economic performance

This CBA reports on the following measures of economic performance:

- *Net Present Value (NPV)* – the difference between the present value (PV) of total incremental benefits and the present value of the total incremental costs;
- *Benefit Cost Ratio (BCR)* – ratio of the PV of total incremental benefits over the PV of total incremental cost;
- *Net Present Value : Investment Ratio (NPVI)* – the NPV is divided by the PV of the investment costs (PVI); and

- *Economic Internal Rate of Return (EIRR)* – the discount rate at which the PV of benefits equals the PV of costs.

Scenarios that yield a positive NPV indicate that the incremental benefits of the project exceed the incremental costs over the evaluation period.

A BCR greater than 1.0 indicates whether a project is also economically viable, as it presents a ratio of benefits relative to costs in present value (PV) terms. A BCR greater than 1.0 indicates PV benefits outweigh PV costs.

The NPVI measures the overall economic return in relation to the required capital expenditure.

Finally, an IRR greater than the specified discount rate (default 7%) also indicates a project is economically worthwhile. However the IRR can yield ambiguous results if the stream of costs and benefits are not continuous over time. It is therefore commonly recommended that the IRR be used along with other measures.

6.1.1 Incorporation of demand forecasting

The economic appraisal is based on the demand modelling outputs provided by ACIL Tasman as part of Stage 2 and presented in Chapter 3. These forecasts are incorporated into the economic appraisal to identify:

- changes in rail and road freight volumes following commencement of project operations; and
- changes in freight volumes attributable to rail and road mode stayers, mode diverters and induced trips.

As the demand outputs were provided for the years 2008-2080, there was no requirement to further interpolate or make assumptions on demand over the appraisal period. In addition, as the freight demand was estimated in annual terms, an annualisation factor was not required in this appraisal. ACIL Tasman incorporated assumptions into the demand forecasts concerning the ramp-up of freight volumes, and hence a ramp-up period is inherently incorporated into the economic appraisal through the application of demand projections. This was assumed by ACIL Tasman as road and rail users take time to adjust their freight consignment patterns to the new infrastructure.

Treatment of freight that is currently freighted on existing rail lines

In incorporating logit model outputs into the economic appraisal, one important adaptation impacting on the economic results was the treatment of freight. Coal currently uses existing track, and is likely to be freighted with or without Inland Rail proceeding. The freight estimated by ACIL Tasman that currently uses existing (non-coastal) rail lines if there is no Inland rail includes:

- Toowoomba-Brisbane agricultural products;
- agricultural products in the catchment between Moree and the QLD border (with a road leg from the Dirranbandi QR rail line through to the Port of Brisbane);
- some Moree-Cootamundra agricultural products;
- some Tocumwal-Shepparton agricultural products on rail to the Port of Brisbane;
- South East Queensland-Brisbane coal; and
- Werris Creek-Narrabri coal.

The most significant of these is Werris Creek-Narrabri coal, which comprises on average 30% of Inland Rail freight net tonne kilometres or 70% of tonnage volumes, for the 1,880 km scenario. As the 1,880 km scenario uses existing line in the central NSW region with proximity to coal mines likely to freight coal between Werris Creek and Narrabri, it has been assumed that this coal will travel by Inland Rail under this scenario. However, for the 1,690 km scenario which is further to the west, all Gunnedah Basin coal volumes are assumed to use the existing railway and not Inland Rail. As a result, financial analysis of the 1,880 km scenario (but not the 1,690 km scenario) has allocated some coal access revenue between Werris Creek-Narrabri to Inland Rail. In the economic analysis, Werris Creek-Narrabri coal has no incremental impact on economic results as this coal freight is expected use existing rail under all scenarios:

- under the Base Case this freight travels on existing rail;
- under the 1,880 km scenario it continues to use the existing rail; however that track is considered part of Inland Rail; and
- under the 1,690 km scenario it is assumed to travel on existing rail (in line with the Base Case).

However, it has been assumed in the financial appraisal that this coal access revenue is allocated to the 1,880 km scenario to part-fund capital outlays on other parts of the inland railway, and thereby improves its viability. A further consideration for the Werris Creek-Narrabri line (that could affect both the financial and economic appraisals) is that there may be a need for an inland railway operator to purchase these lines from the NSW Government. This is discussed further in Section 4.6.

Treatment of induced freight

ACIL Tasman has identified the following sources of freight that will be induced as a result of the inland railway:

- Toowoomba-Brisbane coal;
- Moree-Narrabri coal; and
- NSW/Queensland border-Narrabri coal.

This freight has been captured in the economic appraisal in terms of the freight travel time benefits, producer surplus generated, and also in terms of the environmental externalities it is expected to produce including noise and air pollution.

There may be additional infrastructure costs related to induced freight, for example at ports. For this and similar costs, these have been included in the appraisal as they have been netted out of the 'producer surplus' benefit. This benefit is based on an estimated increase in producer profit margin after considering the related transport and other operating costs.

6.1.2 Economic benefits

This economic appraisal is concerned with assessing the effects on the national community of operators' decisions to switch to Inland Rail. The national perspective requires that all transfers are netted out. Previous economic appraisals conducted for the Inland Rail project have included access charges as an economic benefit. However, access charges are considered to be a transfer between parties that does not have a net economic benefit. This is because an access charge is a payment for the rail infrastructure that represents: (i) a cost to the above rail operator; and (ii) a revenue to the below rail operator. As these two revenue streams cancel out, it is only the costs of infrastructure (i.e. the capital and operating costs) that remain valid for inclusion in the evaluation.

In line with a rail freight CBA framework, this economic appraisal aims to take into account all impacts on society by considering benefits to rail users and the broader community through externalities. The most significant benefits of Inland Rail relate to savings in rail user costs arising from a reduction in freight hours and freight kilometres compared with the Base Case. Benefits will also accrue to third parties through the reduction of external costs, such as environmental externalities. The residual value of assets remaining at the end of the analysis period is also captured in the appraisal.

There are some benefits that are not generally measured in rural areas and subsequently have not been included in this appraisal. These include reduced road congestion and urban separation (removal of freight transport from multiple routes in urban areas to one or more dominant routes). There may be some scope to incorporate these into the appraisal if it is possible to estimate the proportion of road and rail tonne kilometres generated in urban areas.

The approach used to estimate each of the benefits included in the CBA is presented below. More detail on the methodology used to estimate freight travel time, operating cost savings and the net economic value of induced freight is presented in Appendix D.

Savings in freight travel time costs

The approach used in this appraisal to measure Inland Rail benefits incrementally to the Base Case, is based on defining the service being provided as 'freight transport' for either rail or road mode of travel. This approach, along with the method to apply freight travel time to net tonne kilometres (ntk)[27] draws upon the economic approach used by BITRE in October 2000.

The demand forecasts generate freight volumes (in ntk) for rail freight on the new and existing lines and for road freight. In order to estimate the value of freight transit time savings for rail users, these volumes were converted to hours travelled in tonne hours by estimating trip numbers and hours per average trip based on average loads and transit times. The resulting tonne hours per trip derived for each mode, and for the Base Case and each scenario, were then combined with a time value for freight in transit to determine:

- the benefits of existing rail traffic (currently travelling on the coastal railway or other existing railways) travelling faster on the new line;[28]
- the negative benefit of existing road traffic travelling slower when it changes to the new rail network; and
- the benefits of induced rail traffic travelling on the new line.

The time value for freight transit used in this appraisal was determined by applying average road vehicle loads with Austroads 2008 values for non urban freight travel time. Separate vehicle travel times were then weighted against semi and B-double vehicle compositions to determine an average regional freight travel time value of $0.81 per tonne hour. This travel time value was applied to tonne hour demand to estimate the change in freight travel time cost. While derived from road appraisal CBA guidelines, this value of freight travel time is considered to be conservative relative to other estimates. For example in 2000 in its

[27] Tonne kilometres are calculated by the weight of a train and the distance it runs. This can be expressed as the total weight of a train (gross tonne kilometres or gtk) or the weight of the cargo (net tonne kilometres or ntk).

[28] Werris Creek-Narrabri coal volumes were not included in the time savings analysis as it assumed unlikely to be realised.

Brisbane-Melbourne Rail Link: Economic Analysis, BTE (now BITRE) used a value of $1.60 per tonne hour for general freight based on ATEC transit time analysis (equivalent to $2.14 per tonne hour in 2008 dollars).[29]

Savings in train and road operating costs

The project case will result in reduced kilometres on the road network, as well as fewer tonne kilometres of rail travel due to the new rail links providing shorter distances compared to the existing coastal rail link. As a result, this will produce lower operating costs.

For rail users, total resource operating costs include fuel, crew and rollingstock maintenance costs, as well as rollingstock depreciation and return on economic capital. These costs are estimated to total at 2.22 cents per ntk for rail users on the 1,880 km Inland Rail, and 2.05 cents per ntk for the 1,690 km scenario. (The variation in costs between the two scenarios, considering lower transit time and reduced route length, is described further in Appendix D.) In comparison resource operating costs for existing rail users remaining on either the coastal railway or other existing rail lines, are estimated at 2.23 cents per ntk.

For road-rail diverters, road operating costs were estimated at 4.8 cents per ntk based on RTA literature, combined with vehicle mix and tonnage assumptions. For induced rail users, operating costs were captured in the benefit estimating net economic value from induced freight. As such, they were not included in the operating cost estimates in order to avoid double counting.

The resulting costs per ntk were combined with net tonne kilometres to determine:

- the benefits of existing rail traffic with lower operating costs on the new line; and
- the benefit road-rail diverters with lower operating costs on the new line.

Net economic value from induced freight

The ACIL Tasman demand projections have identified a segment of demand that will be induced if the inland railway is constructed, i.e. that is not diverted but is totally new traffic that emerges exclusively because of the project. This freight comprises a relatively minor proportion of total rail demand (between 3-10% per annum of total net tonne kilometres estimated to travel on Inland Rail).

As Inland Rail is estimated to induce new freight volumes, it is expected that there would be an economic benefit for the producers of this freight, otherwise such traffic would not materialise. This implies that:

- *in the base case* – the gross value of the products, less production and transport, results in a negative outcome, hence these producers do not transport their products; and
- *for the scenario with Inland Rail* – transport costs can be assumed to have fallen as this is the only component likely to have changed as a result of Inland Rail. This can be assumed to result in the gross value of the product, less production and transport costs, becoming a positive number due to Inland Rail.

In order to incorporate the producer surplus from the net economic value of induced products into the appraisal, it has been assumed that 20% of the inland railway operating costs of

[29] In 2000, the BTRE (now BITRE) *Brisbane-Melbourne Rail Link: Economic Analysis* used ATEC transit time analysis to derive value of time for freight in transit ranging from $0.00 to $2.99/tonne hour in the appraisal (dependent on freight type), equivalent to $1.60 for general freight (2000 dollars). This analysis also cited a value of $0.60 per tonne hour (2000 dollars) sourced from Austroads and derived on the same basis applied in this appraisal.

2.05-2.22 cents per ntk represents the value of these products. This is explained further in Appendix D.

Savings in crash costs

As the project case is estimated to result in reduced freight vehicle kilometres on the road network, and data indicate that there are reduced fatalities on rail compared to road, it is expected that the project case will result in road crash cost savings. These road crash cost savings are offset by any induced trips to rail in the project case, which result in positive crash costs.

Booz Allen Hamilton estimated crash costs for rural road and rail per net tonne kilometre, which indicates that there are cost savings on rail freight compared to road freight. These values (inflated from 2001 to 2008 dollars) are 0.40 cents per ntk for road and 0.038 cents per ntk for rail.[30]

Existing and induced rail net tonne kilometres are multiplied by rail crash costs, and road freight net tonne kilometres were combined with the road crash costs to estimated net project case crash costs incremental to the Base Case.

Reduced environment externalities – air pollution, greenhouse gas and noise costs

As with accident costs, as a result of reduced freight vehicle kilometres on the road network resulting from Inland Rail coming into operation, it is expected that the project case will result in reduced road air pollution, greenhouse gas and noise costs. The saving in road externalities is offset by induced rail trips in the project case, which result in positive externality costs.

BTE (now BITRE) provides estimates of rail charges under a competitively neutral regime compared with road, which includes costs per ntk for pollution and noise costs. These 1999 noise and air pollution values were also incorporated into the *BTE 2000 Brisbane-Melbourne Rail Link: Economic Analysis*. These values (inflated from 1999 to 2008 dollars) are:

- *pollution costs* – 0.013 and 0.005 cents per ntk for road and rail respectively
- *noise costs* – 0.045 and 0.027 cents per ntk for road and rail respectively.

BAH estimate greenhouse gas costs for rural road and rail per net tonne kilometre, which indicates costs of 0.20 cents per ntk for road and 0.013 cents per ntk for rail (inflated from 2001 to 2008 dollars).

Reduced road maintenance costs

The shift of some road freight onto rail as a result of Inland Rail is likely to result in reduced road maintenance. As the CBA incorporates ongoing rail maintenance, it is relevant to also consider any change in road maintenance costs in the appraisal.

BAH estimate road maintenance costs of 0.801 cents per ntk for road freight (inflated from 2001 to 2008 dollars).

30 Booz Allen Hamilton (BAH) 2001, cited in Freight Australia 2003, The Future of Rail Freight Services in Victoria: a proposal to the Government of Victoria form Freight Australia, 21 March 2003.

Residual value

Each of the project scenarios, as well as the Base Case, assigns a residual value to the key components of fixed infrastructure, rollingstock and land with economic lives which extend beyond the final year of the evaluation period.

For this reason the economic appraisal includes the residual values of rail assets. The residual value reflects the fact that some assets may have economic lives that extend beyond the evaluation period.[31] Each asset item is depreciated in a straight line fashion to determine the incremental residual value based on construction year, and residual values are entered in the last year of the evaluation period (2080) to represent the unused portion of assets that have lives greater than the evaluation period.

6.1.3 Economic costs

The economic costs incorporated in the appraisal include:

- capital costs for the inland and coastal railways (as per LTC estimates presented in Chapter 4);
- below rail operating costs (as per LTC estimates presented in Chapter 4); and
- track maintenance costs (as per LTC estimates presented in Chapter 4).

In the economic appraisal the profit margin was removed from financial costs to reflect resource costs. Road maintenance cost savings, and train and road vehicle operating cost savings were incorporated as benefits in the appraisal resulting from Inland Rail, so are discussed in the section above.

[31] Assets assumed to have a useful life are: land, earthworks, bridges, culverts, viaducts and tunnels.

6.2 Economic assumptions

The general assumptions used in this economic appraisal are presented in the table below.

Table 25 Key economic appraisal assumptions

Economic assumptions	Assumption	Notes
Economic analysis perspective	National interest perspective	
Base year	2010	All values are expressed in constant dollars and all present value costs and benefits are expressed in 2010 dollars unless otherwise stated
Evaluation period	2010 to 2080	The evaluation period starts in 2010 and ends in 2080 (40 years after the last scenario begins full operations)(1)
Economic analysis discount rate	7%	Sensitivity tests @ 4% and 10%. Future net benefits are discounted to the base year using a real 7% discount rate
Freight value of travel time (non urban)	$0.81 per tonne hour	Source: ABS, Austroads and NSW RTA parameters and compositions
Train operating costs	1,880 km scenario 2.22 cents/ntk (resource cost) 1,690 km scenario 2.05 cents/ntk (resource cost) Coastal railway 2.23 cents/ntk (resource cost)	Inland railway fuel consumption for the 1,880 km scenario is estimated to be 5% lower than the coastal route. Source for inland railway basis: LTC WP4 & LTC estimates
Road operating costs	Road (resource cost) 4.8 cents/ntk	Source: RTA parameters
Net economic value from induced freight	0.40-0.41 cents/ntk	It has been assumed that the gross value of induced products less production and transport costs is equivalent to 20% of the inland railway operating costs
Crash costs	Road crash costs 0.400 cents/ntk Rail crash costs 0.038 cents/ntk	Source: Booz Allen Hamilton (BAH) 2001 rate inflated to 2008 dollars
Air pollution costs (rural)	Road air pollution costs 0.013 cents/ntk Rail air pollution costs 0.005 cents /ntk	Source: BITRE 1999, Working paper 40 inflated to 2008 dollars
Noise pollution costs (rural)	Road noise costs 0.045 cents/ntk Rail noise costs 0.027 cents/ntk	Source: BITRE 1999, Working paper 40 inflated to 2008 dollars
Reduced greenhouse gas (rural)	Road greenhouse costs 0.200 cents/ntk Rail greenhouse costs 0.013 cents/ntk	Source: BAH 2001 rate inflated to 2008 dollars
Reduced road maintenance costs	Road maintenance costs 0.801 cents/ntk	Source: BAH 2001 rate inflated to 2008 dollars

(1) Note: operations are modelled to commence in either 2020, 2030 or 2040

As indicated in the table above, the environmental externality parameters used in the economic appraisal (i.e. for noise, air pollution and greenhouse gases) are based on ‘rural’ estimates. 5-7% of the proposed inland route and freight travelling on road between

Melbourne and Brisbane is through urban areas. In the Stage 3 Final Report the FEC will explore if externality rates can be weighted against urban and rural parameters to reflect this. However, as environmental externality benefits achieved by the Inland Rail comprise between 1-3% of the economic benefits identified in this working paper, it is not likely that this will have a significant impact on the results or economic viability.

6.2.1 Employment generation, regional benefits and wider economic benefits

The transport sector in Australia plays a critical role generating economic benefits in other sectors of the economy. Either through the direct or sub-contracting of staff, the rail sector in particular is a significant employer. The Australian transport and logistics industry is estimated to be responsible for:

- generating 14.5% of GDP, with Australia's supply chain being worth an estimated $150 billion every year; and
- providing more than one million jobs across some 165,000 companies.[32]

From a regional development perspective, it is also likely that expenditure on Inland Rail will generate increases in employment, supplier business turnover and profits.

Direct and indirect employment generation

The rail sector plays a significant role as a large employer either through the direct employment or sub-contracting of staff.

Inland Rail is expected to generate direct and indirect employment during both the construction and operational periods of the project.

