APPENDIX A

MAIN ROADS WESTERN AUSTRALIA COMMENTARY

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Mr S Hicks
Chairperson - Perth City Rail Advisory Committee
C/- West Australian Government Railways
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PERTH WA 6849

Dear Stuart

PERTH CITY RAIL ALIGNMENT OPTIONS

I understand that the Perth City Rail Advisory Committee is seeking clarification as to Main Roads' position on the Western and Central rail alignment options, particularly given the evolving nature of these options and the significant changes that have been made since Main Roads last provided comment.

Although the options have been enhanced considerably, the impact from a road management authority perspective remains essentially unchanged. As such, the advice provided previously by this agency still stands.

I favour the Central Option from both an overall transport efficiency point of view and from a constructibility / traffic management perspective.

In transport terms the Central Option fulfils the prime objective of the Government's SWMR project in providing a direct link between Mandurah and the Perth city centre.

Provided it is built in a way that does not preclude a later rail loop to service an expanded Perth City centre, the Central Option is the right solution to optimise patronage.

The Central Option also provides for more efficient rail operation north and south of the city.

It is clear that in terms of disruption to road users, the Western Option as proposed penalises road users to a far greater degree than the Central Option. This is a direct result of following an alignment within a Freeway reserve at the major "pinch point" in the Freeway system. The potential impacts to Freeway traffic are of major concern to Main Roads, particularly given the extent of disruption to the Freeway over the last few years as a result of the Narrows Bridge and Bus Transitway projects. Also, construction of the railway within the Freeway median between the Narrows Bridge and Glen Iris will occur simultaneously with construction of the City section, further adding to the disruption to Freeway traffic over a considerable length. Major traffic delays are inevitable. Public reaction to severance of access to and from the Freeway and delays through temporary detour arrangements associated with the Western Option has been underestimated and such public reaction could embarrass the Government and delay the rail project.

In addition to complex traffic management issues, the Western Option also poses a much greater risk to complex structural elements within the freeway. A thorough engineering assessment of all structures is required to better assess the costs and risks associated with such works.

Main Roads previously advised the Committee that Western Option 3PCC did not provide for safe vehicle movement from the Riverside Drive On Ramp to the Hay Street Off Ramp. Based on the current network configuration and traffic volumes this movement is significant and there is a lack of realistic alternative routes if the current safe movement is closed. Main Roads has indicated that this movement would have to be retained through a reconfiguration of the ramps that would represent an additional cost to this option.

In summary, I favour the Central Option as the right solution with constructability and traffic management risks that can be more easily managed.

Yours sincerely

Greg Martin
COMMISSIONER OF MAIN ROADS

3 MAY 2002

APPENDIX B

WESTERN AUSTRALIAN GOVERNMENT RAILWAYS COMMISSION ANALYSIS & RECOMMENDATIONS

Western Australian Government Railways Commission

Westrail Centre, West Parade, Perth Tel: (08) 9326 2000
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Perth WA 6849

Enquiries

My Ref PCRAC

Your Ref

Date 15 May 2002

Mr Stuart Hicks
Chairman
Perth City Rail Advisory Committee
PO Box 8125
PERTH BUSINESS CENTRE, PERTH WA 6832

Dear Stuart

WAGRC ANALYSIS AND RECOMMENDATIONS ON THE OPTIONS FOR THE ENTRY OF THE SWMR INTO THE CITY OF PERTH

As your Committee is aware, the Commission has undertaken a detailed analysis of the operational implications of the proposed "Central" and "Western" route options for entry of the South West Metropolitan Railway (SWMR) into the City of Perth. The analysis includes a comparative assessment of operating cost, practicality of implementation, current and future customer impacts, safety risk and ability to accommodate growth in patronage. Full details of the analysis have been provided under separate cover in the report entitled "WAGR Analysis, Comment & Recommendations Regarding the Options for the Mandurah Rail Route into the City of Perth".

It is important to note that the Commission's analysis has been undertaken within the context of a strong passenger focus (both current and prospective users) and has considered the issues of operational flexibility and the critical planning requirements for future growth in patronage demand. In this regard, whilst the Western options present many positive aspects, overall, they suffer from several important shortcomings. The Western option described as "3PCC" presented WAGRC and its customers with the least desirable operational outcomes. In summary, our analysis of the 3PCC option revealed the prospect of:

- Unacceptably high passenger impact delays;
- Failure to accommodate future rail network patronage growth;
- Unacceptable customer service legibility through complex service scheduling;
- Requirement for 12 additional new railcars whilst delivering unsatisfactory capacity utilisation;
- Higher infrastructure investment to accommodate operational inefficiencies; and
- Low service punctuality and reliability.

The Western option denoted "3PCC(I)" displays fewer shortcomings, but remains unsatisfactory for the following reasons:

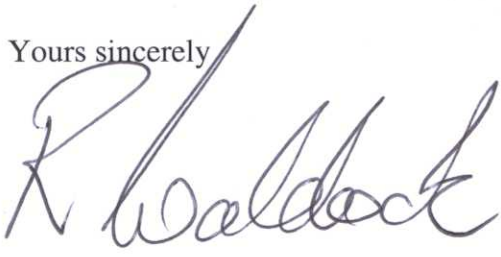
- Requires 12 additional new railcars;
- Dead-ending Mandurah and Clarkson lines at Perth inhibits WAGRC's efficient management of Passenger Delay Impacts and Special Events; and
- Limited scope for accommodating future growth due to its 16 train per hour train capacity.

The Central option "1D" presents the optimal combination of attributes as follows:

- High level of customer service legibility;
- Facilitates effective management of forecast growth in patronage demand and supports the operation of 20 trains per hour along the Clarkson-Mandurah alignment;
- Satisfactory quarantining of the high-incident Armadale line;
- Strongest in minimising customer transfer penalties ;
- Strongest in integrating with other public transport modes;
- Achieves desired outcomes with lowest investment in railcars and infrastructure.

In summary, the Central option offers significant operational advantages over the Western options and in particular, is superior in terms of cost, customer service, reliability and capacity for growth. Accordingly, the Commission strongly endorses the operating scenario for the Central option (1D) and recommends its adoption in preference to both Western options variants (3PCC and 3PCC(1)). I trust that your Committee will take due account of the Commission's analysis in its deliberations.

Yours sincerely



Reece Waldock
ACTING COMMISSIONER OF RAILWAYS

REPORT TO THE PERTH CITY RAIL ADVISORY COMMITTEE

WAGR ANALYSIS, COMMENT & RECOMMENDATIONS REGARDING THE OPTIONS FOR THE MANDURAH RAIL ROUTE INTO THE CITY OF PERTH

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1.0 EXECUTIVE SUMMARY

In summary, WAGR's analysis indicates the following properties in relation to each of the rail options considered:

Western Alignment 3PCC

This option presents numerous serious Operational flaws which in WAGR's view preclude it from further consideration:

1. *Unacceptably High Passenger Impact Delays*.

   This is occasioned by unavoidable through-running of Clarkson services to the Armadale line. The Clarkson line is highly efficient (well spaced stations, negligible delay incidents) and it will be imprudent to align its service with the troubled highly inefficient (closely spaced stations, numerous 'at-grade level crossings) trouble-prone Armadale line which carries responsibility for 55% of the entire system's potential Passenger Delay Impacts. A position which over time will progressively deteriorate.

2. *Will not accommodate future rail network patronage growth.*

   Inappropriate matching of efficient Clarkson line with inefficient Armadale line coupled with a maximum limit of 16 trains per hour track / platform capacity. By 2021, patronage demand will require 20 trains per hour.

3. *Imposes Unacceptable Customer Service Legibility Through Unavoidably Complex Service Scheduling.*

   Customer behaviour modification historically has demonstrated that what is demanded by this model is too onerous. The scheduling and allocation of railcars under this option is not designed to satisfactorily meet known customer demands.

4. *Requires 12 Additional Railcars Whilst Delivering Unsatisfactory Capacity Utilisation.*

   Forced through-running on to the Armadale line from the Clarkson line is not supported by patronage demand.

5. *Necessitates Higher Infrastructure Investment To Accommodate Operational Inefficiencies*

6. *The Achievement of Punctuality and Reliability key performance measures will be difficult, given the complexity of this option's scheduling demands.*

Western Alignment 3PCC (1)

1. *Requires 12 Additional Railcars*

2. *Dead-Ending Mandurah and Clarkson Lines At Perth Inhibits The Operator's Management of Passenger Delay Impact Incidents and Special Events*

3. *Limited Scope For Accommodating Future Growth Due to 16 Train Per Hour Train Capacity*

4. *Satisfactory Customer Service Legibility*

5. *Satisfactory Quarantining Of The Armadale Line*

William Street Alignment (1D)

1. *High Level Of Customer Service Legibility*

2. *Facilitates Effective Management Of Strong Growth In Patronage Demand*

Supports the operation of 20 trains per hour along the Clarkson-Mandurah alignment.

3. *Satisfactory Quarantining Of The Armadale Line*

4. *Strongest Option In Minimising Customer Transfer Penalties*

5. *Strongest Option In Integrating With Other Public Transport Modes*

6. *Achieves Desired Outcomes With Lowest Investment In Railcars And Infrastructure*

1.1 Recommendation

Based upon its exhaustive analysis, WAGR strongly endorses the PURD operating scenario for the William Street alignment (1D) in preference to 3PCC and 3PCC(1).

2.0 OBJECTIVE OF THE ANALYSIS UNDERTAKEN BY WAGR

It is WAGR's clear understanding that three alternative options have been developed which provide for the entry of the new Mandurah rail link into the City of Perth.

WAGR also understands the need for the PCRAC to seek an objective appraisal of those alternative modes of entry from WAGR, the Operator of the Urban passenger train services.

As the Operator of the existing metropolitan train system, WAGR is well positioned to provide expert assessment in relation to the following matters:

- The operating cost differentials between the options;
- The practicality of the arrangements proposed in each of the options, in particular commenting upon the ease with which each option can be translated into reality;
- The impact or consequences of each option upon train customers, both current and future;
- The attendant risks to safety posed by each option and
- The ease with which future growth in patronage beyond 2006 will be accommodated.

3.0 CURRENT SERVICE CHARACTERISTICS PROVIDE A YARDSTICK

3.1 Performance Requirements

The Urban Passenger Infrastructure and Train Service Operations are funded through a Service Level Agreement with Transperth, a branch of the Department of Planning and Infrastructure. That Agreement is typical of the "Service Purchaser – Provider" genre.

The funding covers the recurrent costs associated with operating the train service as well as necessary debt service. Urban Passenger debt service predominantly relates to the debt associated with the creation of the new Joondalup line, electrification of the train network and acquisition of the new Electric Multiple Unit ("EMU") trains in replacement of the diesel locomotives.

In common with all Service Level Agreements, the funding is provided conditional upon Urban Passenger Train Service's achievement of robust Key Performance Targets.

The Key Performance Indicators, their measurement and the required Targets are summarised in the table below:

Key Performance Indicator	Method of measurement	Required target
Service punctuality	% of all scheduled services expected to operate within three minutes of published timetables as measured from terminus to terminus	97.5%
Service reliability (2)	% of all scheduled services operating in accordance with the published timetable	95%
Passenger Satisfaction	% of passenger satisfaction as measured by an index of the 20 most important items in the annual Passenger Satisfaction Monitor survey	90%
Safety and Security	Number of passenger security incidents defined as assault, disorderly conduct, offensive behaviour and substance abuse.	Less than 60 passenger security incidents per million initial boardings
Customer Complaints	Number of passenger complaints received via the Transperth Comment Line.	Less than 5 complaints per million initial boardings.
Presentation	Level of train and station presentation as assessed by the Transperth Service Performance Section via monthly presentation audits including correct uniform, name badge, cleanliness, passenger information, destination information and ticket equipment operation.	Less than 5% non-compliance for all checks conducted.

It is important to note that the Urban Passenger Train Service has an enviable record in its achievement of those performance criteria.

WAGR's results for the year ended 30 June 2001 were as follows:

- Punctuality 97.5%
- Reliability 98.0%
- Satisfaction 86.0%
- Safety & Security 73 incidents per million boardings
- Customer complaints 3.9 complaints per million boardings
- Presentation Nil non-compliance

It is also worth noting that those targets and the robust measures upon which they are based are significantly higher than train operations interstate and internationally in Singapore and Hong Kong. To illustrate this point, the Committee is referred to M>Train performance criteria in Victoria. For comparative purposes, M>Train is required under the terms of its contract with the Victorian Government to operate 92% its services within 5 minutes[1] of scheduled times.

WAGR is justifiably proud of its high standards of performance and takes the view that any addition to the existing service should be achieved without a lessening of that enviable performance.

In this context, as this paper proceeds comment will be made upon the ability of the various Rail Options (3PCC, 3PCC(1) and William Street (1D)) to either achieve or threaten WAGR's maintenance of current performance obligations. WAGR's view is that maintenance of existing service performance levels, given high community expectations, is mandatory.

3.2 Existing System Service Design

The question most often asked by WAGR's counterparts is 'how is this high level of performance consistently achieved upon a regular basis?'

The answer to this question lies in an explanation of the system design characteristics. In brief, the design of the existing train system is

[1] Refer website www.movingmelbourne.com

characterised by a maximisation of "through-running services" and a minimisation of "dead-ended services".

"Through-Running Service"

A "through-running" service is a train operation which moves from the originating terminus to the destination terminus without requiring the Driver to interrupt the journey by deactivating the train at one end and moving to the other in order to complete the journey between the two termini.

The "through-running" mode of operation minimises the "train fleet idle time' and as a consequence maximises train fleet utilisation whilst also minimising the journey time.

"Dead-Ended Service"

By definition a Dead-ended Service is an interruption to a train journey between two termini requiring the movement of the Driver from one end of the train to the other in order to continue the service. Generally, it is characterised by platform and track design that requires each train to enter the platform, detrain and entrain passengers and depart, prior to the entry of the next service.

This aspect inhibits the efficiency of the train flow through:

- The imposition of a time penalty associated with the Driver's movement and the consequent need for the Driver to prepare the train for departure through undertaking mandatory pre-departure checks and various activation routines (setting message announcements, checking/confirming automatic train protection system etc). This time penalty is commonly referred to as "Idle Time". WAGR employs 5 minutes as its standard turnaround time allowance.

- Other trains cannot enter the track located at a platform designed for 'Dead-ended' service until the train at that platform has departed sufficiently clear of the station to enable the next train to arrive. The time commonly allowed for this manoeuvre is 2 minutes.