Construction

During the five year construction period, the construction and upgrade required for the $2.8-3.8 billion inland railway project scenarios assessed in this paper, is expected to generate a significant economic impact, including construction employment. The investment is likely to stimulate demand for a range of skilled labour during construction.

The table below presents total full time equivalent (FTE) employment estimates for the inland railway construction period, based on employment factors presented in a recent Victorian Department of Treasury and Finance technical paper, relating to railway infrastructure construction.

Table 26 Estimated direct and indirect construction-phase employment (gross FTEs, average per annum over 5 year construction period)

Construction employment	Estimated FTE / $m factor (Dec 2008)	Estimated Inland Rail FTE (average per annum)
Direct	2.3	1,300-1,700
Indirect	1.3	700-1,000
Total	**3.6**	**2,000-2,700**

Source: FTE/$m factor: URS, cited in Department of Treasury and Finance, Victoria (2009), *Employment and public infrastructure: an estimation framework, p 9*
Note: Figures in this table may not total due to rounding.

[32] Australian Logistics Council (2008) *'The National Strategy for the Transport and Logistics Freight Industry: Enhancing Australia's Supply Chains* 2008-2015', p.4.

As a comparison with the estimates provided in Table 30, an AustralAsia Railway Corporation estimate of the construction workforce for the Alice Springs-Darwin railway expansion was:

- 1,500 FTE employees at the peak of construction (estimated at an average of 1,300 employees over the construction period);[33]
- as the expansion involved 1,420 kilometres of track, this indicates a ratio of 0.92 employees per track kilometre; and
- considering capital costs of $1.3 billion, this indicates a ratio 0.86 employees/$million.[34]

Considering theses as benchmarks for Inland Rail construction phase employment would indicate that 2,400-3,200 direct jobs could be generated considering capital expenditure, and 1,600-1,700 direct jobs considering track length. These indicate that Inland Rail employment estimates listed above are mid-range based on this similar project.

Operations phase

In consideration of regional employment generated by Inland Rail scenario analysed in this paper, the superfreighters are expected to only stop to refuel and/or exchange freight in Parkes. Alternatively some operators could elect to complete shorter re-fuelling stops in Moree or Junee (without any freight exchange). As there is currently an intermodal terminal located in Parkes, and Moree and Junee both already have refuelling facilities, the regional employment impacts in these areas are not expected to be significant in early years of the project. However with time, an increase of train movements and the attraction of intrastate trains to these locations as a result of Inland Rail, the project is likely to create employment at terminal locations as well as some regional employment. Further, it is likely that terminals will also require expansion resulting from increased train and tonnage movements, which will have further increases in employment.

An important consideration in estimating employment impacts, is that while a number of gross jobs may be created, it is likely that a significant number of positions will be transferred from the coastal railway to the inland railway as freight is diverted from the coastal (for example train drivers switching from the coastal to inland). This would not represent a net increase in employment for Australia. The same argument applies to coal freight. In consideration of these factors, the gross and net operations workforces have been estimated in the table below. These employment estimates are based on the number of trains per day and considering the inland railway route length of 1,690 or 1,880 km of track.

Table 27 Estimated direct operations-phase employment (per annum, FTEs)

Employment type	2020 direct employment
Track operations and maintenance	140-150
Rollingstock operation and maintenance (including train crew)	60-70
Refuelling and terminal employment	20-30
Administration and support	5-10
Total gross employment (FTE)	**225-260**
Total net employment (FTE)	**60-70**

Note: based on ACIL Tasman train movement estimates, track length, LTC operating cost estimates, and other rail operations assumptions. Net employment could also incorporate jobs lost due to the lower road maintenance. Figures in this table may not total due to rounding.

[33] AustralAsia Railway Corporation, '*Benefits of the Rail*', accessed at: http://www.aarc.com.au/aarc/info/factsheets/benefits.pdf
[34] AustralAsia Railway Corporation, '*Economic Facts', accessed at*: http://www.aarc.com.au/aarc/info/factsheets/economic.pdf. [Note: the $1.3 billion capital cost has been inflated to $1.52 billion (December 2008 level)].

In addition, as a result of the direct employment estimated on an annual basis above, there will be indirect employment as a result. Based on ABS input-output multipliers,[35] the direct and indirect employment effect during Inland Rail operations stage is expected to be:

- *direct employment* of 60-70 FTE positions in 2020;
- *indirect employment* of 30-40 FTE positions in the same year; and
- *total (direct and indirect) employment* of 90-110 positions in 2020.

Wider economic benefits

Wider economic benefits is an umbrella term for a set of economic effects that are increasingly being captured in UK and Australian CBAs, with formal guidance provided on estimation by the UK Department for Transport.[36] In this paper, this set of impacts are generalised as Wider Economic Effects (WEEs) to acknowledge that these effects may not always be positive.

The approach to quantify and incorporate WEEs within a CBA was first applied in the Crossrail project in London and the South East. WEEs are still in their infancy in Australian CBA, with only few analyses having been undertaken to date, such as that for the East West Link Needs Assessment (EWLNA) in Victoria, and by PwC for the proposed West Metro development in NSW.

WEEs acknowledge that traditional CBAs may not capture all possible benefits if markets are imperfect. Many markets in the real world demonstrate some form of market failure such as externalities and information asymmetry. This implies that a traditional CBA may not fully reflect the total benefits of a transport policy or project.

WEEs seek to complement traditional CBA by correcting for these market imperfections, just as environmental values were introduced into CBA to internalise negative externalities in these markets.

Importantly, WEEs are not the same as economic impacts – e.g. the growth in GDP and employment with a project. These impacts are captured through economic impact assessments,[37] and are not directly comparable or additive with CBA methodology. Therefore, economic impacts should always be treated in separation.

Three key WEEs and their potential relevance to Inland Rail are discussed below:

1. *Increased output due to agglomeration economies* – agglomeration economies occur as a consequence of an increase in the effective density of economic clusters. By reducing the generalised trip cost within and between economic agents in a cluster, transport infrastructure increases effective density and therefore productivity. The uplift in productivity is measured by the ‘agglomeration elasticity’.[38] Agglomeration economies are most likely to occur in urban areas where new transport infrastructure results in a non-marginal reduction in trip costs between areas of significant economic activity such as CBDs. The Inland Rail superfreighter service examined in this paper is likely to only stop to exchange freight and refuel in Parkes. However, it is unlikely that the project would generate any significant agglomeration gains given the relatively low existing

[35] Australian Bureau of Statistics (1990). Information paper: *Australian National Accounts: introduction to input-output multipliers.* Note however that these multipliers overstate the results as they do not consider the alternative uses of the resources.

[36] UK Department for Transport, *Transport, Wider Economic Benefits and Impacts of GDP,* June 2006.

[37] These impacts are calculated by using input – output multiplies or Computable Generated Equilibrium (CGE) models.

[38] Applied Economics 2009, *Draft paper – the Wider Economic Benefits of Transport: A Review*, May 2009

densities of population and employment in these regional centres. Moreover, as the majority of the freight using Inland Rail is not varying its origin and destination from Melbourne or Brisbane, rather is diverting from another mode or rail line, the agglomeration impact on the capital cities is not expected to be significant.

2. *user benefits when transport users operate in imperfectly competitive markets* – this impact arises because prices exceed marginal costs in imperfectly competitive markets, or when the marginal revenue product exceeds the wage. In such markets, the value of extra goods produced exceeds their marginal cost.[39] For example, there may be a difference between the value the market places on a worker's output from one hour's work, and the cost of the worker's time to a company (e.g. the market price paid for one hour of legal advice may be higher than the wages paid to that lawyer an hour of work). As a result, it is considered that the value of travel time savings on business trips (and the associated increase in output from travelling less whilst working), is underestimated in standard CBA techniques.
   Although this benefit is generally captured for passenger transport developments that will capture benefits for business travellers, it has not been greatly explored in a freight transport context. However, as freight transport is considered a commercial market in which prices charged reflect full costs, the variation in prices and marginal costs required to generate this benefit is not anticipated. As a result it is not expected that Inland Rail will generate significant benefits due to imperfect competition.
3. *economic benefits of increased labour force participation* – for passenger transport, this WEE aims to capture benefits from increased output as a result of savings in commuting time As a result, of a reduction in commuting time and hence, costs some additional people may find it economically viable to enter the workforce, work longer hours, or switch to more productive (higher paid) jobs.[40] This suggests that the value of commuting time savings may be understated. However, as a freight project, it is not expected that Inland Rail will induce increases in the labour force as described in the context of this WEE.

[39] Ibid.

[40] Applied Economics 2009, *Draft paper – the Wider Economic Benefits of Transport: A Review*, May 2009

7. Financial and economic results

WP12 is a work in progress paper for Stage 2, and as such, the results below will be superseded by updated analysis over the course of the study. These Stage 2 results below are likely to change over the course of the study, as costs and routes are further optimised.

7.1 Financial results

The section below presents the results of the financial analysis. These results are likely to change with Stage 3, and within Stage 3 as capital and operating costs are further optimised. In addition to this, furtherance of our analysis and changes in assumptions may yield updated outcomes to the financial analysis, which will involve analysis of possible financing scenarios.

7.1.1 Project financial NPV

The financial analysis has been performed based on nominal cash flows discounted using a WACC of 8.4% to a base date of 1 January 2010.

The financial analysis undertaken suggests that the project will not generate sufficient access revenues to make Inland Rail financially viable on a commercial basis. Indeed, the total nominal capital and operating costs for every option exceeded the total nominal track access revenues, regardless of the assumed operational start date. As a result, the net present values for the Inland Rail cash flows (i.e. not considering specific financing structures) were significantly negative for each scenario.

The table below demonstrates that the project is not financially viable based on the net project cash flows on a real basis, as the project NPV (pre tax) is negative in all cases at a base date of 1 January 2010.

Table 28 Financial – project NPV (pre tax) nominal cash flows ($ million, discounted, excluding financing costs)[41]

Government D&C	1,880 km scenario			1,690 km scenario		
Operations commence:	2020	2030	2040	2020	2030	2040
Indicative capital cost	-2,006	-1,177	-693	-2,673	-1,568	-923
Below rail operating revenue	1,830	1,257	832	1,504	1,095	758
Below rail operating cost	-585	-339	-192	-504	-292	-165
Project NPV – operating cashflows only (excluding capital costs)	1,245	918	640	1,000	803	594
Project NPV – total project cashflows	-761	-259	-53	-1,672	-765	-329

Note: excludes financing cost (debt and equity). Figures in this table may not total due to rounding
Note: as described further below, Narrabri-Werris Creek revenue affects comparability of 'operating revenue' as it is included in the 1,880 km scenario only. Removing this revenue stream results in the 1,690 km scenario generating higher total revenues.
Note: the financial appraisal presented in this paper continues assuming Stage 1 capital estimates as a revised capital cost figure was not developed for the whole railway in Stage 2.

The table above indicates that despite delaying construction of the inland railway until 2040, below rail revenue is not sufficient to recover the significant capital outlay required for construction of the inland railway. The table also indicates, however, that the Inland Rail project results in positive operational cashflows (i.e. if capital costs are excluded). However

[41] Note: coal revenue assumptions for Stage 1 are based on a simplified assumption of $2/tonne for Toowoomba-Brisbane coal, and $1/tonne for Narrabri coal. In addition, Werris Creek–Narrabri revenues for the 1,800 km scenario are capped at $40m, reflecting an approximation of the impact of regulated maximum prices on revenues generated on this part of the corridor.

when financing costs are included in Stage 3, the net operating cashflows are likely to reduce.

Table 32 also indicates that financial viability of the project worsens under the 1,690 km scenario, and despite an increase in demand resulting in an increase in access revenue for the track operator, this is not estimated to be sufficient to fund the higher capital costs and subsequent borrowing costs. An important assumption that affects comparability of the two transit time scenarios is the question of Narrabri-Werris Creek revenue. This revenue is included in the 1,880 km scenario (despite these mines being very likely to use existing rail lines if there is no Inland Rail) but not the 1,690 km scenario. If the revenue is removed from the 1,880 km scenario financial results, then the 1,690 km scenario results in higher access revenue over the appraisal period.

Financial sensitivities

From the financial outputs generated, sensitivity analysis has been undertaken for the WACC used to discount the cash flows in order to assess impacts on project viability. In doing so, the following discount rate variations have been assessed in the financial analysis.

- Discount rate of 8.43% Post tax, Nominal (Base Case)
- Discount rate of 6.43% Post tax, Nominal (reduction of 2% from Base Case)
- Discount rate of 10.43% Post tax, Nominal (increase of 2% from Base Case)

The table below summarises the results.

Table 29 Discount rate Sensitivity analysis ($ million, discounted, 2010 dollars)

Government D&C	1,880 km scenario			1,690 km scenario		
Operations commence:	2020	2030	2040	2020	2030	2040
6.43% Post Tax, Nominal	137	378	414	-998	-363	-61
8.43% Post Tax, Nominal	-761	-259	-53	-1,672	-765	-329
10.43% Post Tax, Nominal	-1,050	-400	-142	-1,801	-753	-306

The table above shows that at different discount rates the overall project viability remains negative, with the exception of the 1,880 km scenario at the lower 6.43% discount rate. At higher discount rates the viability reduces, due to the compounded effect of applying a larger discount factor to future cash flows which are being increased annually at a lower rate.

Sensitivity analysis has also been performed assuming operations commence in 2020 to assess the impact of movements in demand and capital cost on project NPV cashflows. The following tables summarise the results.

Table 30 Net project cashflows – demand/capital cost sensitivity analysis ($ million, discounted, 2010 dollars, excluding financing costs)

Operations commence: 2020	1,880 km scenario			1,690 km scenario		
Sensitivities – Demand and Capital Costs	Demand -30%	Demand (no change)	Demand +30%	Demand -30%	Demand (no change)	Demand +30%
Lower bounds – (capital costs -35%)	-1,231	-682	-133	-2,019	-1,567	-1,116
Capital costs (no change from core appraisal)	-1,310	-761	-212	-2,124	-1,672	-1,221
Upper bounds (capital costs +35%)	-1,389	-840	-291	-2,229	-1,777	-1,326

As indicated in Table 34, the NPV of project cashflows is most sensitive to changes in demand. Changes in demand affect project viability as a fall in tonnage demand results in less revenue generated by Inland Rail. The financial viability is also highly sensitive to changes in capital costs however, indicating that if these costs increase during further Stage 3 analysis, financial viability of the Inland Rail will worsen.

7.1.2 Summary of financial results

In summary, the results of the Stage 2 financial assessment that Inland Rail does not appear financially viable on a standalone commercial basis. While most new coal and iron ore railways are funded by industry often without a government contribution, most new long distance highways and general freight railways have required a significant capital contribution or service payment in order for the infrastructure to be developed and commissioned. The inland railway has the same requirement, as indicated by the results of the Stage 2 financial assessment that it does not appear commercially viable on a standalone basis.

7.1.3 Potential impact on ARTC revenue

This financial analysis presented in this working paper does not incorporate financial effects on ARTC of Inland Rail, such as revenue loss or coastal route capital or maintenance cost savings from decreased volumes.

In the table below, an estimate of access revenue loss to the ARTC as a result of reduced freight volumes travelling from Melbourne-Brisbane, northern Queensland-Melbourne, Adelaide-Brisbane, and Perth-Brisbane on the coastal railway, as the demand modelling has indicated the volumes that will divert from these origin-destination pairs to Inland Rail.

Table 31 Estimated annual revenue loss to ARTC of coastal rail access revenue

Indicator	With or without Inland Rail	Per annum estimate (1) 1,880 km scenario			Per annum estimate 1,690 km scenario		
	Operations commence:	2020	2030	2040	2020	2030	2040
Coastal rail intercapital volumes	*Base case* – without Inland Rail (million ntk)	8,200	11,490	16,100	8,200	11,490	16,100
	Inland Rail Scenario – with an Inland Rail (million ntk)	5,310	1,820	2,420	5,090	540	640
Coastal rail revenue	*Base case* – without Inland Rail ($ millions, undiscounted, nominal)	$70	$133	$250	$70	$133	$250
	Inland Rail Scenario – with an Inland Rail ($ millions, undiscounted, nominal)	$46	$21	$38	$44	$6	$10
ARTC coastal rail annual revenue loss	**Annual revenue loss due to Inland Rail ($ millions, undiscounted, nominal)**	**$25**	**$112**	**$212**	**$27**	**$126**	**$240**
	Revenue loss as a % of ARTC revenue	**3%** (2)	**10%** (2)	**13%** (2)	**3%**	**11%**	**15%**

Source: ACIL Tasman logit model
Note: the volumes and revenues included in the table above comprise Melbourne-Brisbane, Northern Queensland-Melbourne, Adelaide-Brisbane, and Perth-Brisbane on the coastal railway
Note: (1) these are 'annual' estimates, not to be confused to 'commencement years' for Inland Rail operation; (2) ARTC revenue based on 2007/08 Annual Report, increased by 3.5% p.a.

As indicated in the table above, Melbourne-Brisbane, northern Queensland-Melbourne, Adelaide-Brisbane, and Perth-Brisbane freight volumes on the coastal railway are estimated to reduce by between 3-15 billion ntk per annum if an inland railway is constructed. This contributes directly to future ARTC revenue. As a result of the inland railway, the ARTC is estimated to lose $25-27 million in the year 2020 (nominal, undiscounted), increasing in later years to more than $212 million in 2040. On a present value basis, the total loss to ARTC over the 2010-2080 analysis periods is $1.6-1.8 billion, representing 10-12% of ARTC revenue discounted on the same basis.

7.2 Economic results

The methodology for this CBA uses a conventional incremental-to-the-base-case analysis. It also looks at the north-south freight corridor from a holistic or national perspective to incorporate incremental costs and benefits from the development of Inland Rail. The initial economic assessment that has been completed includes costs and benefits accruing to likely users and non-users of Inland Rail benefits. These include freight time savings to end customers, train operator and road freight cost savings, net economic value from induced freight, road maintenance savings and environmental externality cost savings resulting from development of Inland Rail. The economic assessment covers the Inland Rail scenario with three different operating commencement years, assessed incrementally to the Base Case to represent the net economic benefits to community that are expected from the proposed railway. The Inland Rail scenario assumes that coastal route upgrades will take place regardless of whether Inland Rail development occurs. The table below summarise the economic indicators for Inland Rail with variations of the three operational start dates (2020, 2030 and 2040).

The economic assessment presented in this working paper incorporates a range of key updates and amendments since the Stage 1 appraisal, which are presented in Section 6.1. As a result of these amendments, the economic NPV has deteriorated from the Stage 1 1,880 km scenario results of: -$860 million, -$379 million and -$160 million respectively for commencement of Inland Rail operation in 2020, 2030 and 2040. For the 1,690 km scenario the economic NPV has improved from the Stage 1 High Capital Cost results of -$976 million, -$399 million and -$147 million respectively for the 2020, 2030 or 2040 Inland Rail operations.

Table 32 Economic – appraisal results for Inland Rail (incremental to the Base Case, $ million, discounted, 2010 dollars)

Economic indicators	Inland Rail ($2.81b capital cost / 1,880 km scenario)			Inland Rail ($3.75b capital cost / 1,690 km scenario)		
Operations commence:	2020	2030	2040	2020	2030	2040
Economic NPV	-1,229	-554	-300	-923	-252	-71
Economic benefit cost ratio (BCR)	0.27	0.36	0.39	0.58	0.77	0.89
NPVI	-0.91	-0.80	-0.74	-0.49	-0.26	-0.13
Economic IRR	1%	1%	1%	4%	6%	6%

Note: capital cost figures that form the basis for the economic appraisal are indicative and subject to change in Stage 3

As indicated in Table 36, economic viability improves under a 1,690 km scenario; however NPVI remains negative. The improvements in economic viability is a result of an increase in mode shift from road and coastal railway to the inland railway, combined with a reduction in hours travelled for freight diverting to the inland railway. As presented in the table above, this working paper currently presents a comparison of Inland Rail viability based on three different commencement years. It notes it may be more meaningful to provide 'tonnage' rather than 'date' thresholds, and this will be developed further in Stage 3.

To provide further detail on the costs and benefits that are captured in the economic appraisal, and their relative scale, Table 37 shows a breakdown of benefits and costs by category and by party affected.

Table 33 Economic – breakdown of economic costs and benefits by start date (incremental to Base Case, $ million, discounted, 2010 dollars)

Present value (@ 7% real discount rate) $ million	Operations commence:		
	2020	2030	2040
1,880 km scenario			
PV of total benefits	**458**	**307**	**189**
Operating cost savings *(rail users)*	317	208	123
Value of time savings *(rail users)*	8	5	4
Net economic benefit of induced freight *(producers)*	41	20	10
Crash cost savings *(road & rail users)*	21	17	11
Environmental externalities *(non-users)*	10	9	6
Value of residual assets (in 2081) *(Financial)*	6	7	10
Road maintenance savings *(financial)*	55	41	26
PV of total costs	**-1,687**	**-861**	**-489**
Operating expenses *(financial)*	-334	-167	-82
Capital expenses *(financial)*	-1,353	-694	-407
NPV (@7%)	**-1,229**	**-554**	**-300**
1,690 km scenario			
PV of total benefits	**1,260**	**863**	**547**
Operating cost savings (rail users)	766	520	324
Value of time savings (rail users)	312	212	136
Net economic benefit of induced freight (producers)	38	19	9
Crash cost savings (road & rail users)	35	27	17
Environmental externalities (non-users)	20	16	10
Value of residual assets (in 2081) (Financial)	8	10	13
Road maintenance savings (financial)	80	59	37
PV of total costs	**-2,183**	**-1,115**	**-617**
Operating expenses (financial)	-307	-153	-75
Capital expenses (financial)	-1,876	-961	-542
NPV (@7%)	**-923**	**-252**	**-71**

As indicated in the table above, under the 1,690 km scenario train and vehicle operating cost savings and travel time savings are higher than the 1,880 km scenario, which more than offset the increase in capital costs (a 39% increase above the 1,880 km scenario capital costs). Attachment C describes the travel time savings benefit in further detail. However as indicated in Chapter 6, the parameter used to calculate this benefit is considered to be conservative.

Overall the scale of a range of the economic benefits is relatively low. These can be explained by a number of factors including:

- mode shift from road to rail is modest compared to that of the shift from the coastal route (rail to rail), as a result externality savings are minimal;

- as the inland railway traverses mostly rural areas, the economic parameters used to value externality benefits such as reduced noise and greenhouse gas emissions as a result of freight shifting from road to rail, are lower compared to urban rates;
- induced freight (largely coal) creates more externality costs, though this is offset by the net economic value generated from inducing new freight volumes; and
- for the 1,880 km scenario, the extent of travel time savings is low due to ARTC's planned improvements on the coastal railway. (The planned coastal railway improvements are assumed to allow for a coastal terminal to terminal transit time of 28 hours.)

The table above shows that the main economic benefits are found through operating cost savings. These arise as a result of transfer of freight from road to rail, shorter/flatter route and more efficient track; time savings through the coastal to inland railway shift; producer net economic benefits as a result of new freight being of induced as a result of Inland Rail; and road maintenance savings through road to rail shift.

Economic sensitivities

The following sensitivities have been performed to illustrate the scope to improve (or worsen) economic outcomes with +/-35% changes in capital cost and demand.

Table 34 Economic sensitivity analysis: demand and capital cost ($ million, discounted, 2010 dollars)

NPV Inland Rail – Operations commence: 2020 (@ 7% discount rate)	Demand -30%	Demand (as per WP12)	Demand +30%
1,880 km scenario			
Lower bound (capital costs -35%)	-816	-680	-543
Capital costs ($2.81 billion)	-1,365	-1,229	-1,092
Upper bounds (capital costs +35%)	-1,914	-1,778	-1,641
1,690 km scenario			
Lower bound (capital costs -35%)	-567	-192	184
Capital costs ($2.81 billion)	-1,299	-923	-547
Upper bounds (capital costs +35%)	-2,030	-1,654	-1,278

This table indicates that even if capital costs are reduced by 35% and forecast demand increased by 30% the project remains not economically viable for the 1,880 km scenario, however becomes viable for the 1,690 km scenario. This table (along with Table 39 below) indicate that the economic viability of the Inland Rail is most sensitive to the scale of capital expenditure, and consequently if these costs increase during further Stage 3 analysis, economic viability of the Inland Rail will worsen.

Table 35 Economic sensitivity analysis: capital costs and discount rate, $ million, discounted, 2010 dollars)

NPV Inland Rail – Operations commence: 2020	4% discount rate	7% discount rate	10% discount rate
1,880 km scenario			
Lower bound (capital costs -35%)	-816	-680	-543
Capital costs ($2.81 billion)	-1,365	-1,229	-1,092
Upper bound (capital costs +35%)	-1,914	-1,778	-1,641
1,690 km scenario			
Lower bound (capital costs -35%)	-567	-192	184
Capital costs ($2.81 billion)	-1,299	-923	-547
Upper bound (capital costs +35%)	-2,030	-1,654	-1,278

Note: under a 10% discount rate, the economic NPV improves for the 1,880 km scenario. This is slightly misleading, as the BCR actually reduces. However, as a result of all costs and benefits reducing in net present terms for this scenario, the economic NPV appears to have improved

The table above highlights that at different discount rates the project's economic viability remains negative, with the exception of the 1,690 km scenario under a 4% discount rate. At a discount rate of 4%, the 1,690 km scenario is economically viable at all three commencement options examined. For the 1,880 km scenario, a 4% discount rate greatly improves economic results.

A key finding in these sensitivity analyses is that the economic viability of Inland Rail appears to be most sensitive to changes in capital costs, with an increase/decrease of 35% resulting in the NPV increasing/decreasing 45-80% depending on the Inland Rail scenario. In addition, the economic viability is more sensitive to a lower (4%) discount rate than an increase in demand of 30%.

7.3 Summary of financial and economic results

While the majority of new coal and iron ore railways are funded by industry often without a government contribution, most new long distance highways and general freight railways have required a significant capital contribution or service payment in order for the infrastructure to be developed and commissioned. The inland railway has the same requirement, as indicated by the results of the Stage 2 financial assessment that Inland Rail does not appear commercially viable without an upfront government capital contribution or annual service payment during operations, or some combination thereof. In addition to these financial results, analysis in Stage 2 indicates that Inland Rail does not achieve a positive economic NPV at a 7% real discount rate.

7.4 Results – alternative demand scenarios

The FEC has undertaken Stage 2 analysis for two alternative demand scenarios, in order to provide further insight into the financial and economic viability of Inland Rail under these scenarios. The alternative demand scenarios are:

1. revisions to demand based on industry feedback; and
2. impact if demand is capped at 2040 levels.

Results with more sensitive demand

The financial and economic results discussed above are based on ACIL Tasman's assessment of demand based on the approach presented in WP1 and in Chapter 3 in this paper. Included for comparison with these results, Table 40 shows the financial and economic appraisal results based on demand more sensitive to service and price characteristics following ARTC and industry feedback.

During the course of the analysis, ARTC raised a conceptual issue regarding the ACIL Tasman logit model. This model captures four characteristics (price, reliability, availability, transit time) and also includes a 'constant' term that recognises that there is more to the competitive decision than those four characteristics alone – for example:

- past performance;
- preferences regarding double handling;
- unsuitability of a particular mode for a particular product (e.g. rail is preferred for dangerous goods, very dense products and cars);
- efficient infrastructure arrangements at rail loading and receiving terminals (e.g. steel);
- avoidance of damage; and
- flexibility and convenience.

The impact of having a non-zero constant is that even if price and service characteristics were exactly equal between two different modes, the constant would determine that the market shares would not be equal. In Stage 2, ACIL Tasman has calibrated the constant to recognise the operation of time lags in the determination of actual mode choices[42].

The conceptual issue raised by ARTC was whether, in the case of contestable non-bulk freight traffic, the calibration process should be subjected to the constraint that mode shares should be equal when the different modes have the same service characteristics. This in effect assumes that the non-bulk market is completely contestable between road and rail freight services. In demand modelling terms, it implies that the constant should be zero, and the observed elasticities should be calibrated (i.e. re-balanced) to ensure the correct modal shares in 2008[43].

The consequence of this assumption is that general market share is more responsive to changes in the modelled characteristics than would be the case otherwise (i.e. the elasticities are higher). In other words, the other possible characteristics listed above have no influence. The result of using these higher elasticities is a much greater sensitivity to changes in quality and price of service. Therefore the model allocates much greater market share to Inland Rail although this is mostly taken from the coastal railway.

The effect of using the higher elasticities on the intercapital mode share is presented below in Table 40 in comparison with the core appraisal. (For the core appraisal the logit model uses elasticities obtained from ACIL Tasman's surveys of customers, potential customers and freight forwarders, calibrating the model coefficients to the observed market shares for road and rail.)

[42] Thus the calibration of the constant was undertaken to ensure that the model coefficients, when combined with the service characteristics relating to previous years (i.e. lagged characteristics) produces the modal shares for 2008.

[43] For each commodity there are four unknowns, but only one equation to calibrate to the required market share, hence there are an infinite number of combinations of elasticities that combine with a zero constant. To solve for the elasticities ACIL Tasman used Excel's solver and evaluated how far the solved elasticities are from the survey evidence. The final result is a blend of zero constant and survey-derived elasticities.

Table 36 Intercapital rail market share for a selection of years and under each demand approach (Operations commence: 2020)

Demand approach	Scenario	2008	2020	2040	2060
Core appraisal & ACIL Tasman assumptions	Base case	29%	44%	50%	58%
	1,880 km scenario	29%	45% (10% Inland Rail)	53% (45% Inland Rail)	62% (53% for Inland Rail)
	1,690 km scenario	29%	45% (12% Inland Rail)	56% (55% Inland Rail)	65% (63% for Inland Rail)
Demand with more sensitive elasticities	Base case	29%	53%	58%	65%
	1,880 km scenario	29%	55% (15% Inland Rail)	66% (66% Inland Rail)	72.7% (72.2% for Inland Rail)
	1,690 km scenario	29%	56% (16% Inland Rail)	70% (70% Inland Rail)	76.5% (76.4% for Inland Rail)

ACIL Tasman's analysis using the higher elasticities indicates that volumes of intercapital non-bulk and extra-corridor freight expected to travel via the inland railway are significantly higher as a result of the increased sensitivity to service and price characteristics. This is because in selecting these higher elasticities the movements in service characteristics give rail a larger proportion of the market, and this increases over time as a result of movements in the relative price of rail. In addition, under this alternative scenario much of the initial increase in rail's modal share will occur even without Inland Rail – the improvements in coastal service lead to market share for coastal rail of 53% in 2019, the year before Inland Rail is introduced. Inland Rail then predominantly diverts market share from coastal rail.

Table 41 presents the financial and economic appraisal results with the increased sensitivity to service and price characteristics and resulting mode share assumptions.

Table 37 Comparison of core and optimistic demand scenarios ($ millions, discounted, 2010 dollars)

Financial/economic indicator	1,880 km scenario Core demand			Demand with more sensitive elasticities (1,880 km scenario)		
Operations commence:	2020	2030	2040	2020	2030	2040
Financial results – project net present value (excluding financing costs)	-761	-259	-53	-444	-18	116
Economic results – net present value	-1,229	-554	-300	-1,055	-439	-233
	1,690 km Inland Rail Core demand			Demand with more sensitive elasticities (1,690 km scenario)		
Financial results – project net present value (excluding financing costs)	-1,672	-765	-329	-1,431	-584	-206
Economic results – net present value	-923	-252	-71	-546	-3	76

As indicated in Table 41, the financial and economic results for Inland Rail scenario improve with the higher elasticities and resulting higher demand. However Inland Rail is still not financially viable if operations commence in 2020 or 2030. Economically, the 1,690 km scenario becomes viable under this demand when operations are assumed to commence in 2040. Financially, the 1,880 km scenario becomes viable when operations commence in 2040.

Results with demand capped at 2040 levels

In February 2009, SAHA International conducted a peer review of WP1. One of the main issues identified by SAHA is the diminishing reliability of forecasts which extend over 70 years.

In order to understand the extent to which this issue impacts the results was tested in this stage by capping tonnages at 2040 levels as a sensitivity test. This essentially assumes that in the long term demand levels are uncertain.

The impact on the financial and economic appraisals of this analysis is presented in Table 42.

Table 38 Comparison of capped and uncapped demand scenarios ($ millions, discounted, 2010 dollars)

Financial/economic indicator Operations commence:	1,880 km scenario Core demand			1,880 km scenario Capped demand		
	2020	2030	2040	2020	2030	2040
Financial results – project net present value (excluding financing costs)	-761	-259	-53	-981	-479	-273
Economic results – net present value	-1,229	-554	-300	-1,273	-598	-345
	1,690 km scenario Core demand			1,690 km scenario Capped demand		
Financial results – project net present value (excluding financing costs)	-1,672	-765	-329	-1,926	-1,019	-583
Economic results – net present value	-923	-252	-71	-1,090	-419	-238

As indicated in Table 42, the financial and economic results for Inland Rail scenario are slightly worsened when demand is capped at 2040 levels.

7.5 Results – changes to key assumptions

The FEC has undertaken Stage 2 analysis with changes to key assumptions, to assess the financial and economic viability of Inland Rail under these varying scenarios. The changes to key assumptions presented in this chapter are:

1. results with higher reliability to compete with road; and
2. results if Inland Rail terminates at Toowoomba.

Results with varied reliability assumptions

In Stages 1 and 2, an initial assumption has been made about the level of reliability after discussions with the LTC about achievable levels and appropriate amounts of timetabling slack. This led the FEC to an initial assumption of 85% of inland railway journeys being within 15 minutes of scheduled time – this compares with an estimated 70% reliability for coastal rail and 98% reliability for road. This sensitivity analysis examines the impact on demand from a change in reliability on Inland Rail.

Table 43 presents the financial and economic appraisal results with the core appraisal reliability levels (85-87.5%), in comparison with higher (95-97.5%) reliability and lower (75-77.5%) reliability.

These results should be viewed with caution, as there has been no change in capital costs made to compensate for increased or decreased reliability levels. Considering this, it is likely that the 95% reliability results are optimistic.

Table 39 Comparison of core appraisal and changes in reliability for both 1,880 and 1,690 km scenarios ($ millions, discounted, 2010 dollars)

Financial/economic indicator	75% reliability			Core appraisal 85% reliability			95% reliability		
1,880 km scenario Operations commence:	2020	2030	2040	2020	2030	2040	2020	2020	2040
Financial results – project net present value (excluding financing costs)	-922	-387	-147	-761	-259	-53	-669	-186	0
Economic results – net present value	-1,286	-592	-324	-1,229	-554	-300	-1,168	-513	-275
1,690 km scenario Operations commence:	2020	2030	2040	2020	2030	2040	2020	2020	2040
Financial results – project net present value (excluding financing costs)	-1,737	-815	-365	-1,672	-765	-329	-1,630	-732	-306
Economic results – net present value	-1,024	-321	-113	-923	-252	-71	-836	-193	-35

As indicated in Table 43, an improvement in assumed reliability and the subsequent increase in demand were not found to result in economic viability or financial viability.

The results above reflect that demand responds to reliability. Further ACIL Tasman analysis suggests that if Inland Rail could offer 100% reliability (with price and other service characteristics held constant) it could gain 50% of the market, essentially sharing the market with road (48%), because road offers reliability of approximately 98%.

Results if Inland Rail terminates at Toowoomba

Whilst assessment of terminating the railway at Toowoomba is technically out of scope in not being consistent with the terms of reference to evaluate a Melbourne to Brisbane inland railway, in this working paper the financial and economic outcomes of this option have been tested to attempt to understand and resolve all different options that offer potential to improve viability.

Because of high capital costs in the Toowoomba ranges, a staged approach could be considered, with an initial Inland Rail from Melbourne to near Toowoomba and the remainder constructed later. Capital costs in the order of $1.2 billion would be deferred, however a longer pick up and delivery distance increases the risk of full road haul.