  A turnaround allowance at a 'Dead-Ended' platform is therefore 5 minutes for Driver movement end to end, plus 2 minutes for train clearance giving a total 7 minutes. Naturally, to the extent the length of the platform permits, trains may be stacked one after the other at the platform. However, this is not desirable, as a "last train, first train out" scenario then has to be followed.

A 'Dead-Ended' service arrangement inhibits the Operator from responding to unexpected passenger loadings as quickly as may be achieved under a "through-running" service / platform design. In a 'Through-running' situation trains can be stacked one behind the other on the track leading to the platform and moved out on an efficient and customer friendly 'first train in, first train out' basis. Consequently for 'Dead-ended' alignments there are real limitations imposed upon the Operator in attempting to clear unexpected or even expected (such as special events like Skyshow) high passenger loadings in an efficient manner. By contrast, trains may be banked one behind the other with 'through-running' service / platform / track arrangements.

In summary, the maximisation of 'Through-Running' and the minimisation of 'Dead-ended Running' characteristics facilitates the Operator's optimum opportunity to position railcars to meet the passenger demand.

The existing train system, in its current form, facilitates WAGR's rapid positioning of train services to meet customer demands. This is particularly noticeable at times of maximum system stress such as Skyshow, Christmas Pageant and sundry special events. Skyshow imposes patronage movement demands in the order of 25,000 to 30,000 from Perth Station within a 1-hour timeframe. The Operator is at present well placed to respond to those exceptional patronage demands and importantly, accommodate the impact of railcar irregularities.

3.3 Existing Train System Design Characteristics and Service Frequencies

The existing system features the maximisation of "Through-Running".

The only services currently "Dead-Ended" are the Whitfords Shuttle services which terminate in Perth, and 11 times each weekday the Armadale services terminate at platform 4 in Perth station.

The services predominantly run through unimpeded from Midland to Fremantle and Joondalup to Armadale.

The weekday service frequencies are:

Line	Peak of the Peak	Off-Peak
Joondalup	4.5 minutes (including Whitfords shuttle)	7.5 minutes
Armadale/ Fremantle & Midland	7.5 minutes	15 minutes

4.0 OPERATING OPTIONS DESCRIBED

A description of the three options is detailed in the following. The summary characteristics and preliminary comment provide a snapshot of the properties of each from an operating perspective.

4.1 Western Alignment 3pcc (Halliburton KBR Model)

Summary characteristics 3PCC:

- All Whitfords trains are 'through-running' to Armadale and vice versa (Orange)
- Every other train from Clarkson runs through to Thornlie/Nicholson Road (Light green) with the balance turning round, or dead-ended in Perth Station (Dark green).
- The South West Mandurah Railway ("SWMR") operates as a self-contained railway with services between Perth and Thomsons Lake and Perth and Mandurah. Within WAGR's definition, it is a 'dead-ended' service (red).
- It is possible to run a reduced service frequency of a train every 10 minutes (10/5 service) rather than 2 trains every 15 minutes (8/7 service) from Mandurah.

Preliminary comment 3PCC:

- This option teams a more efficient line (Clarkson) with a substantially inefficient line (Armadale). Though this is arguably the case now, it is an issue to be expanded upon later in this paper, as it will lead to future difficulties.
- Will require complex scheduling which impairs its legibility, or ease of understanding, to the customer.
- Utilises new railcars, engineered for high speed and reliability suited to lines with station spacings of no less than 3 kilometres on a comparatively inefficient line (Armadale) with numerous 'at-grade' rail crossings. Given the design characteristics of the new railcars the only combination of stations that could be stopped at along the Armadale line with the new railcars are listed below:

Line/Station	Distance from Perth Station (km)	Distance between stations (km)
ARMADALE LINE		
McIver		0.5
Claisebrook	1.3	0.8
Burswood	4.8	3.5
Oats Street	10.0	5.2
Cannington	12.2	4.8
Kenwick	15.8	3.6
Gosnells	21.2	5.4
Kelmscott	25.9	4.7
Armadale	30.1	4.2

It is apparent that by 2021, a 3 minute service frequency will be required to meet demand on the Armadale line. This therefore implies a number of options which need to be dealt with well before 2021. Those options include not using the new railcars on the Armadale line, use the new railcars and suffer the consequent maintenance problems generated, use the new railcars on a 'skip / stop' pattern or close many stations on the Armadale line.

- WAGR's view is that the operation of six-car trains to Nicholson Road is unavoidable. Six-car sets will be required to service the Peak of the Peak requirement on the Clarkson line, running to Nicholson Road due to railcar number constraints and to maintain the 15 minute service frequency to Thornlie and Nicholson Road. Given this imperative, the platforms at McIver, Claisebrook, Oats Street, Cannington, Thornlie and Nicholson Road will need to be built to six-car standards[2].

- Requires double-track between Kenwick and Nicholson Road[3].

- Requires additional turnback siding at Thomson's Lake to cater for two trains at once[4].

4.2 Western Alignment 3PCC(I)

Summary characteristics 3PCC(1):

- The Clarkson services run to Perth Station where they turnaround and go onto the SWMR (Green). This service by WAGR definition is a 'dead-ended' service.

- The SWMR services run to Perth Station where they turnaround and go onto the Clarkson line (red). This service by WAGR definition is a 'dead-ended' service.

- The Armadale Line operates as a self-contained railway with services between Perth and Armadale and Perth and Thornlie/Nicholson Road (Orange). This service by WAGR definition is a 'dead-ended' service.

- Only existing railcars are utilised on the Armadale line as per existing service.

Preliminary comment 3PCC(1):

- This option features a high level of 'dead-ended' service with the attendant consequence of increased train fleet idle times.

[2] This cost is identified in the PURD submission.
[3] This cost is identified in the PURD submission
[4] This cost is identified in the PURD submission

- Limits the utilisation of the new railcars (engineered for high speed and reliability suited to lines with station spacings of no less than 3 kilometres) to efficient lines designed to maximise the new railcar reliability.

- Requires an additional turnback siding at Thomson's Lake to cater for two trains at once.

4.3 William Street Alignment 1D

Summary characteristics (1D):

- All Whitfords trains run through to Mandurah and vice versa (Red). This is a 'through-running' service with no turnaround at a 'dead-end' in Perth.

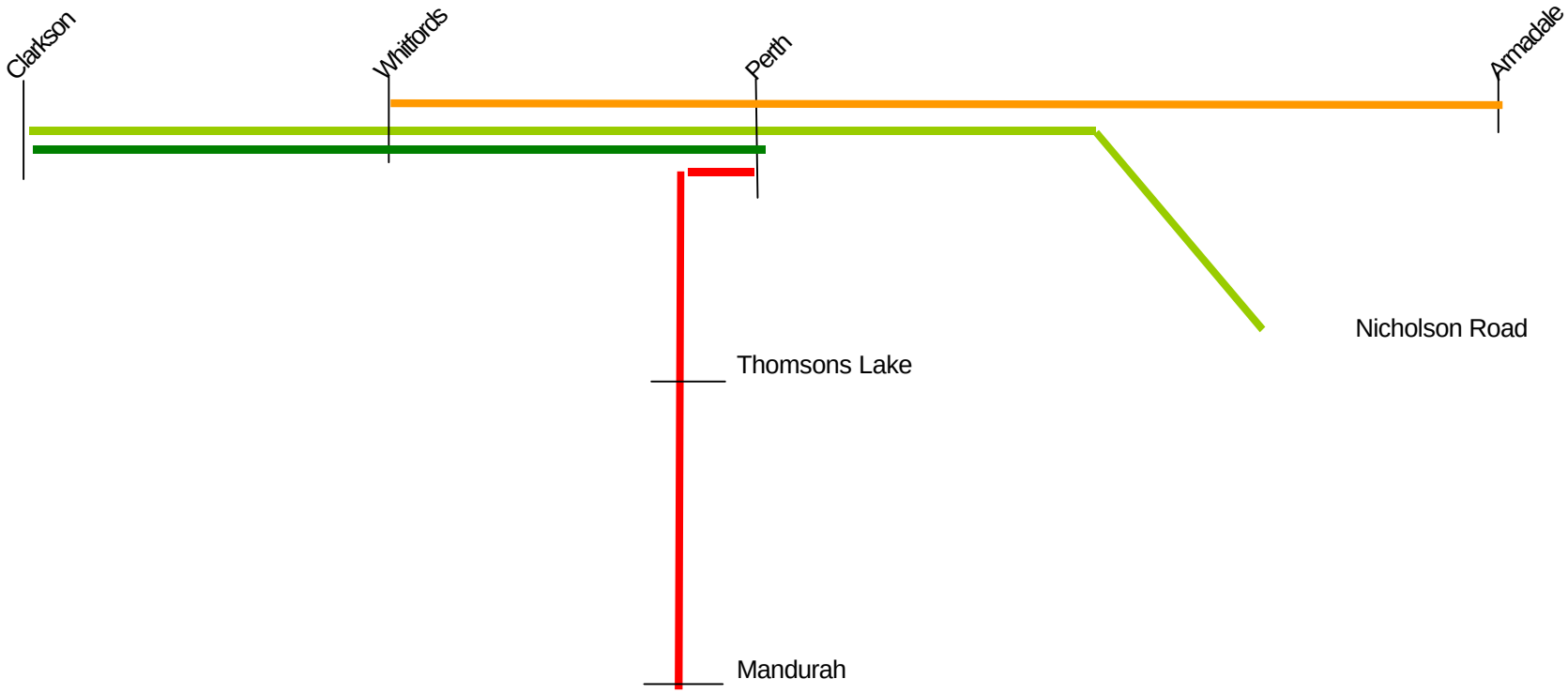
- All Clarkson trains run through to Thomsons Lake and vice versa (Green). This is a 'through-running' service with no turnaround at a 'dead-end' in Perth

- The Armadale Line operates as a self-contained railway with services between Perth and Armadale and Perth and Thornlie/Nicholson Road (Orange). This service is a 'dead-end' service.

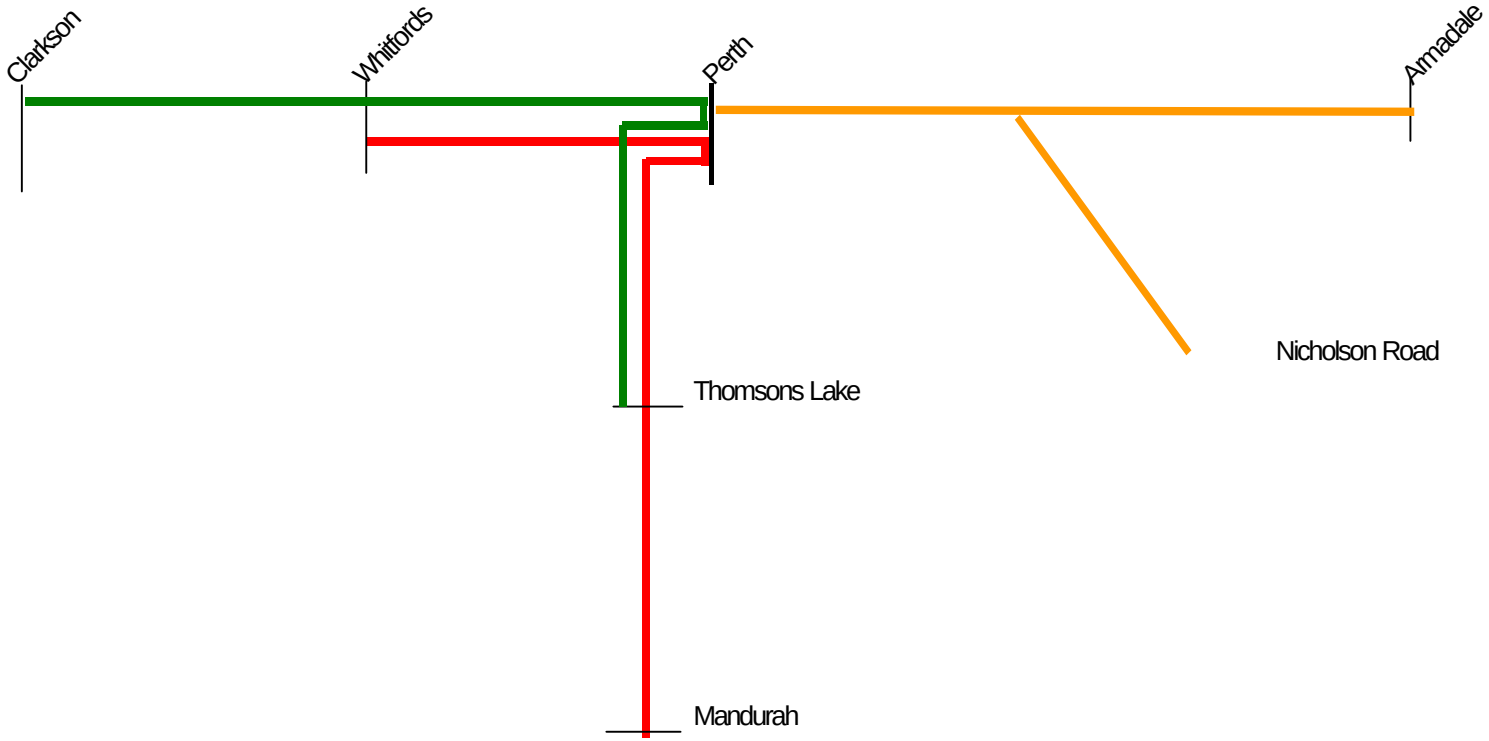
Preliminary comment (1D):

- Maximises 'through-running' service on the Clarkson-Mandurah service.
- Limits the utilisation of the new railcars (engineered for high speed and reliability suited to lines with station spacings of no less than 3 kilometres) to efficient lines designed to maximise the new railcar reliability.