There would be a negative impact on demand as a result, given that pick up and delivery would be required from Toowoomba to the freight's final destination. The costs of trucking containers between Toowoomba and destinations in the Brisbane area are a multiple of the cost of trucking them from the current terminal at Acacia Ridge. Further, these costs are only partly offset by lower rail rates (unless there was a major change in the structure of rail access charges). Freight going to or from north Queensland by rail would use the coastal route, transferring from one train to another at Acacia Ridge rather than switching twice (rail-truck-rail). In addition, the diversion of coal and grain from road to rail in southern Queensland forecast in the core appraisal would not occur, neither would increases in coal freight from the East Surat area near Toowoomba.

A sensitivity analysis has been undertaken to establish the financial and economic viability if Inland Rail were to terminate at Toowoomba. Important assumptions include:

- $1.2 billion (2008 dollars, undiscounted) will be saved on Inland Rail capital costs;
- rail transit time of 24.5 hours assumed (3 hour reduction from the core appraisal);
- pick up and delivery time increased by 2 hours to accommodate Toowoomba-Brisbane trucking required;
- pick up and delivery costs increased by $15 per tonne (this is relatively conservative, as ACIL Tasman estimates indicate this could be increased by up to $45 per Brisbane – Melbourne trip);
- rail route distance reduced by 122 km (to remove Toowoomba-Brisbane section of the line);
- freight transport costs were reduced in line with an assumption that the access price charged on Inland Rail will reduced by 3/27.5 per tonne in the demand forecasts (i.e. assumed to relate to time not distance);
- reliability and availability are unchanged from the core appraisal;
- other freight changes:
  - assumed no coal will travel from Oakey/Toowoomba to Brisbane on Inland Rail;
  - assumed there will be no agricultural diversions from North Star or Toowoomba to Brisbane; and
  - assumed that northern Queensland-Melbourne freight will stay on the coastal railway and will not divert to Inland Rail.

Table 44 presents the financial appraisal results for a Melbourne-Brisbane Inland Rail compared to a Melbourne-Toowoomba railway.

Table 40 Comparison of 1,880 and 1,690 km Melbourne-Brisbane routes and Melbourne-Toowoomba railway ($ millions, discounted, 2010 dollars)

Financial/economic indicator	1,880 km scenario (Melbourne-Brisbane)			1,690 km scenario (Melbourne-Brisbane)			Melbourne-Toowoomba		
Operations commence:	2020	2030	2040	2020	2030	2040	2020	2030	2040
Financial results – project net present value (excluding financing costs)	-761	-259	-53	-1,672	-765	-329	-374	-70	44
Economic NPV @ 7% discount rate	-1,229	-554	-300	-923	-252	-71	-779	-414	-283
Economic BCR @ 7% discount rate	0.27	0.36	0.39	0.58	0.77	0.89	0.10	0.06	-0.02

As indicated in Table 44, if Inland Rail terminates at Toowoomba, it does not become financially or economically viable for operations commencing in 2020 or 2030. More specifically, however:

- *the efficiency of economic benefits relative to costs decreases*, with the economic BCR reducing in comparison to both Inland Rail scenarios assessed. This indicates lower efficiency of spend, i.e. less benefits are generated for each $1 of cost;
- *the net economic benefits improve* relative to both the 1,690 and 1,880 km scenarios when operations are assumed to commence in 2020; and
- *financial viability improves* due to a reduction in capital costs for both the 1,880 and 1,960 km Melbourne-Brisbane Inland Rail scenarios.

Broadly, the results of the additional demand and assumption analyses presented above indicate that the financial and economic appraisal results are relatively volatile and critically dependent on the scale of assumptions.

7.6 Results – implications for corridor preservation

The analysis presented this paper considers an inland railway commencing operations in 10, 20 or 30 years time, and a construction period of approximately five years prior to that. This raises the issue of 'corridor preservation', as there is a risk the identified route will be affected by residential, mining or agricultural development on the chosen alignment.

Taking steps to protect the corridor against encroachments are likely to be worthwhile, as it may reduce potential future costs purchasing land that is improved before construction begins and of extended planning approval processes to acquire land. It also minimises the need to move residential, commercial or agricultural activities, thus reducing disruption to communities and businesses. At its most extreme, development on unreserved corridors can result in the need for expensive tunnelling works, due to the financial costs and public acceptability of relocating surface activity.

When a specific corridor is identified, there are implications for the owners and occupiers of the affected residential, commercial or agricultural land that should be considered in a corridor preservation strategy. For example, the value of land is often directly affected because potential purchasers are concerned about the long term. Decisions about making improvements to the land are also complicated by a concern that the improvements may be not be worthwhile (for example, a business may not wish to make improvements to a factory because of the enhanced risk that the factory will be acquired and so reduce the return on the investment).

Options open to the government for consideration of these issues include:

1) *Pre-purchase land that is not already publicly owned.* Although requiring upfront purchase of land that may not be used for long periods, there may be long term financial benefits once the development proceeds. In addition it provides the private sector with information to help guide future investment decisions. Such land reservations are common in Australian cities, and often date back several decades.

2) *Provide high level maps of the possible route or broad corridor to the public.* This approach provides the private sector with information to help guide future investment decisions, but does little to address the risk that land improvements may occur in the chosen corridor and so the increase in future costs. This approach may be more applicable where major land improvements are unlikely – for instance in remote agricultural areas.

3) *Identify a detailed 'easement' level that is released to the public, without purchasing the affected land.* This alerts the public and the business community to the likelihood that land will be acquired shortly before construction. It gives the community a degree of certainty and reduces the likelihood of land improvements going ahead. However, it may lead to an obligation on government to purchase the land immediately or to pay compensation.

Three case studies of other corridor preservation strategies for projects in Australia are presented below.

Case study 1 – Victorian Outer Metropolitan Ring Transport Corridor

The Victorian Government is currently planning the development and construction of a 70 km Outer Metropolitan Ring Transport Corridor intended to link Werribee, Melton, Tullamarine and Craigieburn/Mickleham. As construction is not expected to occur before 2020, the government has employed the following corridor preservation strategy:

- *early public release of a detailed route map and information brochures to reserve land* – in 2009 a proposal containing a detailed route map was released for community consultation and a series of information open days were held in June and July 2009. In addition a land acquisition and compensation brochure has been distributed to those affected by the route locations, outlining the processes involved with land acquisition, including the compulsory acquisition powered under the Victorian *Road Management Act*; and
- *land acquisition planned closer to the possible 2020 construction date* – the Victorian Government plans to acquire land shortly before construction gets underway, which is unlikely to occur before 2020. Under the *Road Management Act,* the Victorian Government provides compensation to property owners for any financial loss suffered on the sale of property due to announcement of proposed plans.[44]

Case study 2 – NSW F6 Motorway

For several years the NSW Department of Planning and the Roads and Traffic Authority of NSW (RTA) have been assessing the F6 corridor and local road connections in NSW for public transport development options.[45] As part of a 2004 study of the motorway, the issue of corridor preservation was addressed in the following manner:

- *a corridor was identified that is mainly public land* – the study identified an F6 corridor with a mix of private and public land. The majority of the corridor is publicly owned by various State and Local Government agencies. For example, the corridor comprises sections located in Royal National Park and owned by several local city councils;
- *strategic zoning of public land* – some sections along the corridor have previously been zoned by councils in their Local Environment Plans as ‘Special Use – Future Arterial Road’ or ‘Arterial Road and Arterial Road widening’, which has preserved the areas for potential transport development; and
- *public release of a wider ‘easement’* – in the public release of the study outcomes, a detailed route map was released that presents an ‘easement’ that is significantly wider than required for the proposed F6 development. As an indication, the ‘easement’ presented in the public documents is approximately 180 hectares of land (with a 20 km length and average width of 90 m). However, the maximum width for proposed development is approximately 40 m in width. It does not appear that the NSW Government has pursued a strategy beyond this to purchase or preserve land.

Case study 3 – Sydney CBD Metro

The NSW Government has established a Sydney Metro Authority to design, build and manage a new metro rail network that will run on a north-south alignment underground

[44] Department of Transport, Victoria (2008). Website: http://www4.transport.vic.gov.au/vtp/projects/outerring.html

[45] Department of Infrastructure, Planning and Natural Resources and Road and Traffic Authority, NSW (2004), M6 Corridor Public Transport Use Assessment, Final draft report.

Sydney's CBD. Construction is expected to begin in 2010 and the first metro trains will run in 2015. Although the 7 km metro is entirely underground (which minimises land acquisition requirements), there will be some facilities on the surface such as station entrance and exit points.[46] As the CBD metro corridor is densely developed, some privately owned property will need to be acquired. The Sydney Metro Authority addressed the issue of property acquisition by:

- *sending letters to property owners in the proposed corridor* – letters were sent notifying property owners that their property had been flagged as it was within the proposed corridor and may need to be acquired for the metro;
- *community consultations* – as part of the Environmental Assessment, community consultations were held focusing on areas that may be affected by construction and properties which might need to acquired for station access;
- *public release of an information fact sheet* – the Sydney Metro Authority released a fact sheet detailing property acquisition procedures; and
- *Government plans to use public land (where possible)* – White Bay was chosen as the stabling and maintenance site as the land was already publicly owned and did not need to go through a property acquisition process.

Implications for Inland Rail

For Inland Rail, the impact of corridor preservation is somewhat minimised given the railway is expected to make use of existing rail lines for the majority of the route (under both transit time scenarios). The appropriate strategy for the inland railway – or combination of strategies – will need to be identified once the corridor(s) have been identified. In Stage 3, the optimal approach will be considered further.

7.7 Route identified for further analysis in Stage 3

Overall, the results of the Stage 2 financial and economic assessment are that Inland Rail does not appear financially viable on a standalone project basis. In addition, the economic results indicate that Inland Rail is not economically viable.

Comparing a 1,880 km scenario with a 1,690 km scenario (which has a faster transit time, shorter route distance, higher capital costs but also higher demand), indicates the 1,690 km scenario improves economic but not financial viability. More specifically, economic viability improves as a result of an increase in mode shift from road and coastal railway to the inland railway, combined with a reduction in hours travelled for freight diverting to the inland railway. However, the financial viability is worsened as a result of the significant capital cost and subsequent borrowing cost increases while demand and revenues are not estimated to increase by the same scale.

The reason for the different impact on financial and economic viability as a result of the 1,690 km scenario is that whilst the increased cost of the projects is reflected in both the economic and financial appraisals, the benefits are not captured symmetrically. There are two main explanations for this:

First, a series of *significant economic benefits are not captured in the financial analysis*. The 1,690 km scenario causes an increase in mode shift from road and the coastal railway to the inland railway – i.e. demand rises. The impact of increased demand is reflected in the financial analysis via additional revenues. However, two economic benefits are not captured.

[46] Sydney Metro, NSW (2009) CBD Metro Fact Sheet: Property acquisition for the CBD Metro: Information for property owners, March 2009.

- *Train operating costs (incurred by train operators).* These costs, which include costs relating to fuel, train crew and rollingstock maintenance are estimated based on input from the LTC, at approximately 10% lower for the 1,690 km scenario, as the route is shorter and requires less transit time relative to the 1,880 km scenario. This results in greater economic benefits due to cost savings for freight diverting from both the coastal railway and from road to Inland Rail. However, the additional operating cost savings from the 1,690 km scenario are not captured in the financial analysis as it is a below rail financial appraisal. In reality, this economic benefit might be captured by increasing the rail access charges, but this has not been factored into the financial appraisal at this stage, but could result in a reduction in demand is prices were significantly higher than the coastal route or road.
- *Transit time savings.* For freight currently travelling on rail and road that is expected to shift to the inland railway, as well as induced freight that is not currently freighted under existing conditions, the faster transit time of the 1,690km scenario results in significant savings relative to the 1,880 km scenario. For example, freight expected to be transported on the coastal railway if there is no Inland Rail, is assumed to have a terminal-to-terminal transit time of 28 hours. Under a 1,880 km scenario, this freight will save only 0.5 hours on a Melbourne-Brisbane trip relative to the coastal rail. However under a 1,690 km scenario, the freight will save 6 hours per trip. This represents a very significant increase in time savings. Similarly, while freight expected to shift from road to the inland railway is estimated to experience a longer transit time to/from the railhead, which offsets the economic savings from a faster rail journey, this increase in time is significantly reduced under the 1,690 km scenario (i.e. instead of door-to-door transit time increasing by 10.5 hours under the 1,880 km scenario, it will only increase 5 hours for an average Melbourne-Brisbane trip under the 1,690 km scenario). Again, these economic benefits (or reduced negative impacts) are not captured in the financial analysis. Further, in reality, this economic benefit might be captured by increasing the rail access charges, but this has not been factored into the financial appraisal at this stage.

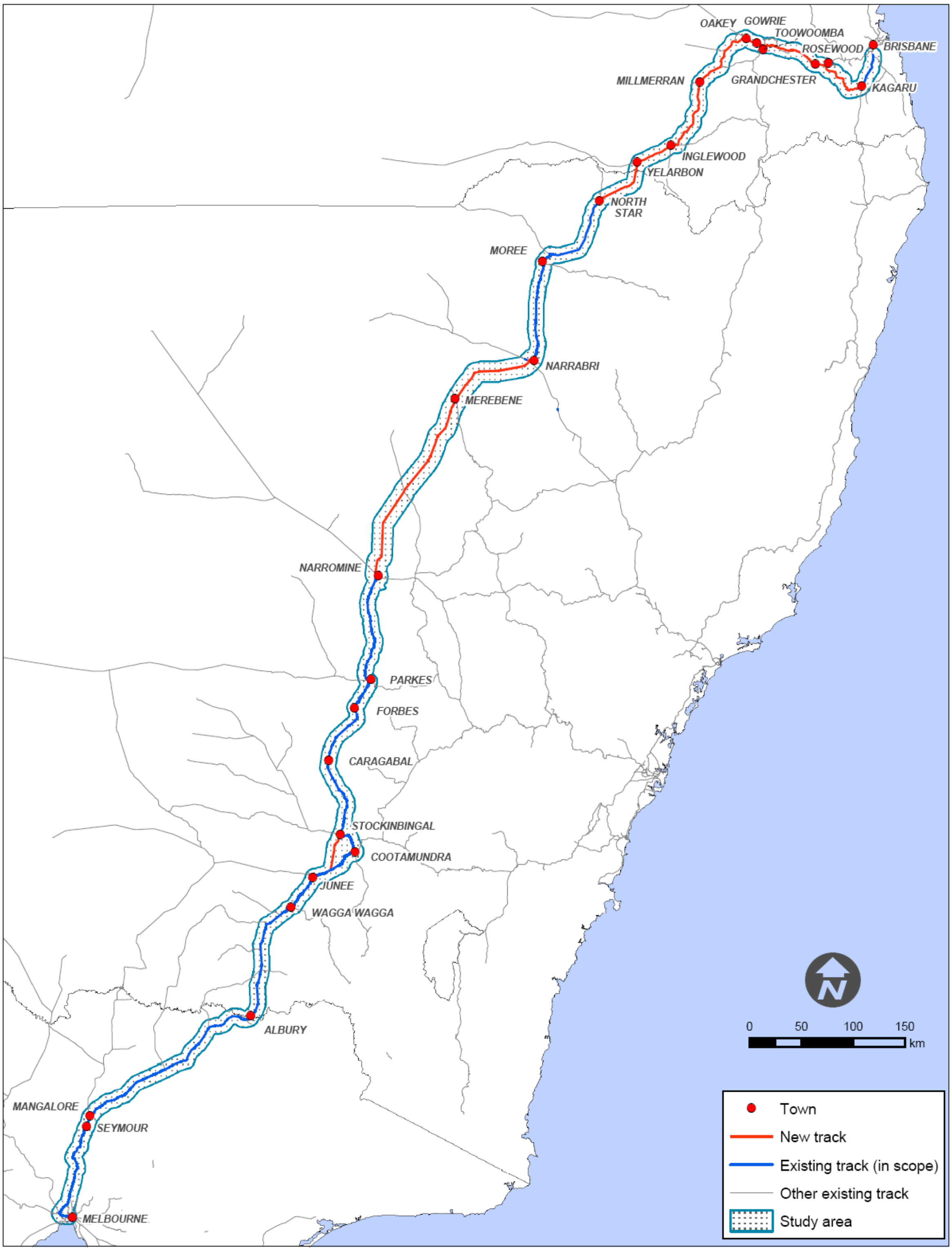
Second, *financial revenue is lower due to the loss of Gunnedah coal revenue.* The 1,880 km scenario captures revenue from the transportation of coal from the Gunnedah basin. This revenue does not appear as a benefit in the economic appraisal because the revenue is unaffected by the completion of the inland railway (as the coal currently travels on existing lines). However, it is counted in the financial appraisal because it is assumed that once the inland railway is built, the revenues would flow to the operator of the railway. Due to this, whilst the 1,690 km route from Narromine to Narrabri is assumed not to capture Gunnedah basin coal revenues due to the new rail alignment, the loss of revenues affects the financial analysis but not the economic analysis.

As a result of the findings relating to the different transit time scenarios, Stage 3 will be an important stage to establish whether there are optimal deviations to the inland route that may result in capital or operating savings, or that may reduce transit time or increase other factors such as reliability, that may induce greater demand and thus impact on economic and financial viability.

The planned focus for Stage 3 will be around routes offering faster transit times. However, as occurred in Stage 2, there is likely to be further optimisation of the exact geographic positioning of the route to further improve its economic and financial viability. If further analysis of this route results in changes in capital cost estimates or demand projections for this scenario, the study may revert its focus to the 1,880 km scenario. Both financial and economic results are most sensitive to the scale of capital expenditure. If these costs are estimated to increase following further analysis in Stage 3, viability of the Inland Rail will worsen.

The route to be examined in Stage 3 is presented in the map below.

Figure 7 Inland rail route identified for Stage 3 analysis



Source: LTC

7.8 Areas of further analysis in Stage 3

Further analysis that will be undertaken in Stage 3 of this study includes:

Technical analysis:

- *Identify the most effective alignment* – the deviations identified in Stage 2 will be formally included and/or excluded from the final route as part of Stage 3;
- *re-validate train operating cost and track maintenance cost assumptions* particularly train operator savings by capital scenario from using the inland route and track maintenance costs for existing and upgraded components of the Inland Rail alignment;
- *assess 1,690 km scenario rail paths* – the LTC is currently assessing if all rail paths will be 22 hours, or if some will be slower or faster, and this will be tested further in Stage 3;
- *assess opportunities for staging of capital spend* – the LTC will assess whether capital spend for the Inland Rail operating from 2020 (relative to commencement in 2030 or 2040) can be staged with loops and deviations delayed until later years when demand has increased. If the possible savings in present value terms is significant, then this will be built into the financial and economic appraisals as a staging approach;
- *compare train specifications* – in Stage 3, assumptions relating to coastal and inland railway train specifications will be compared for consistency of assumptions;

Financial/economic appraisal methodology:

- *further consider Base Case components, demand, costs and timings* – given the Base Case has a significant impact on the financial and economic results, there may be scope to further understand potential cost savings on the coastal railway in the event an Inland Rail is established. Further analysis will be undertaken on the Base Case assumptions and whether capacity will be sufficient on the coastal railway if there is no inland railway, which may have a positive impact on the economic results. In addition, the opportunity to defer potential spending on road infrastructure such as the Newell Highway in the future if trucks are diverted to Inland Rail, will be discussed with the NSW RTA and examined further for the Base Case and the Inland Rail options;
- *provide further analysis for tonnage thresholds* – this working paper currently presents a comparison of Inland Rail viability based on three different options for operations commencing. It is noted that it may be more meaningful to provide 'tonnage' rather than 'date' thresholds, and this will be considered further for the Final Report;
- *explore urban and rural environmental externality parameters* – it will be examined further if externality rates can be weighted against both urban and rural parameters to reflect that 5-7% of the proposed inland route and freight travelling on road between Melbourne and Brisbane is through urban areas. As environmental externality benefits achieved by the Inland Rail comprise between 1-3% of economic benefits identified in this working paper, it is not likely that this will have a significant impact on economic viability;
- *update estimates of WACC and the likely cost of equity tailored for an Inland Rail project* – in Stage 3, the likely cost of equity from the private sector will be analysed, and a bottom up calculation of cost of equity using the Capital Asset Pricing Model will be undertaken;

Policy issues:

- *consider a corridor preservation strategy for Inland Rail* – an optimal approach will be considered further in Stage 3; and
- *analyse road and rail access prices* – during Stage 3 financial and economic viability of the Inland Rail will be assessed if road and rail access prices incorporate full road and rail infrastructure costs.

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Appendix A

Stakeholders consulted

Stakeholders consulted

Table A-1 Stakeholders consulted by the study team (Stages 1 and 2)

Rail customers (operators), end users, etc.	Other stakeholders
Amcor	ATEC
Australia Post	Border Region Organisation of Councils (Moree)
AWB	Farmers' organisations
BlueScope	GATR
Coles	Local councils along the route
Costa	Local government associations
CS Energy	Northern Sydney Freight Corridor study team
Ford	NSW Ministry of Transport
GrainCorp	Pacific National
K & S Freighters	Queensland Department of Mines and Energy
Linfox	Queensland Rail Network
Moraitis	Queensland Transport Shepparton – Food Bowl Inland Rail Alliance
Newhope	RailCorp
Northern Energy	Rail Infrastructure Corporation
OneSteel	Victorian Department of Transport
Pace Farm	Warwick - Cunningham Rail Link
Pacific National	Others who have made submissions or written letters
Peabody	
Port of Brisbane	
QR National	
SCT Logistics	
Toll Holdings	
Troncs Transport Solutions	
Toyota	
Visy	
Woolworths	

Further consultation will be undertaken during Stage 3 of the study.

Appendix B

Case studies of recent rail freight projects

Case studies of recent rail freight projects

Three case studies of relevant rail projects in Australia are presented below.

B.1 Case study 1 – Alice Springs-Darwin railway

The Adelaide-Darwin railway is a north-south transcontinental railway operating across South Australia (SA) and the Northern Territory (NT). The line from Tarcoola was extended from Alice Springs to Darwin by the AustralAsia Rail Corporation in 2000. The track is currently owned and operated by FreightLink, also the train operator of freight on the line. Passenger services are also operated by the Great Southern Railway, with the twice weekly 'The Ghan'.

The railway has progressively accumulated a 90% tonnage market share for general freight. In addition there is good wagon utilisation from Adelaide-Darwin. However there are relatively light volumes southbound.

Funding of the Alice Springs-Darwin extension

The total cost of the extension comprising 1,420 km of new track, is estimated to have been $1.3 billion including rollingstock (equivalent to $0.9 million per kilometre in 2009 dollars).[47] The Australian Government contributed $191.4 million to complete the Adelaide-Darwin railway. The SA and NT governments also contributed over $368 million to the project, and the remaining 57% of the estimated $1.3 billion cost was financed by the private sector.[48]

Rail operations

Construction of the Alice Springs to Darwin extension was managed by the AustralAsia Railway Corporation, and delivered by Asia Pacific Transport. AustralAsia Railway Corporation was commissioned to design, construct and operate the railway under a Build, Own, Operate and Transfer back (BOOT) arrangement. ADrail is the company's design and construction arm and FreightLink its operating arm.

The BOOT arrangement involving government applies to the section of rail from Tarcoola-Darwin for a concession period expiring 50 years after construction. Incentives offered to encourage private sector investment were:

- in return for designing, constructing and also operating and maintaining the railway, AustralAsia Rail Corporation was granted all the revenues from the existing (Tarcoola-Alice Springs) and new (Alice Springs-Darwin) railway lines;[49]
- there is a single train and track operator;
- an Access Regime with a 30 year NCC certification, which arguably provides the owner with a form of first right of refusal on third party access requests; and
- the rail line from Tarcoola to Alice Springs was assigned to the consortium on a long-term peppercorn lease, essentially providing more than 800 km of track for no additional capital outlay.

47 Department of Infrastructure, Transport, Regional Development and Local Government 2009, Transport Infrastructure Programs: Alice Springs – Darwin Railway, <www.infrastructure.gov.au/transport/programs/rail/alice.aspx>

48 Department of Infrastructure, Transport, Regional Development and Local Government 2009, Transport Infrastructure Programs: Alice Springs – Darwin Railway, <www.infrastructure.gov.au/transport/programs/rail/alice.aspx>

49 The Office of the South Australian Independent Industry Regulator (SAIIR), Tarcoola-Darwin Railway: Determining an appropriate 'return on assets', Discussion Paper, January 2002, pg. 27

Economic and financial viability

Studies undertaken in the 1970s and 1980s generally concluded that at the time the Alice Springs Darwin railway was not economically viable. Since that time a number of other reports emerged (including reports prepared by the South Australian Development Council (SADC)[50] and Access Economics[51], which provided a more positive outlook for the rail project. A reassessment of Adelaide to Darwin viability with the Alice Springs-Darwin extension was conducted and presented in the *Economic Evaluation of Darwin-Alice Springs Railway* by Booz Allen Hamilton (BAH) 1999. This appraisal indicated that at a 7% discount rate, the railway had a positive NPV of $310 million and a BCR of 1.35. However some of the assumptions in this analysis have turned out to be optimistic, for example relating to volume of traffic and proportion of road-rail diversions.[52]

Weekly train movements on the railway comprise approximately five container trains, providing a mode share for rail in general freight of greater than 90%. There are also two passenger trains per week.[53] In addition there are 11 mineral trains per week, freighting approximately 2.15 million tonnes (mt) of minerals each year, and comprising nearly half of FreightLink's annual revenues. The majority of the mineral tonnage however, uses mainly the northern end of the Adelaide-Darwin railway.[54] The three key mines using the line (Prominent Hill, Bootu Creek and Frances Creek) move approximately 2.25 mt. The mineral rail haul lengths vary from around 2,000 km (from Prominent Hill via Wirrida) to 210 km for Frances Creek (via Union Reef siding). Despite the volume of weekly train movements, the Adelaide-Darwin railway is not financially viable. This is in part likely to be as a result of lower backloads of general freight from Darwin to South Australia and beyond, combined with modest ship calls to Darwin, which are vital to crystallise the concept of Darwin becoming an export gateway to Asia.

On 19 May 2008 FreightLink announced its decision to sell its ownership of the Adelaide to Darwin rail link after failing to make a profit since the railway line commenced operation. On 6 November 2008, FreightLink went into voluntary administration after failing to reach agreement with creditors on the terms of a sale of the business.[55] FreightLink has indicated that as a result of this, its receivers and managers are pursuing a sale process.[56] At the time of writing there has been no announcement of a decision.

Potential lessons for Inland Rail

- With the concept of the Port of Darwin becoming the gateway to Asia not yet fully achieved, the project needs greater mineral traffic as providing general freight to the

50 South Australian Development Council (1996), Value to South Australia of Completing The Alice Springs - Darwin Rail Link

51 Access Economics, Economic and Budgetary Impacts of the Alice Springs-Darwin Railway Project prepared for the NT Dept of Works, June 1999

52 BAH 1999, *Economic Evaluation of Darwin Alice Springs Railway*, prepared for the Northern Territory Department of Transport and Works, Melbourne, October 1999, pg. 8.

53 The Ghan timetable 2009, available at: http://www.ntescapes.com.au/ghan/ghan_timetable07.html (accessed 12 June 2009)

54 FreightLink website 2009, Minerals & Mining Consumables, available at: http://www.freightlink.com.au/aspx/minerals_and_mining_consumables.aspx (accessed 12 June 2008); and FreightLink pulls major minerals contract, 05 Jul 2007, available at: http://www.asiapactrans.com.au/NewsDetail.aspx?p=72&id=56&np=17

55 ABC News, FreightLink goes into administration, 6 November 2008, <www.abc.net.au/news/stories/2008/11/06/ 2412115.htm>

56 FreightLink 2008, *Receiver and administrator appointed to FreightLink – Business to continue as usual*, Media Release, 6 November, 2008

population of Darwin (120,890[57]) does not generate enough revenue to recover $1.3 billion capital costs.

- Some aspects of the track specification were optimised to decrease the capital costs (e.g. lowering formation height and increasing sleeper spacing), and this coupled with extreme weather conditions leading to instances of heat-induced misalignments has reportedly led to higher maintenance costs. However, the existing Tarcoola-Alice Springs section had a lighter axle load, which reduced the merit of investing in a higher capacity specification for the new Alice Springs-Darwin section.
- Whilst the government contributions, a vertically integrated operation and access regime certainty reduced risk, 'Gateway to Asia' related tonnages needed more proving-up and ideally confirmation via take-or-pay contracts.
- Despite losses to equity holders and possible losses to some debt holders, the railway appears likely to continue to operate, as it is cashflow positive. Volumes on the line also appear likely to grow and the grants provided by the three governments will continue to yield economic returns albeit at lower levels than expected in the 1999 economic appraisal.

B.2 Case study 2 – Bauhinia Regional Rail Project

The Bauhinia Regional Rail Project in central Queensland branches off the Kinrola spur line to the Rolleston coal mine. The line is 110 km in length and provides rail infrastructure to haul coal from the Rolleston mine to the Port of Gladstone for export, as well as to domestic power users such as Stanwell and Gladstone power stations.

Funding of the rail project

QR financed and managed the Bauhinia rail project, in May 2004 securing a take or pay contract with Swiss-based mine owner Xstrata to underwrite the building of the rail line at a cost of $240 million (or $2.18 million per kilometre). Another $100 million also was invested by QR to enhance the Blackwater coal network, by adding 30 km of double-tracking to raise capacity and added balloon loops.[58]

Rail operation

Under the initial agreement, QR Network Access is responsible for providing and managing the infrastructure. An agreement between Xstrata and QR National covers the operation of trains on the line. Xstrata pays track access fees for each train using the 422 km route between Rolleston and Gladstone, providing a revenue stream for QR Network Access to recoup its capital investment in the building of the branch line.[59] During construction of the project, Xstrata committed to haul eight million tonnes of domestic and export coal to Gladstone by 2008 on this line.[60]

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[57] Australian Bureau of Statistics, *3218.0 Regional population growth: Northern Territory 2007-08* (accessed 23 June 2009), available at: http://www.abs.gov.au/ausstats/abs@.nsf/Products/3218.0~2007-08~Main+Features~Northern+Territory?Open Document #PARALINK2

58 QR Network Access, Blackwater System Enhancement Program, Newsletter 2: November 2005

59 Scheuber, B., 'Bauhinia line will expand Queensland's coal exports', Railway Gazette International; June 2007; 161, 6, pg. 333

60 QR 2005, Bauhinia Regional Rail Project News: Issue 6, October 2005

Potential lessons for Inland Rail

- Both government and the private sector made upfront capital contributions to fund railway development, with private sector access charges funding ongoing operation of the rail line.
- Take or pay contracts reduce revenue/demand risks for track owners.
- Coal access rates are usually 2.5–3.5 times that of general freight, providing a much more financially viable revenue stream that decreases or eliminates the need for a government contribution.

B.3 Case study 3 – Pilbara rail projects

The Pilbara region is located in the North-West area of Western Australia (WA). The freight lines in the region service heavy-haul iron ore to the following ports: Port Hedland, Wickham and Dampier. Rio Tinto, BHP Billiton and Fortescue Metals Group (FMG) are the three largest companies operating in the region, making use of the freight lines to link their iron ore mines to the port terminals. Rio Tinto's Pilbara rail division alone is the largest privately owned rail network in Australia. It services ten mines via a mainline system of approximately 1,100 km of track, and has capacity to haul approximately 130 mt of ore per year (compared to Rio Tinto's Pilbara iron ore production of 163 mt annually).[61] BHP Billiton's iron ore rail operations in the Pilbara comprise two separate single track rail lines: one running from Port Hedland to the Newman area (426 kilometres); and the other running between Port Hedland and the Yarrie mine (208 kilometres).[62] In addition, FMG's rail infrastructure in the Pilbara is also significant, comprising a 260 km open access railway in the Pilbara that is the heaviest haul railway in the world, with each 200 wagon train estimated by FMG to deliver more than 30,000 tonnes of iron ore.[63]

The lines are privately owned and operated by each mine, BHP Billiton, FMG and Rio Tinto. An FMG subsidiary, the Pilbara Infrastructure Pty Ltd (TPI) owns and operates the newest rail line and terminal at Port Headland. TPI is covered by the Rail Access Regime implemented by the Economic Regulation Authority of Western Australia. The privately owned and operated BHP-Billiton and Rio Tinto railway lines in the Pilbara region are not covered by the WA Regime but are subject to the TPA Regime.

The efficiency of the private Pilbara railways has meant government intervention has not been required to date for infrastructure development/investment.

Funding of Pilbara rail projects

A recent example of private rail development is the project commissioned by BHP Billiton Iron Ore for the double tracking of sections of the Mt Newman rail line of 220 km. Macmahon Holdings and Leighton Contractors joint venture were awarded the contract to undertake the redevelopment valued at over $500 million.[64] The contract requires duplication of 220 km of existing railway line between Port Hedland and Shaw Siding on the Mount Newman line in the Pilbara region with completion due in 2010. The pre-approval

61 Rio Tinto website 2009, http://www.riotintoironore.com/ENG/operations/301_pilbara.asp & http://www.pilbarairon.c om/SiteContent/operations/ops-rail.asp

62 BHP Billiton website 2009, http://www.bhpbilliton.com/bb/ourBusinesses/ironOre/rail.jsp

63 FMG 2008, *Submission to Standing Committee on Infrastructure, Transport, Regional Development and Local Government*, 10 July 2008

64 *Australian Mining,* 'BHP steams ahead with Pilbara expansion', 9 April 2009, www.miningaustralia.com.au

funding will be used to duplicate the railway track between the Yandi mine and Port Hedland and the expansion of the inner harbour at Port Hedland.

Rail operations

Currently, the Pilbara region freight lines are under consideration by the National Competition Council. In October 2008, the Australian Government announced that the services provided by BHP Billiton's Goldsworthy railway line, and Rio Tinto's Hamersley and Robe railway lines, would be declared open to third parties under Part IIIA of the Trade Practices Act 1974 for a period of 20 years.[65] FMG has also made third party requests to use parts of BHP Billiton's and Rio Tinto's railways for several years.

Potential lessons for Inland Rail

- With substantial volumes of iron ore and relatively short haul lengths, while recognising that the railways were not built as standalone businesses but as part of broader mining developments, the private sector has developed Pilbara railways with no government contribution.
- Whilst there has been some dispute on third party access, capacity has generally been added in sufficient time to cater to demand growth and moderate ship queues.

65 North West Iron Ore Alliance 2008, *Media Announcement Monday 27 October 2008*, 'North West Iron Ore Alliance Welcomes Federal Treasurer's Declaration of Pilbara Rail Lines, http://nwioapublic.powercreations.com.au/images/nwioa---phozu.pdf

Appendix C

Additional information on demand results and assumptions

Additional information on demand results and assumptions

More detail on Inland Rail freight demand estimated for Stage 2 of the study is presented below.

Induced and diverted coal freight

East Surat

An inland railway is likely to induce some additional thermal coal beyond the present 5.5 mt already carried on this line from the East Surat basin near Toowoomba to the Port of Brisbane. The port could handle some growth in current coal volumes with relatively minor augmentation of the present facilities. This area is mainly thermal coal, used mainly for power generation, whose value is typically less than half the value of coking coal (used mainly for steel manufacture). Because of layered deposits it is expensive to mine - and hence is uneconomic to transport by rail for long distances. In contrast to Newcastle (820 km) and Gladstone (530 km), it is economically viable to transport the East Surat coal to Brisbane, the distance being around 220 km.[66] The known deposits are very large, and the industry considers that the potential size is much larger still – a total in the billions of tonnes. The main deposits are at Ackland (owner: Newhope), Wilkie Creek and potentially Horse Creek (Peabody), and Kogan Creek (CS Energy). The main coal sources were shown in a map (Figure 14) in Working Paper No. 1.