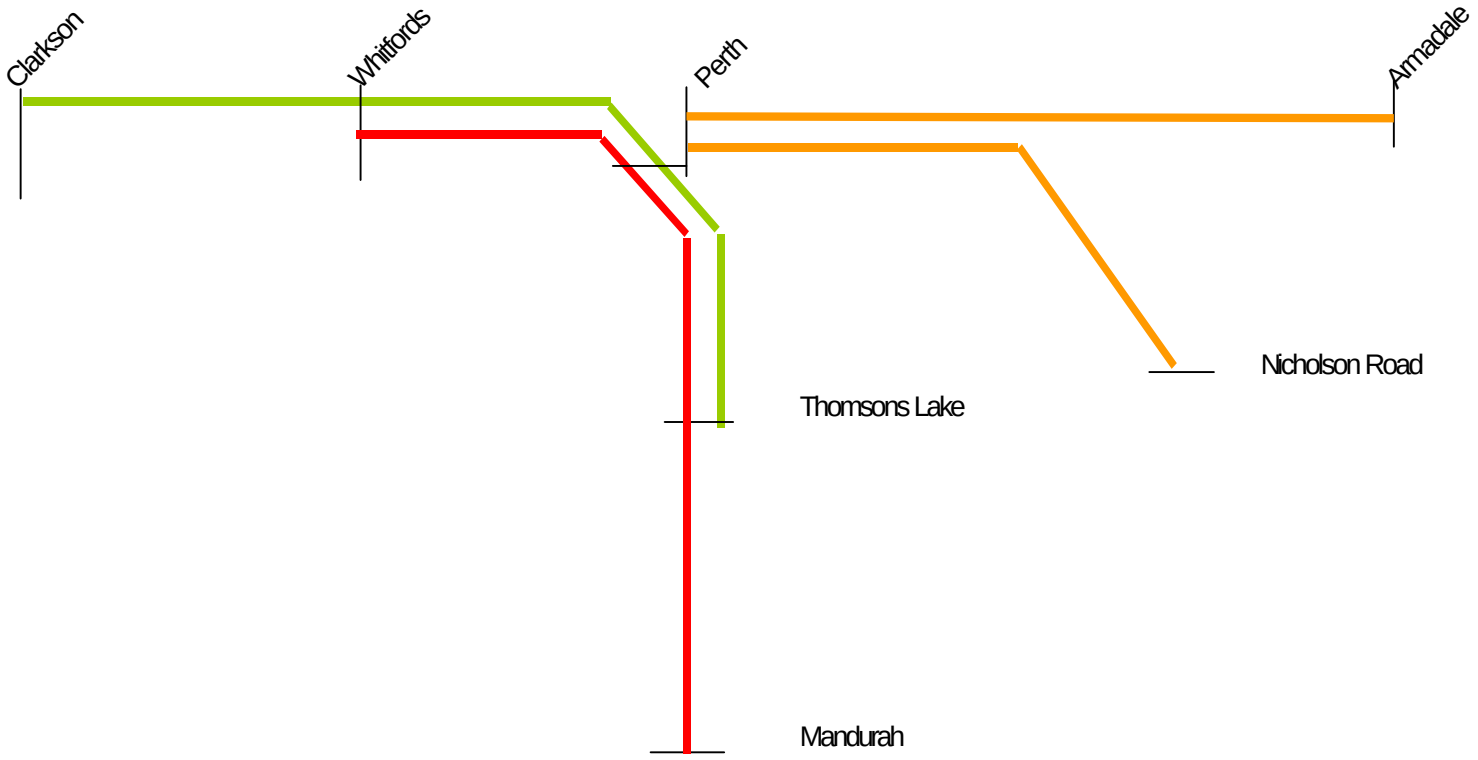
WESTERN ALIGNMENT OPTION 3PCC



WESTERN ALIGNMENT OPTION 3PCC(I)



CENTRAL ALIGNMENT OPTION 1D



5.0 COMPARISON OF DETAIL OF EACH OPTION

5.1 Cost Differentials

Incremental Cost Details	WESTERN OPTIONS				WILLIAM STREET OPTION 1D	
	Western 3PCC (1)	**Addit.Cost NPV $[5]**	**Western 3PCC**	**Addit.Cost NPV $**		**Addit.Cost NPV $**
Personnel						
Drivers (6hr shifts/day)	8	7.5M	4	3.8M	0	0
Turnaround Drivers (6hr shifts/day)	4	3.8M	0	-	0	0
On-Train support (Transit Guards) (8hr shifts/day)	8	8.0M	4	4.0M	0	0
Train Controllers (additional full time shifts per week)	2	3.70M	0	3.7M	0	0
Maintenance, cleaning and energy	0[6]	-	12[7]	2.2M	0	0
Interior repairs - vandalism	10	1.25M	12	1.5M	0	0
Perth Station crossover maintenance						
Points motors		0.2M	0	-	0	0
Signals		0.5M	0	0.5M	0	0
Set maintenance		0.06M	0	-	0	0
OPERATING COST		25.01M		15.7M		0.0M
RAILCARS	12	33.6M	12	33.6M	0	0
Double track Kenwick-Thornlie				**1.5M**		
Armadale station extensions				**5.0M**		
TOTAL		**$58.61M**		**$55.8M**		**$0.0M**

[5] 30 Year NPV @ 3.3% Real, Source WATC

[6] The Western PCC (1) option has more railcars delivering the same service. Accordingly, it is assumed that peak service railcars on the Western PCC (1) option travel less distance than railcars on the William Street option and therefore maintenance and energy costs are equal between the options. In practice, there may be more down time running for the Western options.

[7] The Western PCC option involves an incremental 12 railcars running an additional 375,000 km per annum to meet the daily peak and involves additional maintenance, cleaning and energy costs at the established rate of $0.29/km.

5.2 Operating Costs

The table above shows the incremental costs associated with the operation of the two Western Alignment options by comparison with the William Street (1D).

For simplicity of presentation, the William Street (1D) is treated as a control, against which cost increments or decrements are compared.

A significant portion of the additional costs derive from the need for increased personnel. The analysis of personnel numbers is shown in Appendix 1.

Incremental costs for the option Western 3PCC (1) result from the need for additional rail cars caused by the inefficiency of turning South West Metropolitan Railway services at Perth to run to the northern suburbs and vice versa.

The analysis for that additional time includes provision for added time associated with the train travelling a further 400 metres and the time allowed for the Driver to change the driving end of the train. The procedure for Drivers' changing ends at terminal stations is shown in Appendix 2.

Incremental costs for the Western 3PCC option result from some of the Clarkson system trains turning at the City rather than running through to Armadale or Nicholson Road and augmentation of Armadale line consists to accommodate the higher patronage levels on the Clarkson line portion of their journeys.

To the extent that the 3PCC option requires the use of new railcars on the Armadale line, additional operating and scheduling expense will be incurred through the need to 'dead-run' the new cars back to the Nowergup Depot at end of service.

5.3 Rolling Stock Requirements

Following are the new railcar requirements for each option:

3PCC	
Clarkson/Armadale	
30 Trains	**Cars**
4 x 6 Car	24
12 x 4 Car	48
4 x 3 Car	12
10 x 2 Car	20
Sub-Total	104
Mandurah 7/8 service	
22 Trains	
20 x 3 Car	60
2 x 6 Car	12
Sub-Total	72
Total	**176**

3PCC(1)	
Clarkson-Mandurah	
38 Trains	**Cars**
6 x 6 Car	36
4 x 4 Car	16
24 x 3 Car	72
4 x 2 Car	8
Sub-Total	132
Armadale/Nicholson Road-Perth	
16 Trains	
5 x 4 car	20
11 x 2 car	22
Sub-Total	42
Total	**174**

1D	
Clarkson-Mandurah	
34 Trains	**Cars**
6 x 6 Car	36
4 x 4 Car	16
2 x 2 Car	4
22 x 3 Car	66
Sub-Total	122
Armadale/Nicholson Road-Perth	
16 Trains	
5 x 4 car	20
11 x 2 car	22
Sub-Total	42
Total	**164**

5.4 Operating Differentials

ISSUE	DEFINITION	3PCC		3PCC(I)		1D	
		2006	**2026**	**2006**	**2026**	**2006**	**2026**
Patronage	**Peak Hour Boardings** Clarkson line SWMR Armadale line Nicholson road branch	 14054 9802 5319 2551	 25510 15690 8514 4089	 14054 9802 5319 2551	 25510 15690 8514 4089	 14054 9802 5319 2551	 25510 15690 8514 4089
Patronage Growth	**Percentage Increase** Clarkson line SWMR Armadale line	% 2.98% 2.38% 2.38%	Annual increase same all models				
Service	**Service Frequency** Clarkson line SWMR Armadale Nicholson road branch	 16 16 8 4	 20 16 8 4	 16 16 8 4	 20 16 8 4	 16 16 8 4	 20 16 8 4
System Reliability	**Late Running** (percentage of trains > 3 min late)	4%	6%	4%	6%	2%	2%
Fleet	**Railcars Required**	176		174		164	
Operating Plan	**Routing** Clarkson line SWMR Armadale line Nicholson road branch		Assume no change 2026		Assume no change 2026		Assume no change 2026
Perth Station Capacity	**Platform Adequacy**	Unsure	NO	Unsure	NO	OK	OK

5.5 Infrastructure Additions Or Modifications Required To Meet 2026 Demand

Extrapolation of the 2026 patronage demand forecast indicates the need for the rail system to provide 3 minute service frequencies will arise as early as 2021. In order to meet that increased passenger demand anticipated in 2021, each of the models requires additional infrastructure.

<u>3PCC</u>

- Grade separation of all level crossings on the Armadale line. The cost of grade separation is estimated as follows:

Moore Street	$11.88M
Mint/Archer	$3.6M
Welshpool	$4.5M
Wharf	$3.6M
Hamilton	$3.6M
William	$3.6M

- Extension of all platforms on the Armadale line between Perth and Armadale to accommodate six-car train sets. By 2021, the Armadale line will need to be operating services at the rate of 20 trains per hour. Those trains will need to be six-car sets to accommodate the expected demand on the Clarkson line. If the trains employed possess similar engineering characteristics, then the close station-spacing on the Armadale line will pose serious difficulties. One solution would be to close stations or employ a limited stop pattern stopping at the stations listed, and closing those between as follows:

Line/Station	Distance from Perth Station (km)	Distance between stations (km)
ARMADALE LINE		
McIver		0.5
Claisebrook	1.3	0.8
Burswood	4.8	3.5
Oats Street	10.0	5.2
Cannington	12.2	4.8
Kenwick	15.8	3.6
Gosnells	21.2	5.4
Kelmscott	25.9	4.7
Armadale	30.1	4.2

Alternatively, new railcars with engineering characteristics similar to those currently in use (lower-geared) could be acquired and employed on the Armadale line to reduce the pressure upon station closures. Which of these options are to be employed in the future will depend upon the resultant demand, and the combination of rolling stock design/capacity/numbers and service frequency that is required to meet that demand.

Irrespective of the solution devised for the Armadale line, its linkage to the efficient and relatively incident-free Clarkson line under the 3PCC model is not ideal.

Excluding the stations to be closed, the cost associated with extending the balance of the stations is estimated at $7.7 million.

3PCC(1)

- Two additional six-car platforms at Perth Station together with associated track and signalling. Initial estimates point to an expected cost of $22M in today's dollars.

William Street 1D

- Extension of turnback sidings at Whitfords and Thompsons Lake to accommodate two trains simultaneously. Preliminary estimates indicate $1.5M for each modification, total $3M in today's dollars.

5.5.1 City Station Platform Capacity

Perth station currently experiences the bulk of its passenger movements at its eastern end. Under the 'Western Route' options, this pattern would swing to the western end, requiring re-design to the station facilities.

Additionally, with the platform modification required for the island platform in Perth (currently marked platforms 6,7 & 8), that platform is reduced in size to such an extent that passenger congestion would be expected to seriously diminish its utility.

5.5.2 City Station Platform Availability And City Station Pedestrian Movement

Under the 3PCC model, trains from Whitfords cannot feasibly be turned around to return to Whitfords at Perth because effectively you will need an additional platform for the Thornlie service. There is inadequate platform facility at Perth unless the existing Australind platform is wired and the platform height is adjusted. It therefore follows that the Australind service would no longer be able to terminate in Perth.

6.0 ACCOMMODATION OF THE "PEAK OF THE PEAK" SERVICE REQUIREMENT

It is common practice for public transport service organisation to determine their individual rolling stock requirements by reference to the "Peak of the Peak" patronage demand. The rationale for employing this principle is to ensure that the rolling stock capacity will meet the period of highest passenger demand for the service.

It is critical in undertaking this measurement of patronage demand that the "Peak of the Peak" is accurately identified. Additionally, since the objective is to ensure that passengers are not left standing on platforms it is important to avoid any tendency to smooth out the peak through undertaking passenger counts at inappropriate time intervals during that "peak of the Peak" period. The reason for this lies with the fact that passengers do not normally tend to arrive at stations in uniform flows.

To accommodate this random flow of passengers, WAGR, in common with its counterparts, undertakes the passenger count during the "Peak of the Peak" at 15 minute intervals.
The measurement of passenger at intervals greater than this risks smoothing the "Peak of the Peak" passenger count and consequently understating rolling stock requirements and leaving passengers behind.

It is WAGR's strong preference for the demand in the peak of the peak to be accommodated. Not accommodating this demand will result in leaking of patronage back to road during peak hour traffic and substantial community complaint to Government.

WAGR's "Peak for the Peak" is defined through experience as 0745 to 0815.

WAGR has discussed this methodology with Halliburton and has been informed that the "Peak of the Peak" passenger count was determined at 30 minute intervals. It is WAGR's strong view, a view corroborated by PURD, that the resultant rolling stock numbers calculated by Halliburton is

understated. The 3PCC model is flawed in this regard, and railcar requirements cannot be relied upon.

Conversely, if the Government were to decide not to accommodate the "Peak of the Peak", then the resultant reduction in railcar requirements would apply equally to the Western 3PCC (1) and William Street 1D options.
Thus the cost differentials identified in Section 5.1 in this regard would therefore remain unchanged.

7.0 SERVICE LEGIBILITY FROM A CUSTOMER PERSPECTIVE

Service legibility to the customer is of critical importance. Existing passengers as well as potential customers will be turned away from using the service if it cannot be presented in a clear and relatively simple manner.

It is common practice within public transport operations to attempt to construct timetable schedules which are clear enough to customers to render the possession of a timetable a matter of little consequence.

In this vein, transport planners strive for a combination of high frequency and 'what is commonly referred to as 'clock-face timetabling'. High frequencies in the order of 5 and 10 minute intervals during peak periods and off peak of similar simplicity assist the seasoned traveller as much as the potential traveller. 'Clock-face' timetabling endeavours to have trains departing at both immediately identifiable and memorable times, such as 00 minutes past the hour, 10, 20, 30 minutes past the hour and so on.

In its book 'The Canadian Transit Handbook", the Canadian Urban Transit Association [8] makes the following observation:

> "Variations in the frequency of transit service (headways) may have a significant impact upon transit demand.
>
> For headways greater than ten minutes, even multiples of clock times should be employed. Service headways have most impact where the network design requires a substantial number of customers to transfer."

WAGR has examined each of the options and tenders the following comments with regard to each:

- 3PCC Option:

As originally conceived, the 'Western Route' was to run ex Mandurah, 'dead-end' at Perth and continue on to Clarkson, with much in common with 3PCC(1). This intended design drew criticism from an operating perspective as 'dead-ending' a rail service creates many disadvantages including[9]

- A time penalty associated with the Driver's required change of ends is imposed upon the customer.

- System flexibility / reliability is impaired, as no train may move in until the existing train has exited the approach to the 'dead-end'.

The planner of the 3PCC model, Halliburton KBR, recognised the validity of this disadvantage and moved on to what was perceived to be an enhancement to the 'Western Route' that would remove this problem. The change was to 'dead-end' all services from Mandurah into Perth, but to employ 'through-running' services from Whitfords through Perth to Thornlie/Nicholson Road.

[8] Third Edition, published 1993

[9] Refer Section 3.2

This revision has lead to further complications. The patronage estimates for the 'peak of the peak' requirement indicated that many passengers would be left standing on the platforms on the Northern line if only three-car or four-car sets were to be deployed. It was evident that six-car sets would be required to clear the expected patronage between Whitfords and Perth.

That view was accepted and the model modified to run the six-car sets through Perth to Thornlie. This change in its turn would necessitate the extension of platforms at McIver, Claisebrook, Oat Street, Cannington, Thornlie and Nicholson Road. However, not only would this create a further cost impost upon the 'Western Route' option, but it would also result in sending six-car sets into a line where that capacity was not required.

Faced with this prospect, Halliburton proposed the following in relation to servicing the 'peak of the peak' requirement from Whitfords:

- That a combination of three "three-car", "four-car" and one "six-car" sets be used;
- That an uneven frequency of service be employed of 6 and 9 minutes;
- That customers would be advised of, and adjust to the scheduling of the six-car set within the overall service provided along the Clarkson line.

There are severe constraints to the establishment and maintenance of service reliability on the Clarkson line under the 3PCC model. If WAGR were to employ the 3PCC service frequencies on the northern line, train congestion on that line would be inevitable from the outset. With services departing Whitfords at 6 and 9 minute intervals and express services departing Clarkson at the same frequency, the Clarkson express services would catch the Whitfords services and be held behind those trains for the balance of the journey into Perth. This is due to the fact that there is only 2 minutes differential in the journey-time between those two services. It is difficult to determine how this particular problem could be satisfactorily resolved, if at all. This is not the only difficulty posed by the adoption of the 3PCC option.

Though the description of the process of refinement of the 3PCC model has been lengthy, it is necessary in order to explain a fundamental difficulty from a customer viewpoint.

The expectation that customers will come to understand and adjust their habits to match the method of insertion of the six-car sets into the Clarkson line schedule is not reasonable. The basic tenet for attracting consistent growth in service usage is to develop timetables based upon 'maximising legibility' rather than constructing them to offset Operator difficulties.
This option seeks to offset its operational difficulties through complicated scheduling, which in time, with the onset of further patronage growth can be expected to become more onerous to both Operator and customer alike.

The 3PCC service legibility worsens over time. By 2021, when demand forecasts indicate the need to move service frequencies up to 20 trains per hour, two out of every four Clarkson services will need to be turned at Perth station to return, whilst the other two services run through to Armadale.
The customer will, of necessity, need to become very conscious of this service pattern and in 50% of the cases be required to transfer in order to complete the journey along the Armadale line. This difficulty arises due to the upper limit of 16 trains per hour which applies to the 3PCC option.

From a WAGR perspective, neither the William Street (1D) nor the 3PCC(1) options display adverse customer service legibility aspects.

8.0 SERVICE RELIABILITY & DELAY IMPACTS

Serious disruption can result from the inherent inflexibility in railway systems. The strength of a railway to move large numbers of people efficiently makes it very vulnerable to internal faults and external interference.
Moreover, it is unforgiving and inefficient, when there are system inconsistencies, such as out of balance operation, or variations in station patterns.

In order to provide the reader with a summary view of the Clarkson and Armadale lines, the following comments are made:

Clarkson to Perth is a consistent system:

High track speed and long station spacing
No at-grade vehicle or pedestrian crossings
Low incident history

Perth to Armadale is a <u>different</u> consistent system

Low track speed and short station spacing
Regular at-grade vehicle and pedestrian crossings
High incident history

Differences in track speed, station spacing and level crossings between the two lines are self-evident.

The difference in incident history is shown on the pie charts that cover the years 1999, 2000 and 2001 in Section 11.0.

The total of recorded incidents on the pie charts over the three years was 240 of which 132 were on the Armadale line and 27 were on the Currambine line, a nine times differential.

Differences in incidents and operating patterns on the Armadale line will reflect into the Joondalup line under the 3PCC option and will detrimentally effect service reliability. As indicated in Section 11.0 of this paper it is WAGR's view that the proclivities of the Armadale line warrant its quarantining from the system in order to deal with its problems effectively, whilst at the same time insulating the more efficient lines from the impact of its incidents.

Neither the 3PCC(1) nor the William Street options will incur the potential flow-on impacts associated with difficulties which occur on the Armadale line. Both the 3PCC(1) nor the William Street options quarantine the impact of the Armadale line from the rest of the network.

These flow-on effects are commonly referred to as "Passenger Delay Impacts". By way of illustration, please consider the following example taken from existing service experience:

In the period of the morning from 0745 to 0815 there are 8 trains arriving at Perth station from Currambine. These trains carry 2719 passengers, or 340 passengers per train. Similarly from Armadale to Perth, there are 4 trains arriving which carry 845 passengers or 211 passengers per train.

In this context, a delay caused by an Armadale train will inconvenience 211 passengers times the number of minutes of delay, which when the train continues on to the Currambine line causes further delay to a further 340 passengers. This passenger delay has impacted 551 passengers on this occasion assuming that the train once it completes the Currambine run has managed to eliminate the delay.

In general circumstances the impact of a delay to one train is likely to impact more than one other service. The Armadale line is responsible for 55% of the total network's incidents, the bulk of which have the potential to cause service delays which will undoubtedly generate progressively larger flow-on impacts on the Clarkson line.

In simple terms the Armadale line, generating 10 times the number of incidents likely to cause delays, should not be permitted to impact upon the Clarkson line which will in 2006 be carrying 2.6 times the passenger

volume. This is precisely the scenario that option 3PCC provides for. The Clarkson line's position worsens further by 2026 when the ratio of patronage carried increases from 2.6 times to 3.0 times the Armadale passenger numbers.

In WAGR's view, the continuation of 'through-running' service from the Clarkson line to Armadale, as proposed by the 3PCC model is inconsistent with the efficient management of passenger demand on the Clarkson line and risks increasingly larger Passenger Delay Impacts.

9.0 OTHER CRITICAL CUSTOMER IMPACTS

9.1 The Accommodation Of Special Events

Special Events in Perth, by their nature, can be characterised as follows:

- Unusually large numbers of passengers;
- Passengers who generally 'flood' one or more stations in the network within a very short timeframe– Skyshow & Christmas Pageant - Perth Central station, Rugby, Soccer and Australian Rules Football – Subiaco and West Leederville;
- High variation in event termination times;
- Numerous first-time or infrequent passengers with high expectations regarding the efficiency of the train system and
- Unexpected complications

Both the 3PCC and the 3PCC(1) options are less than optimal in terms of facilitating the Operator's efforts to efficiently manage the extraordinary passenger loadings which typify 'Special Events'.

The 3PCC option with its complex combination of turn-backs to the Clarkson line from Perth, its through-running to Armadale from the Clarkson line (occasioned by Perth station constraints) together with the attendant risk of the 'high-incident' nature of the Armadale line itself, will render Special Event management extremely difficult at best, unreliable at worst. Efficient service through-running with minimal train-idle times will simply not be possible.

The 3PCC(1) option though it removes the influence of the troubled Armadale line, will severely limit efficient Special Event through the inflexibility of its 'dead-ended' treatment of both the Clarkson and Mandurah lines.

Neither 3PCC nor 3PCC(1) will permit the Operator to stow trains on platform approach tracks and move them out sequentially on a "first train in, first train out basis".

9.2 Noise Issues

An absolute design criterion, for all options is that wheel/rail friction must not create noise beyond acceptable standards. This relates to the foreshore, other surrounding areas and to station platforms.

3PCC and 3PCC(1) will both be more susceptible to wheel/rail noise on curves and to turnout clatter between the freeway and City station then the William Street option.

The William Street alignment may be susceptible to wheel rail noise on curves particularly on the foreshore and the northern approach to the William Street station.

10.0 CAPACITY UTILISATION

Each option provides for similar frequency of service.

However both the 3PCC and the 3PCC(1) options require more trains to meet service requirements as there is increased idle railcar time in both options when compared with the William Street 'through-running' option. The disparity between railcar requirements of the William Street option versus the 3PCC and 3PCC(1) options is exacerbated in direct proportion with time and patronage growth.

Increased patronage projections for 2026 are likely to reflect a progressively greater railcar variance between the options as a greater number of trains to six-car capacity will be required to meet that demand.

11.0 HOW THE OPTIONS EACH FACILITATE FUTURE GROWTH

The Department for Planning and Infrastructure estimates patronage annual growth rates will be as follows:

Clarkson line 2.98%
Mandurah line 2.38%
Armadale line 2.38%

On the basis of these expected rates of growth daily Peak Hour boardings are forecast as follows:

	2006	**2026**
Clarkson	14054	25510
SWMR	9802	15690
Armadale	5319	8514
Nicholson road	2551	4089

For purposes of comparison, daily Peak Hour boardings are:

	2001
Joondalup line	10125
Armadale	5440

The capacity of the Western Alignment models 3PCC and 3PCC(1) reach a significant milestone when total growth adds 50% to the estimated 2006 patronage. Given the patronage growth forecast, by 2021, Clarkson trains will be at maximum length (six-car / four-cars) and a three-minute frequency of service will be required on the northern suburbs system.

Indications are that maximum length trains (six-car sets) will be required to meet burgeoning passenger demand as early as 2021.

This rate of growth imposes strict planing constraints upon the system. The decision made now with respect to the choice of 3PCC, 3PCC(1) or William Street (1D) will govern how well Perth's metropolitan train system is able to accommodate that rate of future growth. The critical requirement of the system's design in the future is that it must be able to support train services on a **three-minute headway**.

It is clear from WAGR's analysis that the William Street alignment option has the capacity to accommodate a three-minute headway.

The 3PCC (1) option is restricted to a **four-minute** headway due to lack of platform capacity at City station. As indicated in the preceding, the 3PCC(1) option in order to achieve a three minute headway would require:

- Two additional six-car platforms to be constructed at Perth Station in parallel with the existing platforms and
- Associated track and signaling works.

As stated earlier, the construction of those platforms would be constrained by the available land envelope at the Perth station.

The rail reserve is not sufficiently wide enough to provide for the expansion without being expanded into Roe Street.

WAGR regards this aspect to be a fatal flaw in the design of the 3PCC(1) alignment.

The 3PCC option is also significantly flawed, though for a differing combination of factors. The 3PCC option is constrained by a combination of platform capacity at Perth station and its dependence upon running train services on to the Armadale line. Trains from the Clarkson line must flow on to the Armadale line in increasing numbers as time goes on due to the limited platform capacity at Perth station. The Armadale line itself is the most inefficient line in the existing system as it is severely constrained by two factors:

- Multiple at-grade road-vehicle level crossings;
- At-grade pedestrian maze-gates;
- Platforms which, with the exception of those between Perth and Nicholson road when modified, will only accommodate maximum four-car trains;
- Stations which are too closely spaced for the running of the new three-car sets which have been engineered for the efficient line design of the existing Joondalup line and the new Mandurah line and
- Levels of patronage which in the years leading up to 2026 simply will not support the train capacity which is required to be run on the line as a result of the Perth station platform constraints.

The additional trains on the Armadale line will push boom gate closures of level crossings beyond acceptable limits, and those crossings will in WAGR's view have to be grade-separated.

Whilst not possessing the costings at time of writing, the cost associated with the extension of Armadale station platforms to six-car lengths, the grade separation of the many vehicle and pedestrian in order to render the 3PCC option workable would be prohibitive.

The magnitude of the cost, combined with the inefficient spacings of the stations themselves would undoubtedly require a substantial number of stations on the Armadale line to be closed.

The consequent community cost which would arise from such station closures would argue strongly against taking such action. The Armadale line services a socio-economic group whose capacity to seek alternative modes of transport or alternatively travel greater distances to the train station, following station closures, is more limited than those living in other suburbs in Perth.

The only pattern for station stopping along the Armadale line which would not give rise to new railcar reliability problems is shown below:

Line/Station	Distance from Perth Station (km)	Distance between stations (km)
ARMADALE LINE		
McIver		0.5
Claisebrook	1.3	0.8
Burswood	4.8	3.5
Oats Street	10.0	5.2
Cannington	12.2	4.8
Kenwick	15.8	3.6
Gosnells	21.2	5.4
Kelmscott	25.9	4.7
Armadale	30.1	4.2

This limited stopping pattern implies either a reduced peak hour service or closure of the following stations on the Armadale line:

Victoria Park, Lathlain, Carlisle, Welshpool, Queens Park, Beckenham, Maddington, Seaforth, Challis and Sherwood.

The actions necessary to render the 3PCC option feasible would represent a serious imposition upon those living in that community along the Armadale line. The community's travel options would be adversely affected. In view of recent efforts by the City of Gosnells and Armadale to improve their social landscape and level of community interaction, those necessary modifications to the Armadale line would run counter to those efforts.

The critical point of difference between the 3PCC and William Street models is that the difficulties noted regarding efforts to meet future demand on the Armadale line are crystallised sooner by the 3PCC model's need to run new railcars on the line from 2006.

With the Armadale line quarantined from the balance of the network by both the 3PCC(1) and William Street options, there will be time to determine appropriate strategies to address increasing demand upon that line in a more constructive manner.

11.1 Need to Quarantine Armadale Line from the Rest of the Train System

In WAGR's view, given the inhibitions of the Armadale line, the train service network and the community it services, both now and in the future, would be best served through 'quarantining' the Armadale line from the rest of the network.
The Armadale line, due to its inherent inefficiencies and the substantial social and infrastructure costs associated with its improvement is best positioned if treated as a 'Dead-Ended' service at Perth. This action would not diminish the service provided to those living along the line, rather it would facilitate the provision of a continually improved service over the years that would utilise existing railcars to match the passenger demands with precision.

In order to illustrate the inherent inefficiencies that the Armadale line faces by comparison with the other lines in the network, WAGR has analysed the 240 incidents which have occurred between 1999/00 and 2000/01 across the train network.

The incidents recorded by WAGR fall into the following categories;

- "Near-misses or Near-Hits", being incidents where pedestrians, rail and contract workers on the line or road vehicles narrowly avoid collision with our train services and
- Specific data disclosing 'At-grade' level crossing incidents in particular.