An inland route would replace that existing railway and provide the opportunity to operate a greater capacity train consist which is currently under 2,000 net tonnes per train. It is estimated that Surat Basin coal would utilise the inland route for approximately 220 km to the Port of Brisbane and we have assumed for Stage 2 that the number of coal trains per day remains constant but that a more modern wagon configuration is used over coming decades.

Ashford

There is a small amount of coking coal at Ashford near Moree, 10 mt in all. It is not being mined at present because there is no economic transport route to a port. An inland rail alignment would involve upgrading of the Moree-Narrabri section which would allow this coal to be taken to Newcastle.

Gunnedah basin

For the 1,880 km scenario, coal freight production from the Gunnedah basin is expected to increase from 9 mt in 2009 to approximately 75.2 mt in 2021. We have assumed it stays at this level as new mines replace those that are depleted. The coal would enter at various points on the Narrabri-Werris Creek line which could become part of the inland rail alignment; it would then continue from Werris Creek to Newcastle. Revenue from such coal has been counted as far as Werris Creek, and again it makes a substantial difference to total revenue because of the large volumes and higher access charges. However these estimates will need to be reviewed in Stage 3 once a final route alignment has been determined. For example if there was a deviation between Premer and Emerald Hill to avoid

[66] In contrast to ATEC, we do not consider it would be economic to transport it Newcastle (820 km). It is also unlikely to be economic to transport it the 530 km via a partially new line to Gladstone unless there were very large volumes and world prices were much higher than now. Even then it would face competition from a very large deposit at Wandoan which is 150km closer to Gladstone.

most of the triangle through Werris Creek (see Figure 7 – freight flows along the corridor), the length of the inland route over which Gunnedah Basin coal would travel would be shorter.

For the 1,690 km scenario which is further to the west than the 1,880 km scenario, all Gunnedah Basin coal volumes are assumed to use existing railway and not an inland railway.

All the coal forecasts are subject to international demand and broader energy policies.

Diverted grain freight

Rail is the preferred mode for export grain (mainly wheat, but also barley, sorghum and other grains), as it is logistically more efficient than trucks. The 'pick up and delivery' problem for general non-bulk freight - where rail freight suffers from double handling from/to trucks - is reversed with grain, as rail hopper wagons unload into specialised port facilities. Therefore rail is almost always used for export grain freighting for distances above 200-300 km, which effectively means nearly all export grain. (A door-to-door cost of $70-90 per tonne Moree-Melbourne becomes a road door-to-door cost of $150 per tonne for an equivalent distance). In this corridor grain grows in locations well away from the coast.

The amount of grain carried is a function of production rather than demand, since grain is always sold at a price that clears the market, subject to some relatively small movements in stock levels each year. Production is dependent on weather and on a long-term trend of gradually increasing farm productivity. As the potential inland railway is a long-term project, our forecasts ignore the large year-to-year fluctuations due to weather, instead being based on the long-term trend.

The amount of grain available for export also depends on domestic demand (with exports being the residual). It is understood from the industry that about 60% of domestic demand in the corridor is served by rail, especially major customers in urban centres and some longer distance movements of feed grains. Smaller customers are usually served by road. ACIL Tasman was told that this rail mode share would rise to 80-90% with a good inland railway. Grain growing areas are shown in a map (figure 13) in Working Paper No. 1.

Grain in the inland railway corridor currently moves to ports or cities on other rail routes, e.g. Hunter Valley. Although there is an inland route of sorts between Moree and Melbourne, and grain trains sometimes do that trip, it is slow and tortuous. An improved railway with higher grade track, more passing loops and some deviations, is expected to:

- *divert grain from the difficult Hunter Valley corridor* – which is congested with coal trains that typically pay high rail infrastructure access fees – to Port Kembla (which has superior port facilities for grain) via Cootamundra;
- *capture grain that is now trucked from the Darling Downs to the Port of Brisbane* – because of poor capacity on the old line (about 75% of the grain currently arrives at the port by truck);
- *allow greater movement north and south to balance supply and demand* – which are affected by changing areas of drought/rain, and fluctuating supplies of and demand for particular categories of grain;
- *increase flexibility* – to respond to changing ship schedules and rail and port congestion;
- *increase inter-port competition and potentially divert* Coonamble grain from Newcastle to Port Kembla, Moree 'Golden Triangle' grain from Newcastle to Brisbane, etc. The effectiveness of this outcome would depend on the route configuration.

Overall ACIL Tasman assumes that grain would be diverted from other lines and trucks, initially around 0.5 mt pa from northern NSW and south-east Queensland to Brisbane and almost 0.5 mt from Moree to Cootamundra (and then to Port Kembla). The grain tonnages are assumed to grow in line with long term production trends.

Alternative demand: more optimistic approach

During the course of the analysis, ARTC raised a conceptual issue regarding the demand model. ACIL Tasman's logit model captures four characteristics (price, reliability, availability, transit time) and also has what is mathematically known as a 'constant' term that recognises that there is more to the competitive decision than those four characteristics alone. For example:

- past performance;
- inertia (e.g. customers for whom transport costs are a small proportion of total costs may not be inclined to think about alternatives)
- preferences regarding double handling;
- unsuitability of a particular mode for a particular product (e.g. rail is preferred for dangerous goods, very dense products and cars);
- efficient infrastructure arrangements at rail loading and receiving terminals
- avoidance of damage (a reason, for example, why rail transport is preferred for cars); and
- flexibility and convenience.

The impact of having a nonzero constant is that even if price and service characteristics were exactly equal between two different modes, the constant would determine that the market shares would not be equal. In some cases the constant was a significant determinant of market share. This typically happened in markets where the sample size was small, dominated by a few respondents or where there was a significant determinant of market share which is not captured by the four price/service characteristics (coal and steel are good examples of this).

As described in Working Paper No. 1, ACIL Tasman calibrated the constant so that, when combined with the service characteristic elasticities derived from the survey, the modal shares predicted by the model for 2008 matched the observed data. This calibration process has been refined for the current Working Paper, to recognise the operation of time lags in the determination of actual mode choices[67].

The conceptual issue raised by ARTC was whether, in the case of contestable non bulk freight traffic, the calibration process should be subjected to the constraint that mode shares should be equal when the different modes have the same service characteristics. This in effect assumes that the non bulk market is completely contestable between road and rail freight services. In modelling terms, it implies that the constant should be zero, and the observed elasticities calibrated (i.e. re-balanced) to ensure the correct modal shares in 2008[68].

The consequence of this assumption is that in general market share is more responsive to changes in the modelled characteristics than would be the case otherwise (i.e. the elasticities are higher). In other words, the other possible characteristics listed above have no influence. The difference in elasticities produced by imposing this constraint for non bulk freight is shown below for Melbourne-Brisbane intercapital freight. The constant was maintained for agricultural products, coal and minerals, steel and other bulk because these

[67] Thus the calibration of the constant was undertaken to ensure that the model coefficients, when combined with the service characteristics relating to previous years (i.e. lagged characteristics) produces the modal shares for 2008.

[68] For each commodity there are four unknowns, but only one equation to calibrate to the required market share, hence there are an infinite number of combinations of elasticities that combine with a zero constant. To solve for the elasticities ACIL Tasman used Excel's solver and evaluated how far the solved elasticities are from the survey evidence. The final result is a blend of zero constant and survey-derived elasticities

markets have other factors (such as specialised loading and unloading facilities) warranting the use of a constant.

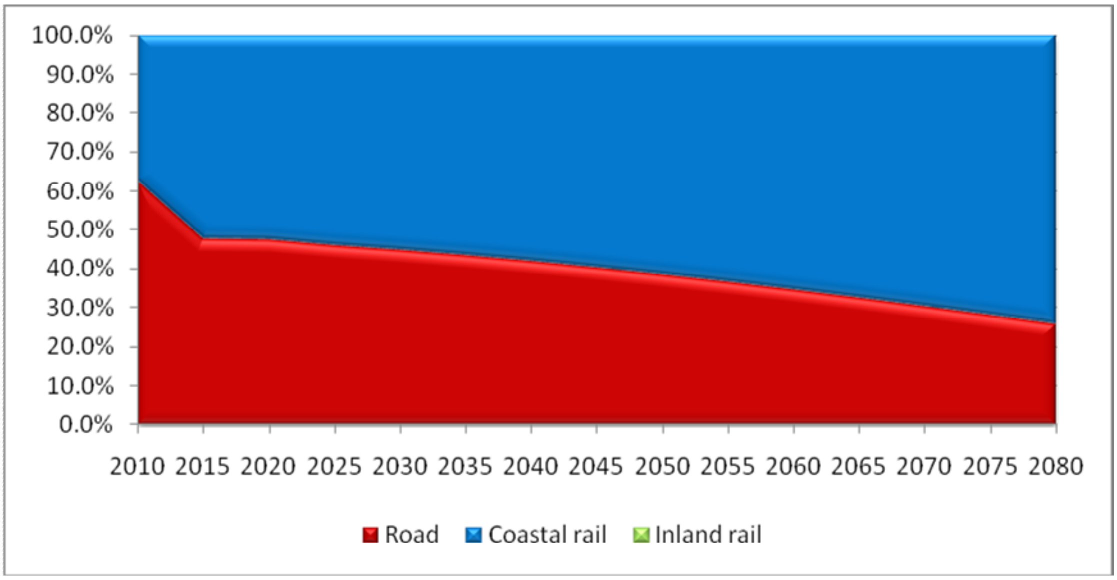
Table C.2 Key elasticities generated from survey, and fitted to obtain zero constants

		Survey derived elasticities				Estimated elasticities			
		Price	Reliab-ility	Availab-ility	Transit Time	Price	Reliab-ility	Availab-ility	Transit Time
M-B	Non bulk	-1.37	0.31		-0.18	-1.24	0.83	-	-0.47
M-B	Non bulk availability sensitive	-0.86	0.31	0.35	-0.18	-1.10	0.08	0.30	-
M-B	Agricultural products	-0.75	0.10	0.25	-	-0.75	0.10	0.25	-
M-B	Coal and minerals	-0.25	-	-	-	-0.25	0.53	0.41	-1.04
M-B	Steel	-0.86	-	-	-	-0.95	0.03	0.04	-0.63
M-B	Other bulk	-0.50	-	-	-	-0.50	0.53	0.41	-1.04
B-M	Non bulk	-1.37	0.31		-0.18	-1.26	0.89	-	-0.49
B-M	Non bulk availability sensitive	-0.86	0.31	0.35	-0.18	-1.10	0.01	0.30	-
B-M	Agricultural products	-0.75	0.10	0.25	-	-0.75	0.10	0.25	-
B-M	Coal and minerals	-0.25	-	-	-	-0.25	0.53	0.41	-1.04
B-M	Steel	-0.86	-	-	-	-0.95	0.03	0.04	-0.63
B-M	Other bulk	-0.50	-	-	-	-0.50	0.53	0.41	-1.04

As predicted, the result of using these higher elasticities is a much greater sensitivity to changes in quality and price of service. Therefore the model allocates much greater market share to the inland route although this is mostly taken from the coastal route.

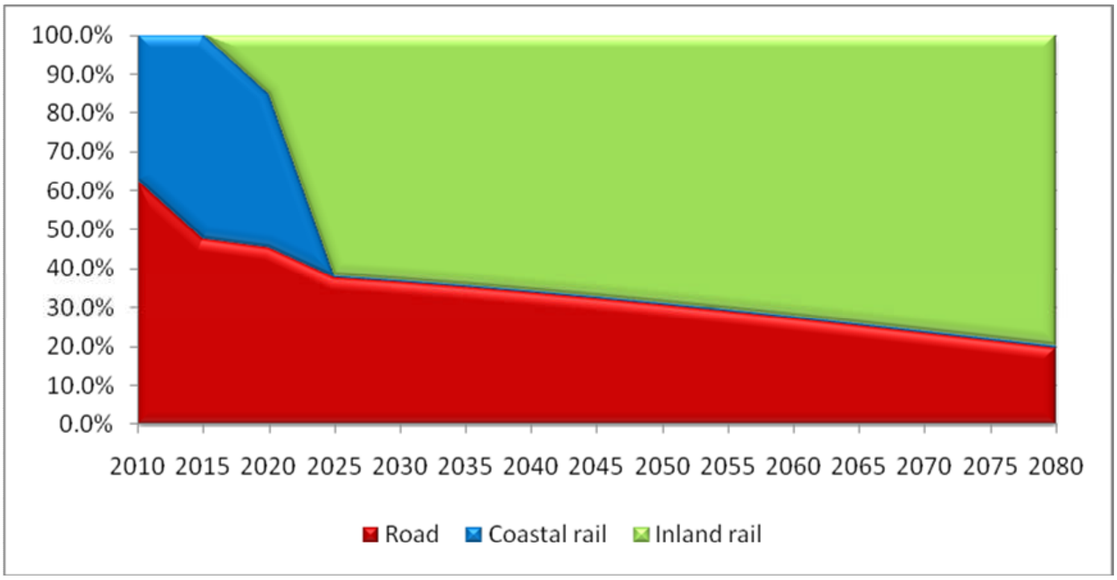
The effect of using the higher elasticities on the intercapital mode share in the 'no inland railway' scenario is shown below.

Figure C.1 Aggregate market shares using higher elasticities (no inland route)



With the higher elasticities, the logit model calculates a market share for coastal rail in the 'no inland route' scenario of 52% in 2020, rising to 58% in 2040 and 65% in 2060. When the inland railway is available (the Inland Rail scenario) the market share for rail (coastal and inland) rises to 54% in 2020 (15% inland rail), 66.0% (65.6% inland rail) in 2040 and 72.7% (72.2% for inland rail) in 2060. As can be seen the inland route initially gains its market share from the coastal route, and then gains market share at road's expense. With the higher sensitivities to service an even greater amount of coastal rail's market is taken by Inland Rail.

Figure C.2 Aggregate market shares using higher elasticities (2020 Inland Rail commencement)



In Working Paper No. 1, ACIL Tasman reported results from the 'ARTC sensitivity' which were higher than those reported above, but after discussion it was agreed that the above results are more relevant to this inland study.

By reducing the number of explanatory characteristics in a model the constant would normally adjust to capture the variation in market shares which would have been explained by the omitted variables. However by removing the constant as well as explanatory variables, the ARTC model overstated the elasticity response in ACIL Tasman's view.

This sensitivity with more optimistic elasticities is constructed on the basis that if all characteristics were equal across modes – for example if reliability, availability, transit time and price were equal for rail and road the market shares would be equal. This may be intuitively appealing but does not match the observed market shares or movements in market shares on the corridor. On the other hand, ARTC considers that the quality of the data is low and there is considerable uncertainty regarding actual market shares and the actual response which market participants would make. With poor quality data, the disadvantage of imposing the constraint is lowered. On balance our view is that the lower elasticity estimate is more robust, because it allows better calibration to observed Melbourne-Brisbane market shares, and generates predictions which have been reasonably consistent with recent history.

However ACIL Tasman recognises that there is a degree of sample selection bias in determining the starting elasticities. Our sample was predominantly from current and past customers of the railways; these customers may have a lower preference for transit time and reliability than potential customers who have always used road because of their transit time or reliability preference. We therefore consider that our estimates are a conservative demand estimate for the inland railway, and the higher elasticities represent a more idealised view of the competitive interaction. Caution would be needed with either approach in extreme scenarios, such as very large differences in relative price.

The total freight forecasts on inland route using the higher, constrained, elasticities are shown in Table C.3.

Table C.3 Forecast tonnes and net tonne kilometres carried on the inland route (higher elasticities)

'000 tonnes	2020	2030	2040	2050	2060	2070	2080
Intercapital	1,104	6,195	8,671	12,129	16,932	23,555	32,597
Induced	10,000	10,250	9,500	9,500	9,500	9,500	9,500
Diverted from Road	1,720	2,369	2,701	3,115	3,629	4,268	5,063
Diverted from Rail (e.g. Branch line, not coastal line)	38,142	81,226	81,354	81,513	81,711	81,957	82,263
Extra-corridor	1,095	1,792	2,408	3,250	4,399	5,968	8,243
Regional	228	284	353	439	546	678	843
Total	**52,290**	**102,117**	**104,988**	**109,946**	**116,717**	**125,926**	**138,508**
Million NTK	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Intercapital	2,077	11,653	16,310	22,815	31,850	44,306	61,314
Induced	1,220	1,242	1,178	1,178	1,178	1,178	1,178
Diverted from Road	328	750	895	1,077	1,302	1,582	1,930
Diverted from Rail (e.g. Branch line, not coastal line)	5,752	12,029	12,132	12,259	12,417	12,614	12,858
Extra-corridor	1,420	2,547	3,461	4,720	6,451	8,833	12,357
Regional	158	196	244	303	377	468	582
Total	**10,954**	**28,417**	**34,220**	**42,351**	**53,575**	**68,981**	**90,220**

These compare to the forecasts generated using the surveyed elasticities as shown in Table C.4:

Table C.4 Comparison of results between survey and higher elasticities (thousand tonnes on Inland Rail)

Survey Elasticity							
'000 tonnes	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Intercapital	721	4,095	5,868	8,429	12,113	17,374	24,802
Induced	10,000	10,250	9,500	9,500	9,500	9,500	9,500
Diverted from Road	1,720	2,369	2,701	3,115	3,629	4,268	5,063
Diverted from Rail (e.g. Branch line, not coastal line)	38,142	81,226	81,354	81,513	81,711	81,957	82,263
Extra-corridor	1,066	1,630	2,184	2,943	3,984	5,415	7,439
Regional	228	284	353	439	546	678	843
Total	**51,878**	**99,854**	**101,960**	**105,939**	**111,483**	**119,192**	**129,910**
Higher elasticity							
'000 tonnes	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Intercapital	1,104	6,195	8,671	12,129	16,932	23,555	32,597
Induced	10,000	10,250	9,500	9,500	9,500	9,500	9,500
Diverted from Road	1,720	2,369	2,701	3,115	3,629	4,268	5,063
Diverted from Rail (e.g. Branch line, not coastal line)	38,142	81,226	81,354	81,513	81,711	81,957	82,263
Extra-corridor	1,095	1,792	2,408	3,250	4,399	5,968	8,243
Regional	228	284	353	439	546	678	843
Total	**52,290**	**102,117**	**104,988**	**109,946**	**116,717**	**125,926**	**138,508**
Difference							
% change	**2020**	**2030**	**2040**	**2050**	**2060**	**2070**	**2080**
Intercapital	53%	51%	48%	44%	40%	36%	31%
Induced	0%	0%	0%	0%	0%	0%	0%
Diverted from Road	0%	0%	0%	0%	0%	0%	0%
Diverted from Rail (e.g. Branch line, not coastal line)	0%	0%	0%	0%	0%	0%	0%
Extra-corridor	3%	10%	10%	10%	10%	10%	11%
Regional	0%	0%	0%	0%	0%	0%	0%
Total	1%	2%	3%	4%	5%	6%	7%

It can be seen that the intercapital non bulk and the extra-corridor freight are significantly higher as a result of the increased sensitivity to service and price characteristics. This is because in selecting these higher elasticities the movements in service characteristics give rail a large proportion of the market, and this increases over time as a result of movements in the relative price of rail. Much of the initial increase also in rail's modal share is happening without Inland Rail. The improvements in coastal service lead to market share for coastal rail of 52% in 2019, the year before Inland Rail is introduced. Inland Rail then predominantly diverts market share from coastal rail.