WAGR's analysis reveals the Armadale line's responsibility for 52% of all "Near-Hit" incidents which occurred across the train network during the period reviewed.

In moving from "Near-Hits" to specifically analyse the incidents which occur on 'At-Grade' levelling crossings, again the vulnerability of WAGR's service operation on the Armadale line is starkly illustrated.

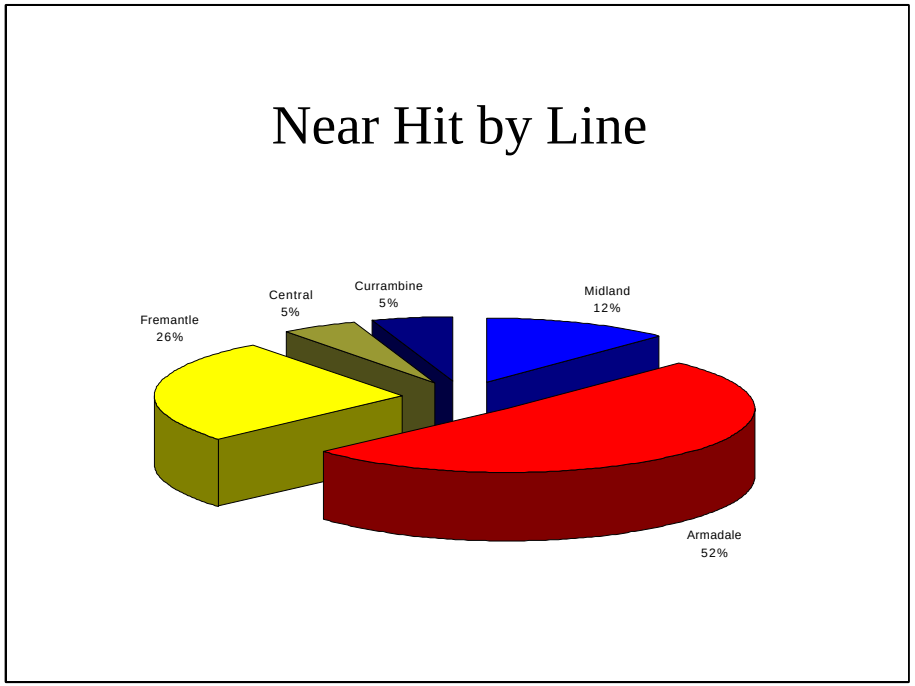
The Armadale line accounts for 66% of the level crossing incidents experienced across the network. It is pertinent to indicate that incidents of this nature have been observed to increase over the past 12 months.

Section 8 in this paper documents the outcomes of these incidents in the context of:

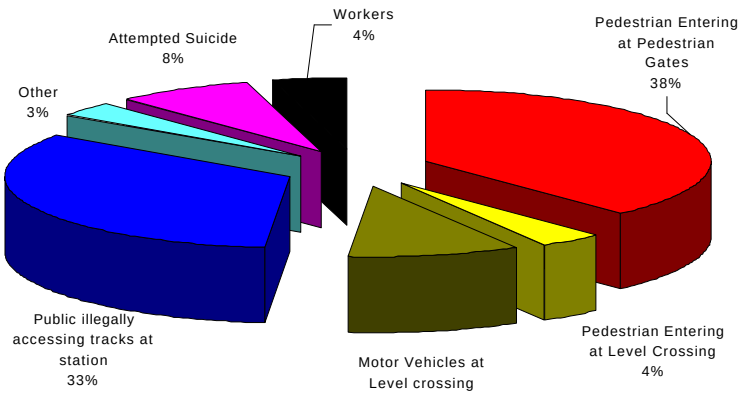
- Passenger delay impacts;
- Safety; and
- Rolling-stock damage and consequent long-term service impacts which occur whilst repairs are made.

In conclusion, the Armadale line's inherent inefficiencies which give rise to its generation of 66% of incidents occurring on the entire network lead WAGR to make the following comments:

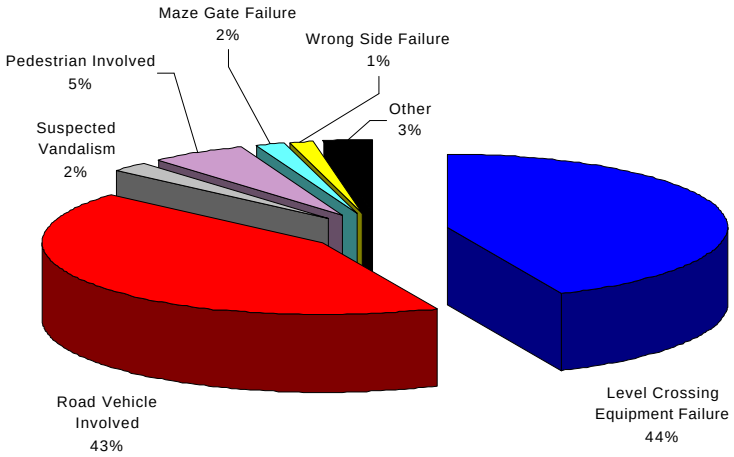
- The current performance of the line mitigates against the employment of the 3PCC option, which in WAGR's view requires new six-car sets to be run along the line in increasing numbers as time goes on. This will occur due to the combination of platform constraints in Perth which require Clarkson line six-car sets to run through to the Armadale line rather than turnaround at Perth. The running-through of six-car sets from the Clarkson line will increase in line with the need to match patronage demand on the Clarkson line;
- The socio-economic cost to the Armadale line community and the State of closing stations, extending platforms to accommodate six-car sets and grade-separation of level crossing points is excessive. Such expenditure and infrastructure modification would be premature given patronage growth rates;
- The inefficient running of railcars with capacity in excess of passenger demand on the Armadale line is not a prudent undertaking; and
- The Armadale line for all these reasons is best quarantined from the more efficient Clarkson-Mandurah line.



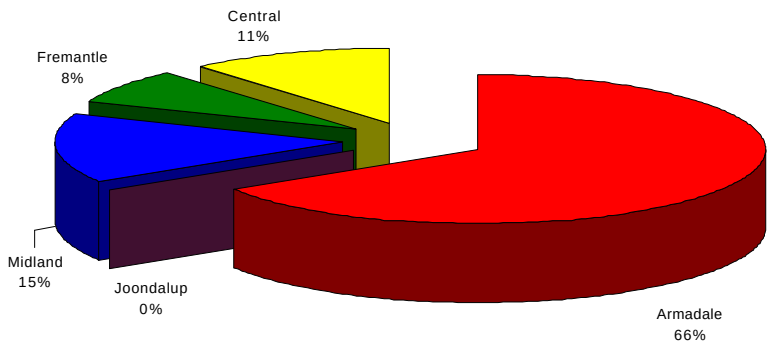
Near Hit by Type of Incident



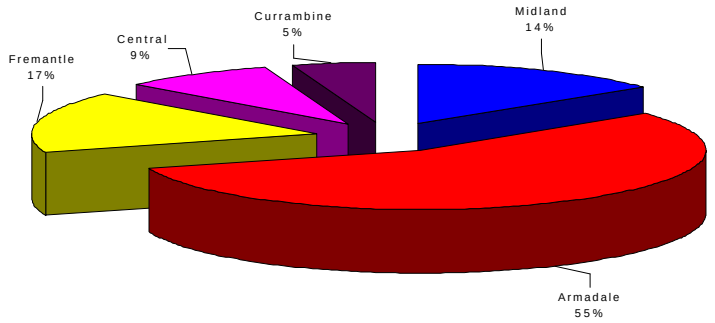
Level Crossing Analysis



Level Crossing Analysis by Line



Total number of incidents per Line



12.0 EXISTING SERVICE IMPACTS DURING THE CONSTRUCTION PHASE

This, at time of writing, is an unknown quantum and needs to be investigated by the Committee.

APPENDIX 1: SUPPORTING ANALYSIS REGARDING PERSONNEL DIFFERENTIALS

WESTERN APPROACH

Western 3PCC (1)

Drivers

1. Additional Trains

   Four (4) additional trains in the AM/PM peak

   0630–0900 1530–1800

   Equates to eight (8) additional shifts[10] per day

2. Turnaround Drivers at Perth

   One (1) additional for NST ----> SWMR
   One (1) additional for SWMR ----> NST

   Equates to four (4) additional shifts per day

On-train Support Staff (Transit Guards)

1. Due to Additional Trains

   Four (4) additional trains in the AM/PM peak

   0630–0900 1530–1800

   Equates to eight (8) additional full-time[11] shifts per day

Train Control

2 Train Controllers

Two (2) additional full-time shifts per weekday

Western 3PCC

Drivers

1. Additional Trains

   Two (2) additional trains in the AM/PM peak

   0630–0900 1530–1800

   Equates to eight (4) additional shifts per day

2. Turnaround Drivers at Perth

   Nil

On-train Support Staff (Transit Guards)

1. Due to Additional Trains

   Two (2) additional trains in the AM/PM peak

   0630–0900 1530–1800

   Equates to eight (4) additional full-time shifts per day

[10] Definition of Shift = One 6 hour part-time employee (conservative). Assumption – no additional staff for off-peak services.

[11] No industrial provision for part time employees

Train Control

2 Train Controllers

Nil

APPENDIX 2: PROCEDURES FOR CHANGING ENDS AT TERMINAL STATIONS

To change ends on traffic carry out the following instructions:-

1. Stop at the designated stopping position on the platform and place the brake controller in the Full service brake position.

2. Press the PARK BRAKE **ON** button.

3. Switch **OFF** the headlights.

4. Switch **ON** the RED TAIL lights and switch **OFF** the MARKER lights as necessary.

5. Move the Direction Controller to **I** (Isolate), remove it from the instrument and place it in the holder provided on the back of the communication locker door.

6. Ensure the cab doors are locked and the cab windows are closed when leaving the cab.

7. Proceed to the new driving cab.

8. Remove the Direction Controller from the communication locker and place it in the control instrument, move the Direction Controller to **N** (Neutral) to activate the cab and wait for the FIS display to light up (at least the time must be shown on the display).

9. Select **"FOR"** forward with the Direction Controller, place the power brake controller to the **"OFF"** position and allow the brake pipe pressure to charge to 500 KPa, allow the ATP system to carry out its set up tests. Whilst the brake controller is still in the **"OFF"** position press the ATP Read In and Test button to activate the ATP system. When the ATP system is activated apply **Full** brake again.

10. Press the correct DOOR RELEASE button to activate the station monitor.

11. Switch **OFF** the Red marker lights if necessary.

12. Set the correct destination.

13. Switch on the required lights for night operation and the headlights.

14. Drive the EMU in the normal manner.

APPENDIX 3: TIMETABLE DETAILS

		Mandurah to Whitfords Trains		Clarkson to Thomson's Lake	
Timetable	**Time**	**hh:mm:ss**	**Comments**	**hh:mm:ss**	**Comments**
Leederville Station	Dwell Time	0:00:20	Only Mandurah to Whitfords trains stop	0:00:00	Clarkson to Thompson's lake trains do not stop at Leederville
Leederville-Perth	Travel Time	0:02:00		0:01:45	
Perth Station	Dwell Time	0:05:00	All trains stop	0:05:00	All trains stop
Perth-Elder Street	Travel Time	0:02:00	Applies to all trains	0:02:00	Applies to all trains
Elder Street Station	Dwell Time	0:00:00	Stop	0:00:20	Stop

Platform Usage at Perth Station

Trains Using Platform	Platform No.	Assumption
Mandurah to Whitfords trains	1	These trains do not use any other platform, no other trains use Platform 1
Thomson's Lake to Clarkson trains	2	These trains do not use any other platform, no other trains use Platform 2
Whitfords to Mandurah trains	3	These trains do not use any other platform, no other trains use Platform 3
Clarkson to Thomson's Lake trains	4	These trains do not use any other platform, no other trains use Platform 4

Recovery Time

The minimum dwell time at Perth Station is 0:01:00 for drivers to turn around

Frequency

All trains assumed to be 15 minutes frequency and are evenly spaced

First scheduled after 7:00am arrives at Perth at:

Origin	Time
Clarkson	7:05:00
Whitfords	7:07:00
Thomson's Lake	7:04:00
Mandurah	7:06:00

APPENDIX C

OPERATIONAL RELIABILITY ASSESSMENT OF PERTH CITY RAIL ALIGNMENT OPTIONS

(Booz Allen Hamilton, May 2002)

1 Introduction

This paper presents the key findings of an operational reliability assessment of the Western Alignment and the Straight Through Options in the vicinity of Perth Station. This analysis involved:

- Assessing timetable robustness in light of actual operating performance through use of the Simu++ simulation model
- Considering the reliability the additional infrastructure required by the Western Alignment option only

This paper provides key preliminary findings, with a full report to be provided in due course.

2 Operations Modelling

For each option, one hundred and twenty full weekday timetable scenarios were simulated with each scenario applying a variation to scheduled run times of each service from a distribution of actual running times.

The modelled track section for the Western Alignment is between Leederville and Elder Street with a reversal at Perth Station. For the Straight Through Alignment, the modelled track section was from Leederville to Esplanade via new underground Perth Station platforms at William Street.

The operating performance measure is the percentage of services arriving within three minutes of the schedule, with the target being 97%.

The performance measures at the entry and exit points of the modelled sections are presented in Tables 1 and 2.

Table 1: On Time Performance (<3 mins) Simulation Results: Straight Through Alignment

Service	Peak		Off Peak		All Day	
	Entry	Exit	Entry	Exit	Entry	Exit
Joondalup Up All Stop – Mandurah Down Express	86%	96%	100%	100%	95%	99%
Joondalup Up Express – Mandurah Down All Stop	77%	99%	100%	100%	92%	100%
Mandurah Up All Stop – Joondalup Down Express	81%	87%	100%	100%	93%	95%
Mandurah Up Express – Joondalup Down All Stop	77%	99%	100%	100%	92%	100%
Average	80%	95%	100%	100%	93%	98%

Table 2: On Time Performance (<3 mins) Simulation Results: Western Alignment

Service	Peak		Off Peak		All Day	
	Entry	Exit	Entry	Exit	Entry	Exit
Joondalup Up All Stop – Mandurah Down Express	86%	93%	100%	100%	95%	98%
Joondalup Up Express – Mandurah Down All Stop	79%	89%	100%	100%	93%	96%
Mandurah Up All Stop – Joondalup Down Express	82%	86%	100%	100%	94%	95%
Mandurah Up Express – Joondalup Down All Stop	76%	86%	100%	100%	92%	95%
Average	81%	89%	100%	100%	93%	96%

These results indicate that across the weekday, the Straight Through Alignment will provide a better performance result by 2%. Given the target performance measure is set at 97%, the 2% superior performance of the Straight Through Option is significant.

In the critical peak periods, the difference is more significant with the Straight Through Option improving performance 7% more than the Western Option.

The primary reason for this difference is that there are conflicts that occur during peak periods between trains heading in opposing directions at Perth Station in the Western Alignment Option.

3 Impact of Equipment Failure

An important difference between the two schemes being considered is the potential of equipment failure to impact service reliability.

The Western Approach Option requires a significant amount of switching and signalling equipment in order to terminate and reverse the train services. There are four crossovers critical to this operation and a number of other connections provided for operational flexibility. On the other hand the Straight Through Option requires no switching to meet the operational requirements.

To assess the operational implications of this difference we have examined equipment fault reports provided by WAGR for point machines over the last 2 and half years. During this period of 909 days, a total number of 76 faults where reported for 50 machines out of a total population of 166 machines. This indicates on average 0.46 faults per machine during the period or Mean Time Between Failure of 1976 days. The reports also provide details of time the fault was reported and repaired. The mean time to repair was 2hours 13 minutes for all faults. However, if we only consider faults reported between 6am and 10pm the mean time to repair reduces to 1hour 54 minutes.

The impact of point failure depends on the nature of the fault. A typical fault will prevent the signalling system from obtaining either normal or reverse route setting. For the purposes of this assessment, it has been assumed that the fault will allow trains to continue operate (at least under manual safe working) to one platform rather than two platforms that is typically required. We have also assumed that trains can operate normally in the opposite direction.

One platform can be expected to turn around 10 trains per hour (6 minutes turn around per train under fault conditions). During peak periods it is necessary to turn around 16 trains / hr dropping to 8 trains / hr in the off peak. Therefore a point failure during peak period is expect to delay all subsequent trains until the fault is cleared and train operations normalised. In the off peak period, a single platform face will be operating at 80% of its capacity and therefore is unlikely to have sufficient capacity to clear the initial queue that is expected while the manual operating procedures are put in place.

The MTTR point machine failure is approximately 2 hours. Therefore a failure can be expected to directly delay 32 arriving services and 32 departing services in the peak and 16 arriving services and 16 departing services in the off-peak. The total

number of services in the weekday timetable is 712. Therefore a peak period fault will directly affect 10% of services while only 5% of services would be directly affected in the off-peak.

A delay of this type is also expected to have significant flow-on affects to subsequent trains arriving at Perth and connecting train services departing from terminal stations. The number of services affected from these flow-on effects can only be considered by simulating the entire rail system including the recovery strategies used by the rail operator. Therefore for the purposes of this discussion we will assume that a 2hr delay would affect 10-30% of all services.

The Western Approach relies on 8 eight critical points (2 points per cross over). There are also 6 additional machines that are proposed to provide operational flexibility. Therefore the probability of point machine faults on any day is 0.007 (14/1976). If this results in 10-30% of services being delayed then over the over on-time performance is expected to drop by 0.07-0.21% due to point machine failure.

In addition to point machines, other risks to on-time performance includes failure from signals, interlocking and overhead wiring all of which are more complex under the Western approach. There are also some risks of operational and rolling stock faults occurring during the turn around process. While these risks exist their impact should not exceed the impact from point machines as detailed above. Therefore we would expect that the overall impact of the additional complexity of Western Approach on on-time reliability is of order of 0.1-0.4%.

4 Conclusion

Reliability tests have been conducted to compare the relative performance of the Western and Straight Through Alignment Options. Theses tests involved simulating the proposed timetable and determining the impact on reliability performance of cross overs.

The results of these tests are that the Straight Through Alignment will result in better On Time Performance than the Western Alignment. Across all services, this margin is 2%, where as for the critical peak period it is 7%.

Analysis of failure rates of track cross – overs in the Western Alignment option have indicate an impact on punctuality performance of 0.1% to 0.4%. There are no cross overs in the Straight Through Option

The analysis demonstrates that the simpler configuration of the Straight Through Option offers significant reliability benefits.

About Simu++

Simu++ is a specialist software suite for the planning, analysis and optimization of railway infrastructure, rolling stock and operating plans. The software comprises of three modules:

- Track Editor Module creates a model of the infrastructure configuration with inputs including track layout, signaling, speed restrictions and stations locations.
- Simulation Module provides the interface for inputting rolling stock characteristics, timetable development, on - time running distributions and importing the infrastructure data. This module's outputs include run time determination, conflict identification and reliability determination.
- Statistical Evaluator presents results of the simulation, including calculation of delay distribution and average delays by train type and period of the day.

The software suite is typically used to test alternative operating plans and infrastructure configurations to determine the optimum configuration in terms of performance (speed, reliability and capacity) and cost.

APPENDIX D

DEPARTMENT FOR PLANNING & INFRASTRUCTURE COMMENTARY

Department for Planning and Infrastructure
Government of Western Australia

Mr Stuart Hicks
Chairman
Perth City Rail Advisory Committee
Westrail Centre
West Parade
EAST PERTH WA 6004

City Route Options for the South West Metropolitan Railway

The Report of the Perth City Rail Advisory Committee was released to the public on 14 March 2002 and comments have been received and assessed. It has become apparent during this process that there was considerable failure to communicate to the public key issues as explained within the Perth City Rail Advisory Committee Report. This lead to a misunderstanding of the defects of the Mitchell Freeway option and a consequential lack of appreciation of the Central (William Street) option.

The Department's strong view is that the William Street option, which has been considerably refined since the publication of the Report, is the preferred option from a planning perspective, a land use perspective and a transport perspective. The Committee's report clearly demonstrated that what was then the improved William Street Option (ie 1D) provides for a 49% improvement in patronage over the Western Option (3D) and that there are predicted to be 148% more employees and residents within a 5-minute walk by 2031. This option also provides an Esplanade station that serves the Busport, city and the foreshore and provides for through running to the northwest line. This will maximise the opportunities provided by the new 130km/hour trains. This option also provides the opportunity to lower the railway lines near Northbridge. The recent refinements to this option now provide for a tunnel that commences within about 100 metres of the Mitchell Freeway and improvements to the relationship between the new platforms and existing station infrastructure at Perth Station. This provides the opportunity for significant improvements to the foreshore open space and further improvement to pedestrian movement between the city and Northbridge.

A western option cannot deliver any of these advantages. Importantly, a western option will lead to significant operational disadvantages in terms of capacity and reliability. This is because the train operation proposed requires reversing out of Perth Station. In this type of operation, I am advised that it is typically a 7-minute turnaround time for the train driver to decommission and close one end of the train, walk to the other end and open and commission the other end, and leave the station safely. In addition, the cost of lowering the railway lines near Northbridge is

estimated to be $71 million compared to $41 million for the central option and the rail configuration is such that the essential King Street to Lake Street connection cannot be provided.

I understand that you have also been advised of the significant costs that would be required to redirect the bus system should the Esplanade Station-Busport connection not be provided. These costs range from $19 million to $30.4 million in capital expenditure and $200,000 to $778,000 in additional operating costs for the same income. These are unnecessary costs to the community that would result from the selection of the western option.

However, the key issue is that the South West Metropolitan Railway is being built in order to increase patronage in public transport. While modelling is important, we know from the Northern Suburbs Transit System that actual patronage can exceed projections if the planning for a new railway line is fundamentally sound and well executed. In this case the fundamental issue is that the new railway station must serve the centre of the city.

It has been conclusively shown that the centre of employment is close to the corner of St George's Terrace and William Street and that a railway station within 400 metres of the centre is far more attractive to commuters than a station over 800 metres away. This is easily demonstrated by calculating the time taken for a commuter to reach a destination at or near the centre (and this is what the greatest concentration of commuters will seek to do) and the result is that it adds 5 to 8 minutes to the average commuter if the western option is chosen. More time is added if the commuter's employment is east of the centre and obviously this is the case for half of all employees. It makes no sense to make major changes to the route of the SWMR in order to save 12 minutes in transit time just to squander up to two-thirds of that saving by locating the second city station at Elder Street.

The Metropolitan Transport Strategy requires a doubling of public transport use over the next thirty years. I fail to see how this can be achieved if the western option is adopted and for this reason DPI strongly supports the central option.

M. L. Harris

M L Harris
Acting Director General
Department for Planning and Infrastructure

14/ 5 / 2002

Department for **Planning and Infrastructure**
Government of **Western Australia**

Statutory Services

Internal Memoran

TO:	Richard Mann, Executive Officer PCRAC, WAGR	DATE:	May 13, 2002
CC:	Stephen Goldie ED Statutory Services, DPI Barrow Emerson, Mgr Integrated Transport Planning		
FROM:	Garry Merritt, A/ Services Development Manager, Transperth		

Per a request from the PRAC at an April 30th meeting with DPI staff, provided is the formal Department for Planning and Infrastructure and Transperth position on issues relating to the Perth CBD rail alignment discussion.

DPI and Transperth strongly support the Central alignment based on its better and more cost effective public transport outcomes, which is the primary goal of the entire SW railway initiative.

Central Alignment Provides Better Bus Interchange

The CBD, in addition to being a destination, is also the major transfer-interchange location for the entire public transport system (buses and trains). More than a quarter of all daily public transport trips taken involve at least one transfer. Transferring (travel time and convenience) is among the most significant factors in the decision by potential users to continue to use the private car. Travel time is the feature of using public transport that is least competitive with the car. It is documented that transfers are perceived as having twice the travel time impact as they actually do which further highlights the importance of maximising the efficiency and quality of the interchanges that are required.

Central Alignment Bus Network is Less Expensive to Provide

Relative to the central alignment (which requires no additional costs), the Western Freeway railway proposal would require a significant redesign of the CBD bus network to reconnect regional bus routes to either Wellington Street Bus Station or an Elder Street bus facility.

The financial impact of such changes would be in three areas:

1. Annual operational cost
2. Additional bus cost
3. The cost of an expanded facility at Wellington Street or a new facility Elder Street

A table reflecting these costs is provided in the Western Alignment Bus Network Report and is reproduced below.

	Option 1	Option 2	Option 2
Additional Operating Kilometres	185,200km	311,000km	85,000km
Additional Operating Costs	$458,000 pa	$778,000 pa	$200,000 pa
New Buses Required (CBD Only)	20 buses ($8 million)	26 buses ($10.4 million)	11 buses ($4 million)
Capital Cost for New Facilities	$15-20 million	$15-20 million	$15-20 million

Even with the restructuring of services there would still be a negative impact on a portion of bus-to-bus transfers. Transfers that currently happen between platforms at the Busport would require a walk from a Terrace bus stop to the Busport in the new scenario. A less serious deterioration but still an issue would be transfers which would need to take place between bus stops on the Terrace or Barrack services on-street rather than in the Busport station environment.

Analysis Prepared by DPI for This Project

You have received a package of four reports from Barrow Emerson of DPI. Two of the items are recent surveys which profiled the journeys for public transport to the CBD, including their walk trip and destination. These surveys were done on northern suburbs trains and southern suburb buses (which will be replaced by SW rail).

The other two items are bus network plans for the Central and Western options. These two documents were prepared over three months by a team made up of Transperth, DPI, WAGR and City of Perth officers. It is important to note that although the City of Perth officers question philosophically whether we need to recreate the lost connections, they have not expressed any problems with the route network structure or operational costings developed in either report with their participation.

The primary government policy document on public transport is the Metropolitan Transport Strategy that requires a doubling of public transport use over the next 30 years in metropolitan Perth (ie approx 2.3% real growth per annum). This target is similar to the goals for most urban centres of similar size and urban form as Perth.

Bus Network Prepared in Support of the Western Alignment

In addition, at the PCRAC meeting of the 30th April, the Committee specifically directed DPI to provide a critique of the "Riley" report prepared for the City of Perth. DPI comments on this report are in two areas:

1. As stated on pages 3 and 5, "the report should not be used as a comparison to Central Alignment". This and the premise of the report that the western alignment would be better than today's network connections seem to make the analysis not relevant to the question of which of the two alignments is a better solution.

2. While noting the lack of relevance of the report to the question at hand, DPI and Transperth have reviewed the Riley product for technical accuracy and have found that:

    - The Riley report only addressed the connections between the southern suburbs bus services (that will be replaced by the SW Rail) and the balance of the public transport network.

- The report fails to address the disconnection of 31 bus routes to the future rail system that is the subject of operational and capital analysis in the chart earlier in this memo.

- Even with the analysis done on page 7 on the limited set of service connections, there are a number of "better/similar/worse" scores where Transperth has identified a number of inaccuracies. In some cases the actual walking transfer would be similar, but the report has not considered the added travel time (6-8 minutes) of going all the way to Wellington Street Bus/Rail Station for a connection back to a western destination like UWA as opposed to making the connection at the Busport directly to a Mounts Bay Road service. Ignoring this travel time penalty makes the "better/similar/worse" scores inaccurate. The report seems to assume that train travel to the CBD will be faster than the current bus trip. This issue is not relevant given that the train will exist in any future scenario.

When asked by the PCRAC what features would make a western alignment work best for public transport DPI staff noted that provision for northbound movements (two way traffic or contra flow bus priority) on William Street would be a very helpful initiative to minimise bus travel time and reduce operating kilometres. Given the high operating cost increases imposed by a western option, we consider that Government would have little option but to require this change to the traffic system

Conclusion

Bus planning for the western option cannot depend upon the Riley report. DPI-Transperth reports demonstrate significant cost implications should the bus system need to be re-routed because of an Elder Street railway station. These costs range from $19 million to $30.4 million in capital expenditure and $200,000 to $778,000 in additional annual operating costs for the same income. This expenditure does not rectify all of the reduction in service that would result from the construction of a railway station at Elder Street.

The central option requires no significant expenditure in re-routing buses and has the added advantage of building on the current success of the Busport while creating some room for expansion within it (NB it is currently at capacity in terms of bus stops and close to capacity in terms of number of services).

Barrow Emerson
Manager Integrated Transport Planning

Garry Merritt
A/ Services Development Manager, TransPerth

APPENDIX E

ECONOMIC & FINANCIAL ANALYSIS

PERTH CITY RAIL ALIGNMENT PROJECT

FINANCIAL AND ECONOMIC EVALUATION OF WESTERN AND CENTRAL OPTIONS

INTRODUCTION

This paper has been prepared for the Perth City Rail Alignment Committee (PCRAC) to provide a financial and economic evaluation of the two alternatives currently being considered for the connection between South Western line at the Narrows Bridge and Perth station. This has been undertaken using the standard framework for the evaluation of transport projects[1] and parameters that are consistent with those recommended by the WA Treasury.