Access prices

This section of Appendix C provides further detail on the analysis undertaken by ACIL Tasman to estimate the revenue maximising access price for the track owner. In Stage 1 the analysis assumed access prices that are similar to those charged on the coastal route (identical on a per tonne basis). The possibility of different prices needs to be considered because of the cost of constructing an inland route. Up to a point, higher prices can be charged because the inland route offers reliability and transit times that are superior to the coastal route. Above that maximising point, the revenue gains from the higher price are more than offset by loss of tonnage to the cheaper coastal route, or to road.

Determining the access price that delivers the greatest revenue (allowing for demand responses) involves running multiple demand scenarios through the logit model to show consumers' response to changes in the retail price of freight. This analysis has been carried out for Melbourne to Brisbane (and vice versa) intercapital non-bulk freight carried on the reference train.

There is a question about the extent to which increases in access costs would be passed on to customers. If prices are set competitively then price would reflect marginal cost and when the marginal (access) costs to both operators increase then we could expect this to be fully passed on to customers. However with a more complex market we might expect a less than full pass through of costs – particularly if access charges were to decrease – since operators may take the opportunity to increase their profit margins. To cover this range of possible behaviours, ACIL Tasman has modelled three cost scenarios: 100% pass through, 75% pass through and 50% pass through. This is a much wider range than had previously been reported.

The analysis also assumes that the prices of road and coastal rail alternatives do not adjust in response to changes in the price of Inland Rail. With road being competitively priced it will not be affected by rail access costs and the freight rates charged by rail; the main competitive force will be between road haulage firms. It is assumed that the rail access prices on the coastal rail would continue at present levels in real terms.

Methodology

The revenue maximising access price was calculated by entering the reference case characteristics of the inland route, coastal route and road into a logit model. A variety of access prices (and therefore retail prices for rail) were assumed and the resulting market shares were determined. Multiplying this market share by the non-bulk market forecasts and estimates of train numbers allowed the calculation of access revenue on the inland route. ACIL Tasman calculates the base-case intercapital Melbourne-Brisbane non-bulk access revenue to be approximately $43.1 million per annum when inland rail access charges are the same as the coastal rail access charges.[69]

The impact of different access prices operates through the Inland Rail retail price, i.e. door-to-door transport costs. The movement in access price is scaled by the degree of pass

[69] In the demand forecast and financial analysis, it has been assumed that Inland Rail access charges are the same as current coastal railway access charges, and for simplicity ARTC prices have been applied to the full Melbourne-Brisbane journey. But it is noted that QR and RailCorp access prices currently apply for parts of this route.

through and the proportion of total costs on this route represented by access costs (approximately 17-23% per discussion with rail operators). Obviously higher rates of pass through mean that changes in access costs have a larger impact on the final freight price.

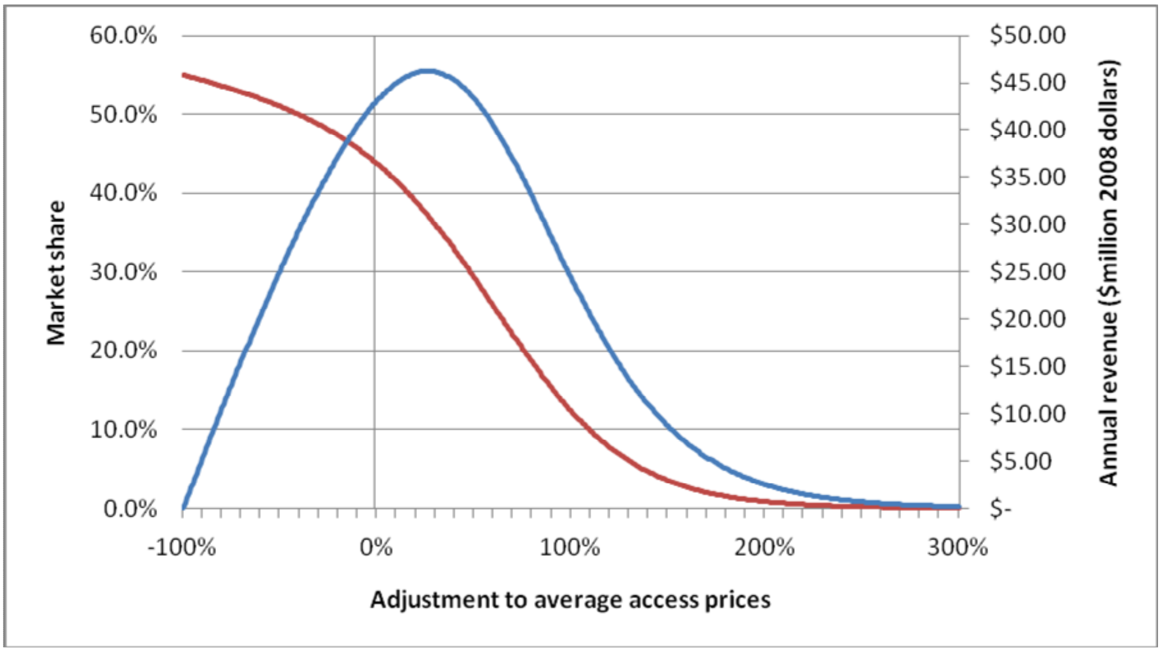
Box C.1 Calculation of the impact of changes to access prices on the retail price

For example, the increase in retail door-to-door transport price resulting from a 10% increase in access costs, with a 90% degree of pass through and access costs representing 23% of price would be:

(Retail price * 23%) * (90% pass through) * (10% increase) = 2.07% increase in retail price.

Considering the inland route with all service characteristics as described Chapters 3 and 4, the assumed average access charge for a reference train running at 78% of capacity is calculated as $2.98 per thousand gross tonne kilometres on the coastal route (in 2008 dollars, average for access charges and flagfall). The pattern of revenue that follows from changes in the access price is shown in the curve below. Increases in price generate more revenue where the price elasticity is inelastic. At higher prices the demand becomes more elastic and the track operator begins to lose revenue to coastal rail and road in response to price increases. The price rise is made possible by the increased level of service offered by Inland Rail in 2020.

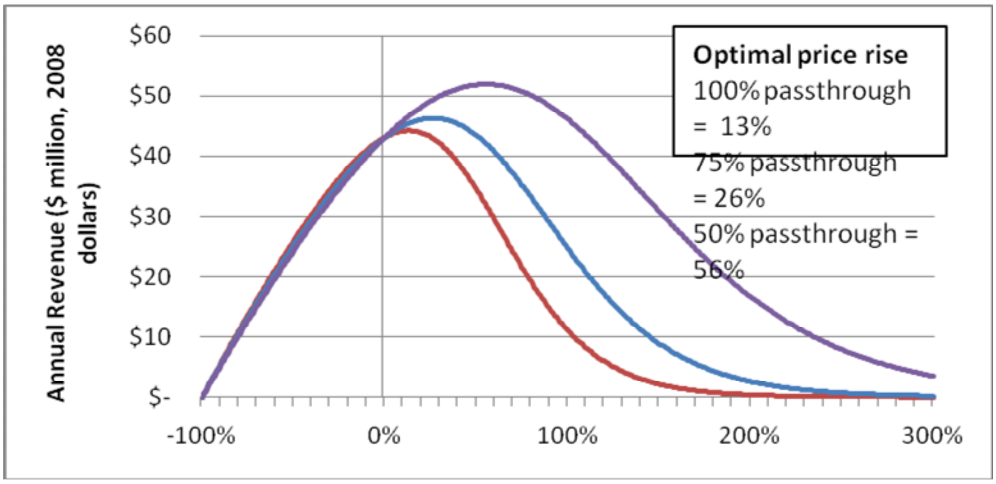
Figure C.3 Market shares and revenue under different access prices



The shape of the curve depends on the assumptions made regarding the price elasticity for Inland Rail and the strength of competition with the coastal route, as well as the degree to which costs are passed through to freight rates by the train operators. If inland access prices are at parity with the coastal route and there is 100% pass through of cost increases, then the revenue maximising access price for the inland railway is a 13% premium over current coastal access charges. In other words the improved services would compensate for the higher price. If the cost pass through is 75% access prices could increase by 26%, and if the cost pass through were 90% then access prices could rise by 56%.

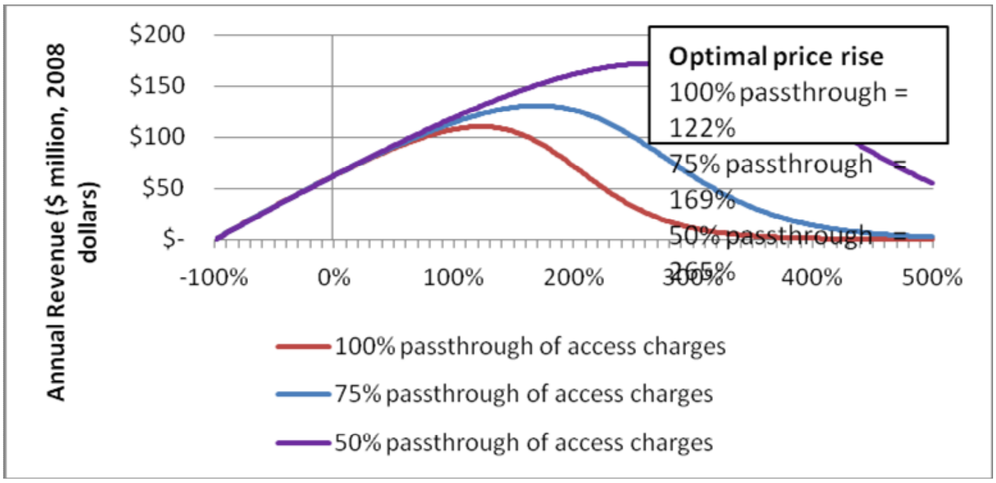
The results of this analysis indicate that annual intercapital, non-bulk freight revenue would be $44.2 million per annum at 100% pass through, $46.3 million per annum at 75% pass through and $51.9 million per annum at 50% pass through. At a 100% pass through, this reflects a 2.6% increase above the current annual revenues of $43.1 million per annum. The impacts of different levels of pass through are shown in the graph below:

Figure C.4 Impact of access prices on revenue with different pass through assumptions, survey elasticities



The previous section on alternative calibration assumptions presented a higher set of service elasticities (see 'Alternative demand: more optimistic approach' section and Table C.2 above in this appendix). Undertaking this analysis using these higher elasticities results in higher revenue to the track owner because the service characteristics are valued much more highly. Using these higher elasticities, the revenue maximising access price is 122%, 169% and 265% higher than the current access price with 100%, 75% and 50% pass through. This means that under the alternative elasticities, the inland rail service is sufficiently valued that with 100% pass through of costs, the owner could charge an access price which was 122% higher than on the coastal route. The annual revenue would be an order of magnitude greater than under the ACIL Tasman elasticity estimates ($110.2 million with higher elasticities shown in Figure C.5 below: compared to $43.1 million with survey-based elasticities shown in Figure C.4 above). ACIL Tasman would urge caution in relying on the higher elasticities because our survey evidence suggests that market participants do not place that amount of value on service characteristics (our analysis shows a 13% premium is revenue maximising for the inland route with 100% pass through of costs).

Figure C.5 Impact of access prices on revenue with different pass through assumptions, higher elasticities



Appendix D

Additional information on economic parameters

Additional information on economic parameters

More detail on the methodology used to estimate freight travel time, operating cost savings and net economic value from induced freight is presented below.

Savings in freight travel time costs

The approach used in this appraisal to measure inland rail benefits incrementally to the Base Case, is based on defining the service being provided as 'freight transport' for either rail or road mode of travel. This approach, along with the method to apply a freight travel time to net tonne kilometres (ntk)[70] draws upon the economic approach used by BITRE in October 2000.

The demand forecasts generate freight volumes (in ntk) for rail freight on the new and existing lines and for road freight. In order to estimate the value of freight transit time savings, these volumes were converted to hours travelled in tonne hours by estimating trip numbers and hours per average trip based on average loads and transit times. The resulting tonne hours per trip derived for each mode and for the Base Case and each scenario were then combined with a time value for freight in transit to determine:

- the benefits of existing (coastal) rail traffic travelling faster on the new line;[71]
- the negative benefit of existing road traffic travelling slower when it changes to the new rail network; and
- the benefits of induced rail traffic travelling on the new line.

The time value for freight transit used in this appraisal was determined by applying the average load carried per trip for a 6-axle semitrailer and B-Double road articulated freight vehicles (assumed as 25 and 40 tonnes respectively) with Austroads updated 2008 values for non urban freight travel time (per vehicle hour and by road vehicle type for 6-axle articulated and B-Double vehicles)[72] to estimate freight travel time per tonne hour for each vehicle type. The separate vehicle travel times were then weighted against vehicle compositions (assumed as 60% articulated and 40% B-Double for this freight demand) to determine an average regional freight travel time value of $0.81 per tonne hour.[73] This travel time value was applied to tonne hour demand to estimate the change in freight travel time cost.

(i) Existing rail traffic (coastal traffic and coastal-inland rail diverters)

These benefits are derived through reduced journey times, as a result of faster trips on the proposed inland railway.

[70] Tonne kilometres are calculated by the weight of a train and the distance it runs. This can be expressed as the total weight of a train (gross tonne kilometres or gtk) or the weight of the cargo (net tonne kilometres or ntk).

[71] Werris Creek-Narrabri coal volumes were not included in the time savings analysis as it was assumed unlikely as the volumes are currently being freighted on existing rail, and for the Low Capital Cost scenario this rail line will form the Inland Rail. This is a conservative assumption, as it is expected that approximately half of coal volume use the existing Werris Creek-Narrabri railway and half use the new Inland rail route.

[72] Austroads 2008, *Guide to Project Evaluation, Part 4: Project Evaluation Data*, p 18, Table 3.2

[73] In 2000, the BTRE (now BITRE) *Brisbane-Melbourne Rail Link: Economic Analysis* used ATEC transit time analysis to derive value of time for freight in transit ranging from $0.00 to $2.99/tonne hour in the appraisal (dependent on freight type), equivalent to $1.60 for general freight (2000 dollars). This analysis also cited a value of $0.60 per tonne hour (2000 dollars) sourced from Austroads and derived on the same basis applied in this appraisal.

*The benefit to existing rail freight = the number of existing rail trips * (travel time by rail trip with the Base Case – travel time by inland rail trip with the project case) * value of travel time.*

An alternative approach to estimate travel time benefits for rail freight could be to consider total tonne hours (as opposed to considering tonne hours 'per trip' and the number of trips). However, as the tonnes per train, utilisation rate and trailer load have been assumed as the same for both inland rail and the coastal rail, and in addition as travel time is only currently known on a per-trip basis, the approach above has been used in order to capture the increase in rail trip numbers compared to the Base Case. There may be grounds for adjustment of this assumption in Stage 3 to accommodate potential changes in train numbers and loadings between routes, if total travel time can be estimated on a 'total tonne hours' as opposed to only on a per-trip basis.

(ii) Road-rail diverters

The inland rail project will result in freight diverting from road to rail compared with the base case. The benefit gained by diverted road-rail trips is calculated using the rule of the half whereby the benefit of each diverted trip is equal to half of the unit benefit accruing to existing rail freight remaining on the same mode. So for a particular trip on road with the Base Case that diverts to rail under the project case:

The benefit = ½ (the number of diverted trips to rail with the project case) * (travel time by road trip with the Base Case – travel time by inland rail trip with the project case) * value of travel time.*

(iii) Induced rail traffic

The project case is also estimated to result in induced rail freight compared with the base case. The benefit gained by induced rail trips is calculated using the rule of the half whereby the benefit of each induced trip is equal to half of the unit benefit accruing to existing rail freight. So for a particular induced rail trip:

The benefit = ½ (the number of induced trips to rail with the project case) * (travel time by rail trip with the Base Case – travel time by inland rail trip with the project case) * value of travel time.*

Box D.1 Economic basis of capturing freight travel time savings

Introduction

The measurement of freight travel time is a contentious issue, particularly if the traffic is not just-in-time deliveries. However, in principle, it can be contended that it is preferable to have freight delivered sooner rather than later, ceteris paribus, as it would be available for use/on sale sooner. In consideration of this it is likely that the longer the distances the less critical small savings become, e.g. a 30 minute delay in a 24-hour trip has less significance than a 30 minute delay in a 1-hour trip.

However, the approach in this appraisal, in line with previous analysis undertaken by BITRE (formerly BTE) has been to assume that the principle is sound that quicker freight deliveries are preferable over slower ones for freight customers.