The evaluations have been prepared using the information available at end-April 2002. Additional analysis is currently in progress to estimate the impact on passenger demand, rail operations and road traffic patterns of recent revisions to the options; however, the impact of this analysis on the assumptions used in this evaluation is unlikely to be significant.

DESCRIPTION OF OPTIONS

The evaluation compares two alternative corridors, the Western and Central, within each of which a number of sub-options were considered by PCRAC. The alternatives included in this evaluation are:

- Western Corridor: PCRAC Option 3PCC(I). This option has been developed by PCRAC from the 3PCC option proposed by Perth City Council. It includes additional roadworks at the Riverside Drive interchange to allow vehicles to continue to access Hay St from Riverside Drive, re-profiling of the Mitchell Freeway, revised costing of the Hay St station works and additional grade-separated crossovers and new platforms at the west end of Perth station to facilitate through running between the Northern Suburbs line and the SWMR. Coming northwards from the Narrows, the railway is above-ground until just after Mount St, where it descends into a mixed cut-and-cover/bored tunnel and curves east to emerge west of Perth station.
- Central Corridor: PURD Option 1D (Improved). This option is based on that proposed in the PCRAC report but with refinements to minimize its visual impact near the Convention Centre as well as minimizing disruption in William St during construction. Coming northwards, it swings east immediately after the Narrows Bridge into a sunken trench to skirt the Convention Centre, through Esplanade station and into a bored tunnel that runs under William St before turning west at Perth station to run into the Northern Suburbs line.

SCOPE OF EVALUATION

The evaluation considers the following costs and benefits:

- Construction costs, including an allowance for risk and contingencies
- Costs of disruption during construction, reflecting the cost to business and road traffic
- Rail operating costs, reflecting differences in route distance and pattern of operation
- Rail rollingstock capital costs, reflecting differences in cycle times
- Impact on bus operations, due to the differing interchange requirements of the alternative station locations
- Impact on road traffic, due to changes in the road layout
- User benefits, due to different travel times and access distances
- Impact on user demand
- Changes in the levy on CBD parking places to the WA Government
- Land values, due to changes in accessibility to the rail network

Changes in land values and parking revenue are not included in the economic evaluation, which instead measures differences in

[1] The framework uses the same principles as were used for the evaluation of both the original electrification of the Perth suburban rail network and the Northern Suburbs rail line.

accessibility through the user benefits. The estimated construction costs exclude GST; as the financial impact on the Government of the GST for these costs is unclear, it has been omitted from the financial evaluation. All other costs and benefits include GST and the economic evaluation adjusts them to resource costs by removing an assumed GST component of 10%. Fuel costs were also adjusted by removing the Government excise (reducing the financial cost by approximately 50% in total).

The financial evaluation measures the impact on Government finances and does not include the costs of disruption or the change in user benefits. However, it includes the differential land tax arising from the forecast differences in land values between the two options.[2]

Rail traffic volumes are assumed to grow at 2% p.a. under both alternatives, based on the growth forecast by the Future Perth transport model.

All costs and benefits are in 2002 prices. Both the economic and financial evaluation discount the streams of annual costs and benefits by 8% p.a. over a period of 25 years from the date of opening to produce a Net Present Value (NPV) of the difference between the two alternatives.

CONSTRUCTION COSTS

The construction costs used in the evaluation are those current as at May 1, 2002 (Table 1). They include:

- Base construction cost (including the components estimated by PCRAC to create 3PCC(I) from 3PCC)
- Cost of intermediate stations
- Allowance for weighted risk
- 10% contingency

The costs, adapted from those in Table A.3 of the March 2002 PCRAC report, cover all works from the north side of the Narrows Bridge.

For the purposes of option evaluation, both alternatives are assumed to take thirty months to construct, with equal expenditure throughout the period (i.e. 40/40/20 per year).

Table 1 Construction cost ($ million 2002)

	1D(I)	3PCC(I)
Financial cost		
Base construction cost(1)	163.0	115.0
Intermediate station	18.0	22.0
Project Management	27.0	21.0
Weighted risk	14.5	3.9
Railway lowering(1)	39.0	75.0
Total (excl. lowering)	222.5	161.9
Total (incl lowering)	261.5	236.9
Economic cost		
Total (excl. lowering)	222.5	161.9
Total (incl lowering)	261.5	236.9

(1) Includes distributed contingency

[2] The evaluations should theoretically also include the differential impact of the variations in demand between options attributable to the differing levels of demand. However, in the long-run, any such variations would lead to corresponding changes in supply, at least in the peaks, and any change in revenue would need to be net of the associated changes in operating costs. The financial projections prepared for the SWMR show that revenue is approximately equal to the combined cost of electricity and vehicle maintenance, the two elements most likely to vary with demand. The net effect of any demand variations will thus be very small and has been omitted. The parallel economic impact (marginal change in user benefits from the variation in demand less the marginal change in economic operating costs) has been similarly excluded from the economic evaluation.

COSTS OF DISRUPTION DURING CONSTRUCTION

Table 2 of the March 2002 PCRAC report identified five construction impacts:

- property settlement
- noise and vibration
- impact on vehicle flow
- impact on pedestrian flow
- construction impacts on business

The first and fifth of these are included in the weighted risk allowed in Table1; the impact on business of $23.4 million for Option 1D(I) estimated in March 2002 has been reduced to $5 million for this evaluation with the confirmation of bored-tunnel as the method of construction.

Noise and vibration is not susceptible to quantitative measurement and has been excluded from the evaluation.

The impact on pedestrian flow is likely to be small in both options. Above-ground construction works for Option 1D(I) which will affect pedestrians are confined to the southern end of William St, where flows are relatively small and most pedestrian routes should also be maintained under Option 3PCC(I). The differential impact has therefore been disregarded.

There will, however, be substantial impacts on vehicle traffic (Table 2), particularly for Option 3PCC(I).

Table 2 Road traffic impacts during construction

	Duration (weeks)
Option 1D	
Lower William St reduced from 4 lanes to 2 lanes	27
Minor short-term restrictions	1-2
Option 3PCCI	
Murray St/Elder St access replaced by detour via Entertainment Centre carpark road	112
Elder St closed between Murray and Wellington St. Flow reversed to northbound in Elder St between Hay St and Murray St.	112
Hay St closed at freeway	48
Murray St closed at George St.	37
Divert around southbound freeway carriageway (3 lanes each way, assumed as 800 metres)	29
Four lanes each way at tunnel ramp (assumed as 500 metres)	30

Under Option 1D(I), the southern end of William St, between the Esplanade and Riverside Drive, would be reduced to two lanes and traffic from William St to the Kwinana Freeway would need to divert via the Esplanade and Barrack St, involving an extra 0.5 km and two sets of traffic lights. Traffic modeling reported by BDS in their March 2002 report found no significant congestion effects, with traffic readily redistributing to alternative routes. For the purposes of evaluation, it is assumed that 5000 vehicles per weekday are forced to make this detour (in practice, a significant proportion will probably change to alternative freeway access points), with an average extra journey time of 2 minutes.

The detailed arrangements for Option 3PCC(I) are given in Chapter 8 of the BSD report:

- the closure of Elder St will affect through southbound flows (3190 vpd assumed to transfer to Milligan St), and flows southbound to the freeway (1260 vpd assumed to travel via the temporary access road)

- the closure of Hay St will affect through westbound traffic (3960 vpd assumed to divert to St. Georges Terrace, southbound freeway traffic (1500 vpd assumed to divert via William St) and 870 vpd northbound assumed to divert to Wellington St
- the closure of Murray St will affect 9650 vpd accessing the freeway and 5480 vpd through traffic to the City. All is assumed to divert to Wellington St.
- the closure of one of the carriageways will have major effects on freeway traffic (approximately 70,000 each way per weekday). Off-peak traffic will have a limit of 50 km/h, compared to the current 80 km/h, but peak traffic will experience significant congestion, with speeds dropping to around 30 km/hr and queuing for up to 20 minutes at the height of the peak.
- The reduction to four lanes each way will also be accompanied by temporary speed restrictions of 50 km/h but the impact during peak periods will not be as severe.

Table 3 summarises the cost of the estimated delays during the construction period. The table assumes:

- Only 50% of the delays that would arise from full diversion actually occur in practice because of re-routing by drivers
- Some freeway traffic will divert to alternative routes; the 3-lane configuration will have a capacity of 5600 vph and the 4-lane configuration a capacity of 7600 vph
- Distance and time penalties have been costed at 15c/km (resource cost) and $15/person-hour (assumes a business:leisure split of 20:80 and values of time of $35/hour for work time and $10/hour for leisure. Average vehicle occupancy is taken at 1.2

Table 3 Cost of road traffic disruption during construction ($ million 2002)

	$ mill
Option 1D	
Lower William St. reduced from 4 lanes to 2 lanes	0.5
Minor short-term restrictions	-
Option 3PCCI	
Elder St closed between Murray and Wellington St.	1.1
Hay St. closed at freeway	0.9
Murray St closed at George St.	1.0
Divert around southbound freeway carriageway	11.4
Four lanes each way at tunnel ramp	1.9
Total	16.3

[Independent modelling of this road traffic disruption by Main Roads Western Australia identified a total value of $7.6 million, which may reduce the economic impact of road traffic disruption by $8.7 million.]

RAIL OPERATING COSTS

Although Option 1D(I) permits through running via Perth station, Option 3PCC(I) requires trains to reverse at Perth and thus generates more train-km for the same timetable. It is also slightly slower because of the need to enter the proposed dead-end platform at Perth at 10 km/h. As a result, relay drivers are required at Perth station (to avoid trains having to wait while the drivers physically change ends) and extra train sets (and on-train staff) are required to maintain the peak service. Against this, Option 1D(I) requires additional station staff and station operating costs because of the split operation at Perth; this effectively creates two new stations (William St and Esplanade) against the single one required for Option 3PCCI at Elder St.

The two options have very similar distances of new infrastructure, with similar geometry. However, Option 3PCC(I) has an additional 10 turnouts which, with their associated signalling, increase the maintenance task significantly.

Table 4 summarises the differential operating resources and costs for the two alternatives, using unit costs for vehicle maintenance, on-train crew, infrastructure maintenance and station manning which are consistent with the rail operating budget prepared for the project as a whole.

Table 4 Differential rail operating costs ($ 000 2002 p.a.) (Option 3PCC(I) less Option 1D(I))

	Resources p.a.	Unit	Financial	Economic	Growth % p.a.
Vehicle mtce/ traction elec.	230	Vkm 000	417	379	2
Drivers	10	Staff	700	700	0
Guards/security	11	Staff	594	594	0
Station staff	-10	Staff	-550	-550	0
Station mtce/operation	-1	Station	-100	-91	0
Infrastructure maintenance	-75	Metres	-5	-5	0
Turnouts and interlockings	10	Units	111	100	0
Total					
Variable			417	379	2
Fixed			750	748	0
Total			1167	1127	

RAIL ROLLINGSTOCK CAPITAL COSTS

The reversal at Perth required under Option 3PCC(I) increases cycle times and hence increases the number of trainsets required to operate the service. The increased time per trip is 6 minutes, consisting of three components:

- 1 minute to travel the additional 900 metres required by the reversal compared to the through operation
- 1 minute because the dead-end platform to be used for the reversal must be approached at 10 km/h for safety reasons
- 4 minutes because the reversal requires 5 minutes dwell time in the station compared to 1 minute in the peak for the through-routed option

The overall effect is to increase cycle times by 12 minutes (6 minutes in each direction). During the peak, this is equivalent to slightly over three headways. The precise number of trainsets required will depend on the duration of the peak and the extent to which peak sets actually make round trips. The additional requirement has been rounded down to two sets; with an average peak consist of 4 cars, this has been taken as 8 cars.

In practice, this will increase over time as the duration of the peak increases (increasing the number of sets which make round trips in the peak) and the average size of train increases and for evaluation purposes it is assumed the equivalent of an extra 0.2 cars are required each year.

The estimated cost of the additional trainsets is expected to average about $3 million per car. However, this includes a component of fixed costs and the marginal cost of an additional car has been taken as $2.8 million. Table 5 summarises the differential railcar capital costs.

Table 5 Differential railcar capital costs ($ million 2002) (Option 3PCC(I) less Option 1D(I))

	Resources p.a.	Unit	Financial	Economic
Base year	12	Cars	32.4	29.5
Successive years	0.2	Cars	0.6	0.5

IMPACT ON BUS OPERATIONS

Option 1D(I) will maintain existing bus interchange arrangements for passengers from the north at Perth (using the Wellington St interchange) and for passengers from the south at the Busport, adjacent to the Esplanade station.

Option 3PCC(I), however, only provides ready access to the interchange at Perth station. Three alternative network concepts have therefore been developed (described in the March 2002 BSD report) to restore access to the Busport routes for passengers from the south.

Option 1 redirects many of the CBD bus routes from the Wellington St interchange to a new facility at Elder St, with rail to bus transfers for all city routes occurring there. This option, whilst beneficial for passengers from the south, disadvantages passengers from the north, who will have to wait while the train reverses at Perth, and those from the Fremantle, Midland and Armadale lines, whose services do not pass through Elder St.

Options 2A and 2B upgrade the Wellington St interchange, Option 2A routes north-south buses via Milligan St, providing Elder St with good access. Option 2B routes north-south buses via the existing William St/Barrack St couplet, maintaining existing accessibility but requiring most passengers from the south to interchange at Wellington St.

Table 6 gives the capital and recurrent costs of the three options. Of these, Option 2B has the lowest cost and has been adopted for the evaluation. Operating costs are assumed to increase at 2% p.a. in line with the assumed patronage growth and buses are assumed to have a 12-year life. The growth in demand will also require incremental capital expenditure.

Table 6 Bus network options to support Option 3PCC(I) ($ 000 2002)

	1	2A	2B	Growth % p.a.
Financial cost				
Terminus capital cost	17000	15000	15000	-
Bus capital cost	8000	10400	4400	2
Incremental bus capital p.a.	160	208	88	-
Operating cost p.a.	458	778	200	2
Economic cost				
Terminus capital cost	15450	13640	13640	-
Bus capital cost	7270	9450	4000	2
Incremental bus capital p.a.	145	189	80	-
Operating cost p.a.[(1)]	436	741	190	2

[(1)] Discounted by 5% to allow for labour/non-labour mix

IMPACT ON ROAD TRAFFIC

No significant permanent impacts on road traffic have been identified for either alternative.

USER BENEFITS

While the two options both serve Perth station, the proposed Esplanade and Elder St. stations serve quite different catchments within Perth. The benefits to users of the two options were assessed by analysing the trip-ends (i.e. the ultimate start or finish of the journey) of the potential users. A detailed origin-destination study was undertaken by SKM in October 2001 of bus passengers from the south, who will form the bulk of rail passengers on the new line and this provided CBD trip-ends on a block-by-block basis. A parallel survey was undertaken of rail passengers from the north.