Economic basis

The economic basis behind capturing freight travel time savings is that there is a willingness to pay for freight service quality improvements, not only linked to train operating costs but also freight travel time and the opportunity cost of freight: In other words, there is assumed to be a benefit to shippers/ receivers of getting goods to destination more quickly, represented by some value being place on this

Box D.1 Economic basis of capturing freight travel time savings

for commodity type movements.[74] It is captured in the 'freight travel time savings' benefit in this economic appraisal.

The infrastructure users that will gain benefits from transit time savings include:

- *a freight shipper/customer* – for a freight shipper paying a sum of money to have their goods moved, they will place a value on goods arriving more quickly at a destination, having no direct interest in vehicle or driver costs. In practice, many shippers will have some experience of freight haulier costs, or will read through into how the charge they have to pay to their haulier is related to vehicle and driver costs, and so may include some element of those costs in their response. As a practical example, freight shippers do not place a higher value on rail transport exclusively, rather they place a higher value on lower travel time regardless of the mode involved; and
- *freight hauliers/train operators –* are only directly concerned with train operating cost savings that may reduce as a result of lower transit time (captured separately in the economic appraisal). These hauliers may however appreciate that the shipper would be willing to pay a higher rate (on account of heading two) if the journey were made quicker and more reliable.

In the Inland Rail economic appraisal, the time value for freight transit is based on the Austroads updated 2008 values for non urban freight travel time,[75] which has been used to average regional freight travel time value of $0.81 per tonne hour.[76] This is an average value for all commodity types. The Bureau of Transport Economics (now the Bureau of Infrastructure, Transport and Regional Economics, BITRE) and a recent UK paper on freight travel time savings have indicated that this value varies by commodity, for example is higher for motor vehicles and shipping containers, but lower for bulk agricultural products and coal.[77]

Other applications of this benefit in transport appraisal

- **Australian Transport Council (ATC) support inclusion** – in its *National Guidelines for Transport System Management in Australia*, the ATC supports the inclusion of freight travel time savings, as evidenced by the statement:

  > *For most transport initiatives, the bulk of the benefits accrue (at least in the first instance) to users of the infrastructure. Trains, trucks and cars save operating costs; passengers and freight save time.*[78]

- **BITRE has captured in its own economic appraisal of rail freight** – the Bureau of Transport Economics (now the Bureau of Infrastructure, Transport and Regional Economics, BITRE) included the value of freight travel time savings in its appraisal of the Brisbane-Melbourne rail link in October 2000. In a similar approach as used in the current Inland Rail appraisal, BITRE applied a freight travel time to net tonne kilometres.[79]
- **Austroads and the NSW RTA provide a dollar value for inclusion of this benefit in road infrastructure appraisal** – the estimate of freight travel time savings is commonly applied to road transport appraisals. Austroads and the NSW RTA provide values per hour road freight transport, for use in such appraisals.[80] (This Austroads value forms the basis for the value used in the Inland Rail appraisal.)

Practical example

Some of the practical reasons behind freight shippers placing a higher value on a rail line with lower travel time include:

- *benefits due to perishability and shelf life for goods to be in transit for less time* – some goods deteriorate, as regards value at destination, the longer they are in transit. For example, perishable foods with a shelf life of only a few days will be more valuable at the destination the sooner they are

[74] Fowkes, Tony and Whiteing, Tony 2006, *The value of Freight Travel Time Savings and Reliability Improvements – Recent Evidence from Great Britain*, Institute for Transport Studies, University of Leeds, UK

[75] Austroads 2008, *Guide to Project Evaluation, Part 4: Project Evaluation Data*, p 18, Table 3.2

[76] In 2000, the BTRE (now BITRE) *Brisbane-Melbourne Rail Link: Economic Analysis* used ATEC transit time analysis to derive value of time for freight in transit ranging from $0.00 to $2.99/tonne hour in the appraisal (dependent on freight type), equivalent to $1.60 for general freight (2000 dollars). This analysis also cited a value of $0.60 per tonne hour (2000 dollars) sourced from Austroads and derived on the same basis applied in this appraisal.

[77] BTE 2000, *Working Paper 45: Brisbane-Melbourne Rail Link: Economic Analysis &* Fowkes, Tony and Whiteing, Tony 2006

[78] ATC 2006, *National Guidelines for Transport System Management in Australia*, Part 3: Appraisal of Initiatives, p 64

[79] BTE 2000, *Working Paper 45: Brisbane-Melbourne Rail Link: Economic Analysis &* Fowkes, Tony and Whiteing, Tony 2006

[80] Austroads 2008, Guide to Project Evaluation, Part 4: Project Evaluation Data, p 18, Table 3.2

Box D.1 Economic basis of capturing freight travel time savings

there; and

- *additional benefits in having the goods on hand at the destination earlier* – for example, part-load and parcels operators using a hub and spoke system, speeding up travel on the spokes allows later final collection times or earlier delivery times. Speeding up the trunk section offers both of these, but also permits a wider area to be covered by the collection and delivery spokes within standard collection and delivery schedules. Manufacturing companies may be able to schedule production more efficiently with their raw materials available earlier, or else the level of stocks might be reduced. [81]

As a further practical example considering an average container, the value of freight travel time is fairly modest in relation to both freight value and total freight transport costs:

- *travel time as a proportion of freight value* – as an example, if each TEU contains products with a market value of $36,000/TEU, then the value of freight time savings as a proportion of this is only 0.018% (noting that these values are not directly comparable and are provided for high level information only);[82] and
- *travel time as a proportion of transport costs* – considering transport costs incurred by a freight shipper of approximately $200/tonne or $2,000 in total for a container freighted from Melbourne-Brisbane, this indicates transport costs averaging $65 per tonne hour given the approximate 30 hour door-to-door transit time. The value of freight time of $0.81 per tonne hour as a proportion of this is only 1.2%.[83]

Comparison of the $0.81 per tonne hour value

Assuming that the principle behind the measurement of freight travel time has economic basis, then a more difficult issue is how to appropriately value this.

The only substantive work undertaken to date appears to be by Austroads in its 2008 *Guide to Project Evaluation*, and BITRE's *Working Paper 45: Brisbane-Melbourne Rail Link: Economic Analysis & Fowkes* that applies transit time analysis undertaken by ATEC.

This appraisal has incorporated the Austroad's value of freight for semis and B-doubles, despite this being based on Melbourne-Sydney and Melbourne-Adelaide road freight that has a just-in-time component not readily captured by rail. It is thought that this value is more conservative relative to the ATEC estimates used by BITRE (formerly BTE). In the BITRE 2000 appraisal, a value of $1.60 per tonne hour for general freight was incorporated in the Brisbane-Melbourne rail link economic appraisal based on ATEC transit time analysis (equivalent to $2.14 per tonne hour in 2008 dollars).[84]

Savings in train and road operating costs

The project case will result in reduced kilometres on the road network, as well as fewer tonne kilometres of rail travel due to the new rail links providing shorter distances compared to the existing coastal rail link. As a result, this will produce lower operating costs.

This item in the CBA captures additional train operating costs as road users switch to rail, as well as corresponding lower road operating costs from these road-rail diverters. Also rail users that switch from the coastal rail to the inland railway are estimated to benefit from reduced operating costs. As such the following incremental benefits are captured:

- the benefits of existing rail traffic with lower operating costs on the new inland rail line; and

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[81] Fowkes, Tony and Whiteing, Tony 2006, *The Value of Freight Travel Time Savings and Reliability Improvements – Recent Evidence from Great Britain*, Institute for Transport Studies, University of Leeds, UK

[82] Value of freight travel time in this appraisal is: $0.81 per tonne hour, or $6.48/TEU per hour – considering each container freights approximately 8 tonnes per TEU (excluding container weights)

[83] Assuming a 10 tonne weight per TEU including container weights.

[84] In 2000, the BTRE (now BITRE) *Brisbane-Melbourne Rail Link: Economic Analysis* used ATEC transit time analysis to derive value of time for freight in transit ranging from $0.00 to $2.99/tonne hour in the appraisal (dependent on freight type), equivalent to $1.60 for general freight (2000 dollars). This analysis also cited a value of $0.60 per tonne hour (2000 dollars) sourced from Austroads and derived on the same basis applied in this appraisal.

- the benefit road-rail diverters with lower operating costs on the new line.

The approach to estimate operating cost savings is based on an assumption that modal shift determinants would be influenced by the travel time (already allowed for in travel time savings) and more particularly by the price. In commercial markets, the prices charged reflect full costs, which include taxes. Thus, for commercial freight, it has been assumed that the principal distinction is between financial (which drive prices) and resource costs. Unlike public transport evaluations where perceived costs are generally lower than resource costs because of constrained fare settings, commercial freight can expect that prices are generally fully reflected in financial costs (except for any commercial discounts applied which are then offset by higher prices elsewhere, all driven by market elasticities and the objective that total revenue should cover total costs). Thus, resource costs essentially are financial costs less taxes.

(i) Existing rail traffic (coastal traffic and coastal- Inland Rail diverters)

Firstly, reduced rail operating costs resulting from the project were determined by applying a total resource cost per net tonne kilometre for rail operators. Given that in a commercial freight market, the prices charged are likely to reflect full resource costs including taxes, the operating costs reflect long run financial costs. Our data does not include taxes, but comprise the following resource costs:

- rollingstock depreciation and return on economic capital;
- basic running costs of the rollingstock, such as fuel, crew wages, repairs and maintenance;
- additional running costs due to any significant speed fluctuations; and
- additional fuel costs due to stopping.

Train operating costs of 2.22 cents per ntk for the 1,880 km scenario and 2.05 for the 1,690 km scenario were estimated from preliminary costs and assumptions, and 2.23 cents per ntk for coastal rail was based the transit time differential with the inland railway estimates. It has been considered that fuel is the only train operating cost that will be significantly different between the coastal route and inland route, however without detailed analysis it is difficult to assess what the impacts of either route will have. The LTC indicates that the following differences between the routes will impact on fuel consumption (however detailed study would be required to further understand the precise impact from each):

- *inland route* – steep climb out of Brisbane, but then a flatter route on the line; and
- *coastal route* – consistently hillier route but without the Toowoomba range climb; much busier line therefore having more stops in passing loops; and a different average speed.

The table below presents details for the inland rail operating cost estimates, which is based on the LTC estimates provided in Table 21, Chapter 4.

Table D-1 Train operating cost assumptions assumed in economic appraisal (2008 dollars)

	1,880 km scenario		1,690 km scenario		Coastal railway	
Cost item	Train operating cost per km	Train operating cost per net tonne km	Train operating cost per km	Train operating cost per net tonne km	Train operating cost per km	Train operating cost per net tonne km
Train crew costs	$ 2.94	$ 0.002	$ 2.61	$ 0.001	$ 2.96	$ 0.002
Fuel cost (1), (2),	$ 13.60	$ 0.007	$ 10.88	$ 0.006	$ 13.85	$ 0.007
Annual rollingstock depreciation and return on economic capital	$ 14.07	$ 0.007	$ 15.60	$ 0.008	$ 13.90	$ 0.007
Rollingstock maintenance - locomotive costs (4)	$ 4.09	$ 0.002	$ 3.27	$ 0.002	$ 4.17	$ 0.002
Rollingstock maintenance - container wagon costs (4)	$ 3.32	$ 0.002	$ 2.76	$ 0.001	$ 3.37	$ 0.002
Administration and management (5)	$ 3.80	$ 0.002	$ 3.51	$ 0.002	$ 3.82	$ 0.002
Total (3)	**$ 41.82**	**$ 0.0222**	**$ 38.64**	**$ 0.0205**	**$ 42.07**	**$ 0.0223**

Source: LTC in WP4, pp 15 & 16; Austroads 2008, Sydney 2007 resource price for diesel, Table 2.4, p6; & reference train assumptions
Notes: (1) assumes diesel fuel resource price of $0.83/L; (2) consumption per km is based on application of LTC initial estimates for sections of the Stage 1 identified rail line, and are for a non-stop run and do not include engine idling time while stationary or at the terminals, however do include engine idling time while travelling down hill; (3) average load to convert km to ntk is 1,886 tonnes per train and 85% inland railway utilisation; (4) Annual rollingstock depreciation and return on economic capital based on the following indicative capital costs (LTC February 2009): Locomotive $5.5 million; and Wagon $200,000. Also assumes rollingstock asset life of 20 years; and (5) Administration and management has been assumed to comprise 10% of total costs

The operating costs per ntk were applied to the rail traffic under the Base Case and project cases, to estimate incremental operating cost savings as a result of the project.

*The benefit = (base case train operating cost * the number of rail net tonne kilometres in the base case) - (project case train operating cost * the number of rail net tonne kilometres in the project case).*

(ii) Road-rail diverters

As discussed above, the Inland Rail project will result in freight diverting from road to rail compared with the Base Case. As a result of diverting to Inland Rail, the previous road users will benefit from a reduction in vehicle operating costs due to lower train costs per ntk.

Road user vehicle operating costs (VOC) are a function of the length of a journey, traffic volume, vehicle speed, road condition (surface roughness) and characteristics (i.e. gradient and curvature). Total VOC are comprised of:

- basic running costs (fixed and operational) of the vehicle, such as depreciation, fuel, repairs and maintenance;
- additional running costs due to road surface;
- additional running costs due to any significant speed fluctuations from free flow speed; and
- additional fuel costs due to stopping, such as queuing at traffic signals.

For road-rail diverters, road operating costs were estimated at 4.8 cents per ntk based on RTA literature, combined with vehicle mix and tonnage assumptions. More specifically, the resource cost correction is based on RTA literature for 6-axle articulated and B-Double VOCs including fuel per kilometre. Then the costs were converted to net tonne kilometres based on the ABS average load of 24.7 tonnes per trip for articulated freight vehicles. The

6- axle truck and B-Double figures were then weighted based on a vehicle composition assumption of 60% and 40% respectively, to derive a weighted resource VOC of 4.8 cents per net tonne km. These costs reflect the total resource cost for road freight.

> *The benefit = (the number of road-rail diverted net tonne kilometres induced to rail with the project case) * (road operating cost – inland rail operating cost).*

For induced rail users, operating costs were captured in the benefit estimating net economic value from induced freight, so were not included in the operating cost estimates in order to avoid double counting.

A possible consideration in estimating train operating costs is that different train loads for backhaul are likely to result in lower operating costs per kilometre for southern compared to northern flows of freight. For example, approximately 66% of current Melbourne-Brisbane freight is estimated to flow north from Melbourne to Brisbane. However, as the demand forecasts reflect the different directional flows, and as it has not been possible to establish definitively the proportion of operating costs that would vary with different utilisation, this appraisal reflects average loads and costs per ntk.

Net economic value from induced freight

The ACIL Tasman demand projections have identified a segment of demand that will be induced if the inland railway is constructed, i.e. that is not diverted but is totally new traffic that emerges exclusively because of the project. This freight comprises a relatively minor proportion of total rail demand (between 3-10% per annum of total net tonne kilometres estimated to travel on rail under the Inland Rail scenario).

As Inland Rail is estimated to induce new freight volumes, it is expected that there will be an economic benefit for the producers of this freight, otherwise such traffic would not materialise. This implies that:

- *in the base case* – the gross value of the products, less production and transport, results in a negative outcome, hence these producers do not transport their products; and
- *for a scenario with Inland Rail* – transport costs can be assumed to have fallen as this is the only component likely to have changed as a result of Inland Rail. This can be assumed to result in the gross value of the product, less production and transport costs, becoming a positive number due to Inland Rail.

In order to incorporate the producer surplus from the net economic value of induced products into the appraisal, it has been assumed that 20% of the inland railway operating costs of 2.22 cents per ntk for the 1,880 km scenario (and 2.05 cents for the 1,690 km scenario) represent the value of these products.

The table below presents a sample of outcomes possible for the net economic value when comparing against a base case characterised by unviable production as a result of base case transport costs. The 20% assumption was selected as a conservative estimate considering these and further examples.

Table D-2 Examples of net outcome as a proportion of transport costs

Cost item	Example 1		Example 2		Example 3	
	Base case	Project case	Base case	Project case	Base case	Project case
Gross value of production	100	100	100	100	100	100
Production cost	70	70	90	90	85	85
Transport cost	40	17.5	20	8.8	25	11.0
Net outcome	**- 10**	**12.5**	**- 10**	**1.2**	**- 10**	**4.0**
Net outcome as a % transport cost		**71%**		**14%**		**37%**

Based on the approach discussed above, the formula below was applied to demand to estimate the net economic value of induced freight:

> *The benefit = 20%* (inland railway operating cost per net tonne kilometre) * (the number of net tonne kilometres attributable to freight induced as a result of Inland Rail).*

Appendix E

Terms of reference for the study

Terms of reference for the study

Melbourne/Brisbane Inland Rail Alignment Study
Terms of Reference

The objectives of the study are to determine:

- The optimum alignment of the inland railway, taking into account user requirements and the economic, engineering, statutory planning and environmental constraints. The alignment will be sufficiently proven up so it can be quickly taken through the statutory planning and approval process and into detailed engineering design and construction, should a decision be taken to proceed;
- The likely order of construction costs +/- 20%;
- The likely order of below rail (infrastructure) operating and maintenance costs;
- Above rail operational benefits;
- The level and degree of certainty of market take up of the alignment;
- A project development and delivery timetable;
- A basis for evaluating the level of private sector support for the project.

In developing the detailed alignment for the route, ARTC will generally follow the 'far western sub-corridor' identified by the North-South Rail Corridor Study.

The study is to be carried out in three stages, with a review of progress and direction at the end of each stage.

Proposed stages are as follows:

- Stage 1 – Determination of the preferred route;
- Stage 2 – Engineering, environmental and land baseline analysis;
- Stage 3 – Development of the preferred alignment.

Each of the stages will represent a milestone for the project as a whole. The progress of the study will be reviewed in detail at the end of each stage. Progress to the following stage will be dependent on satisfactory outcomes for the study to date.

Within each stage there will be a series of working papers produced to document the progress of the study. The ARTC will consult with key interested parties during the study.

The study is to be completed by the end of 2009.