The access and egress time and distance for passengers to access a rail station under the two options was estimated, taking into account rail travel times and the possible use of the CAT and other bus services. The various elements of each trip (walk time, in-vehicle time, wait

time, number of transfers) were then combined to form a generalised time for each option, using the same factors as the Future Perth transport model.

Option 1D(I) showed an average net benefit of 2.8 minutes per Southern passenger and 2.3 minutes per Northern passenger; the variation reflects different station choices for the two groups of passengers to access central city zones. The results are dominated by trip-ends in St George's Terrace/Hay St between King St and Barrack St, which represent about 30% of all terminating trips (i.e. excluding the 20% who transfer to other rail and non-CBD bus services) and is adjacent to the Esplanade station in Option 1D(I). The catchment where Elder St has a clear advantage is much smaller, covering under 10% of trip-ends; trips to and from the West Perth area represented about 3% of those surveyed in October 2001.

These per capita benefits are valued at $10 per person-hour (assuming rail travel is predominantly for non-business purposes). Each weekday about 120,000 passengers are forecast to board and alight at the CBD stations, of which about 25% are on each of the Northern and Southern services. Suburban rail in Perth has an annualisation factor of 300, giving annual benefits of $7.6 million. These will increase at 2% p.a. in line with traffic volumes[3].

Access patterns in future years are likely to broadly reflect the pattern of development in the central city area. The 2031 land-use forecasts underlying the Future Perth model reflect current DPI thinking and show employment growing uniformly across all sectors of the Perth CBD. In particular, it increases by about 8,000 in West Perth and 6,000 in Northbridge but by 12,000 in East Perth and 22,000 in Central Perth, the areas where Option 1D(I) has the greatest comparative advantage. The user benefits attributable to Option 1D(I) are thus likely to persist throughout the evaluation period.

[3] The surveys were undertaken during the morning peak; all-day surveys would be similar but probably show a greater concentration on the Central Perth retail area, strengthening the relative benefits of Option 1D.

IMPACT ON USER DEMAND

The two options will have slightly different levels of demand, for two reasons:

- the generally better accessibility of Option 1D(I) will generate more public transport trips
- Option 1D(I) is expected to have a higher level of reliability (arrivals and departures within 3 minutes of timetable) and this has been shown to have a direct link with demand

In both cases, the additional demand will be partly transferred from private car and partly generated.

The magnitude of the increase in demand because of the improved accessibility can be estimated by applying an elasticity to the implied change in generalized time arising from these two factors.

The typical public transport trip has a generalized journey time of about 80 minutes (25 minutes in-vehicle, 10 minutes for each of access and egress, wait time of about 4 minutes and a fare of about $2 per trip, converted using a value of time of $10 per hour). The improved average accessibility of Option 1D(I) of about 2.3 minutes is equivalent to a reduction in generalized time of about 3%. The known rail fare elasticity of about –0.2 implies a generalized time elasticity of –1.3 and this in turn gives a growth of about 3.7% in response to the reduced journey time. This applies to all northern and southern line passengers with a trip-end in the CBD, about 35% of the total suburban rail patronage.

The impact of the difference in reliability can be similarly estimated. The more complex station working of Option 3PCC(I) is estimated to reduce reliability from the current 98% to 96% for the northern and southern lines. This will give an increase in the estimated average delay of about 0.17 minutes per train, equivalent to about 0.4 minutes of generalized time (unexpected delay is weighted by 2.5, based on

consumer studies)[4]. This in turn generates a reduction of demand for Option 3PCCI of 0.65%. Although user benefits will also theoretically be greater for Option 1D(I) because of this better reliability, by about $1.1 million p.a., they have been omitted from the main evaluation because of their small unit saving.

The combined effect of these two impacts is that CBD traffic from the northern and southern lines is estimated to be 4.5% greater under Option 1D, equivalent to about 1.6% of overall traffic or 2,750 trips per day. Possibly 35% of these might be attracted from private vehicles because of the improved level of service, equivalent to around 400 vehicles per day assuming 1.2 average occupancy.

CBD PARKING LEVY

The WA State government earns fees from a car parking levy of $120 p.a. on off-street tenant carpark spaces in the CBD. There are currently about 27,000 of such bays in the CBD, out of a total of about 40,000. The higher demand in Option 1D because of the improved level-of-service it provides would lead to a reduction of about 1% in parking demand, reducing the parking levy by about $32,000 p.a. This has been omitted from the financial evaluation because of its small value.

LAND VALUES

Improvements in accessibility eventually lead to increases in the value of real estate. Transport economics theory assumes that most, if not all, of user benefits from a transport project will eventually be converted into increases in land values. Increases in land values and increases in user benefits should therefore be much the same in the long-run and projects can in theory be evaluated with reference to either one or the other. The current economic evaluations are undertaken using changes in user benefit as the measure of these accessibility changes.

Independent estimates of the change inland values have been made in the Syme Marmion report of February 2002. This assesses the improvement in long-term land values from Option 1D(I) as $204 million and from Option 3C (similar to 3PCC(I)) at $31 million, a difference of $171 million compared to the estimated user benefit NPV of $78 million. In practice, the increase in land values depends on the discount rate used and the time period over which the NPV is taken; evaluating over 35 years at 6% p.a. increases the NPV of user benefits to $117 million.

The differential increase in land values will increase the land tax that is paid to the government, at a rate of about 0.6% p.a. For the purposes of the financial evaluation, an annual differential increase in land values of $5 million p.a. has been assumed throughout the evaluation period, giving a cumulative increase of $125 million by the end of the period, and incremental land tax estimated at 0.6%.

PLANNING BENEFITS

The improved local accessibility under either option will clearly provide a stimulus to development in the vicinity of the stations. In addition, the improved level of absolute accessibility of the CBD as a whole (as evidenced by the user benefits) should stimulate additional development of the center of Perth, over and above what it would otherwise have been. Part of this will be at the expense of suburban centers in Perth but part will be at the expense of other cities.

No attempt has been made to value these benefits and include them in the evaluation; however they undoubtedly exist and would support the option with the greater user benefits (Option 1D(I)) if they were capable of being quantified.

ECONOMIC EVALUATION

Table 7 summarises the differences in the economic costs and benefit identified in the previous sections. All values are presented as the

[4] See the Passenger Demand Forecasting Handbook for references

difference between Option 3PCC(I) and Option 1D(I); positive numbers mean that Option 3PCCI has greater costs or lower benefits.

The annual differences are discounted at 8% over 28 years to 2030, representing 30 months of construction followed by 25.5 years of operation. No residual values have been allowed for the additional railcars required under Option 3PCC(I).

Table 7 Summary of economic evaluation of Options 3PCC(I) and Option 1D(I) ($ million 2002)

Source of difference	$ mill
Construction	(56.9)
Disruption during construction	15.2
Rail operating cost	11.5
Additional railcars	29.5
Bus operating cost	2.1
Bus terminal	12.2
Additional buses	6.1
User benefits	85.8
Total	**107.2**

FINANCIAL EVALUATION

Table 8 summarises the differences in the financial costs and benefit identified in the previous sections. As for the economic evaluation, all values are presented as the difference between Option 3PCC(I) and Option 1D(I); positive numbers mean that Option 3PCC(I) has greater costs or lower benefits.

The annual differences are discounted at 8% over 28 years to 2030, representing 30 months of construction followed by 25.5 years of operation. No residual values have been allowed for the additional railcars required under Option 3PCC(I).

Table 8 Summary of financial evaluation of Options 3PCC(I) and Option 1D(I) ($ million 2002)

Source of difference	$ mill
Construction	(56.9)
Rail operating cost	11.9
Additional railcars	32.4
Bus operating cost	2.3
Bus terminal	13.4
Additional buses	6.7
Land tax	2.5
Total	**11.3**

SUMMARY

Option 1D(I) is better than Option 3PCC(I) from both an economic and financial view. Economically, the lower construction costs are balanced by the greater traffic disruption cost during construction. Option 1D(I) does not have the additional rail and bus operating and capital costs which Option 3PCC(I) requires and also has substantial user benefits from its more central alignment. Overall Option 1D(I) has economic benefits over Option 3PCCI with an NPV, discounted at 8% to 2003, of $107 million. It is also better financially, with an NPV of $11 million on the same basis.

APPENDIX F

COMMUNITY CONSULTATION REPORT

REPORT OF THE PERTH RAIL ADVISORY COMMITTEE

DRAFT REPORT ON COMMUNITY COMMENT – DEPARTMENT FOR PLANNING & INFRASTRUCTURE

Introduction

The Report of the Perth Rail Advisory Committee (PCRAC) was released by the Minister for Planning & Infrastructure at a press conference held on Thursday 14 March 02.

The Minister stated that:

"Over the next month we will be providing information about the alternatives, inviting public discussion and conducting additional research, before the Government makes a final decision."

Forms of Consultation

A web page was provided shortly after the release of the report and this was updated on Wednesday 3 April by the inclusion of three disruption management plans.

A full-page advertisement was placed in the West Australian on 16 March 02 and this included a tear-off, mail-in response form. This advertisement showed two options for public comment (Central and Western Options) and outlined key advantages of each one.

Two public forums have been conducted, one for relevant professional associations and interest groups on Monday 25 March and the other for property owners on Tuesday 26 March. Advertisements for the forums were placed in the West Australian on 20 March (business pages) and 21 March (general news section) and in The Business News on 21 March.

Ninety-six people recorded their names at Monday's forum and fifty at Tuesday's event. The recorded feedback is at Attachments A and B respectively.

Information displays were placed at the Rockingham City, Thomson's Lake Gateways and the Mandurah Forum shopping centres from Thursday 21 March to Friday 5 April. Information leaflets with a tear-off, mail-in response form were freely available (10,000) at these displays.

Thirty thousand information leaflets were handed out at Perth City Station and the Mounts Bay Road Busport between Thursday 21 March and Wednesday 3 April.

During this consultation period the City of Perth mounted a campaign in support of the Western Option. This included handout leaflets and a full-page advertisement in the West Australian promoting the Western Option. These included a tear-off, mail-in response form to be mailed to the Department for Planning and Infrastructure (DPI). This City of Perth comment form is prefaced with the following:

"I advocate the adoption of the Western Route Option, and support the City of Perth in its efforts to preserve the environment of the CBD and ensure quality public transport in the future."

The City of Perth did not request DPI permission to use the DPI address.

Processing of Submissions

The submission period closed on Friday, 5 April 2002, although a 2-week extension was granted for more detailed submissions from key stakeholders.

DPI has summarised and counted all submissions received by 5 April 2002.

Those on City of Perth response forms have presented somewhat of a dilemma as the form is not impartial and therefore influences the nature of the submission. It has been decided to tally these forms separately in much the same way as a petition would normally be reported separately in this type of public submission process.

Therefore responses have been identified as City of Perth or DPI forms, as well as identifying other submissions as letter, fax, email or telephone calls.

Responses have also been identified as supporting the Central or the Western Options or "Other" (which includes other options as well as neither, not stated, etc.). If some other option was listed as the person's first preference but they also indicated a second preference for Western or Central Options then the response was counted as favouring Central or Western, as appropriate.

Outcomes

A total of 3119 submissions had been received by close of business on Friday, 5 April 2002. These included 57 submissions (and 2 which were received after April 5) from directly affected businesses, residents, local government and others considered as key stakeholders. Of this total, 41 submissions were subsequently identified as invalid (prank emails with made-up names all delivered via the same overseas email server) and have been excluded from further analysis of the results.

A small number of submissions have been received after the closing date and are not documented here.

A total of 565 submissions are treated separately as City of Perth submission forms, including 40 emails that reflect the wording of the City of Perth form.

Analysis of the remaining 2513 submissions recorded the following results:

Western Option	1301	(51.8%)
Central Option	776	(30.9%)
Other submission	436	(17.3%)

The "other" submissions included: 187 Not clear/not stated, 55 Neither, 71 Kenwick route, 30 Fremantle route, 14 Modified Western (eg deviated to allow a station at PCEC), 14 CBD rail loop, 12 Eastern Option (PCRAC preferred option), 10 Buses (instead of rail), and 43 for various other options.

The City of Perth form submissions results were: Western 518, Central 10, and Other 37.

The key themes among the comments received are:

- Disruption
- Visual impact
- Access around Perth
- Transfer between trains

- Development of West End
- Patronage
- Northbridge
- City loop
- Cost
- General

Typical comments sorted by themes are listed below. The degree of disagreement within each theme is noticeable.

a. Disruption

- Central route is disruptive, will have problems as in Northbridge tunnel
- disruption is outweighed by long term advantages
- need to consider what is best for the majority, not the vocal minority
- freeway disruptions would be massive compared to those along William St
- Central route is focused on long term community benefit, not traffic disruption
- tired of construction on the Freeway
- absurd not to integrate with busport to avoid short term disruption
- Concern that construction under William St will be difficult (water table)
- construction inconvenience will be forgotten (eg Northbridge tunnel is now popular)
- Central option must use tunnel bore method, not cut-and-cover

b. Visual Impact

- need to minimise aesthetic impact on foreshore
- the esplanade is very attractive, and would be ruined by a railway
- foreshore is already blighted
- aesthetics are more important than commuter convenience
- Western option is less obtrusive to the city skyline
- rail should be underground in front of the convention centre
- Western route does not restrict access to Perth water
- shame that central route cannot be underground all the way from the Narrows
- Western route follows an existing heavy traffic area

c. Access around Perth

- Central option integrates with busport, takes workers where they need to go, should reduce the number of buses and cars in the city
- inner city light rail could link destinations in Perth - would be a tourist attraction
- CAT buses can take people to the foreshore
- CAT buses can serve west end, could be light rail
- existing Perth station gives good access to CBD, walking to the foreshore will encourage people to traverse the shopping arcades
- access to convention centre could be by underground walkway from the western station
- central option gives direct access to Perth, also ferries, busport, convention centre
- connection with busport and convention centre are not important
- Central option stations are too close together
- people want public transport at their doorstep
- Central route benefits more people, but needs to link with Perth station
- need to arrive in the heart of the city
- need train access to high rise part of the city
- need a station at the convention centre (Subiaco oval experience)
- Central route is closer to both ends of the city

d. Transfer between trains

- need for integration of all services in the central city
- Western route provides for better transfers
- indirect connection between Perth central and William St stations is not important, especially if underground travelators are provided
- need to avoid confusing underground connections as in London
- all trains need to connect at one station - people don't use underground connections at night
- Mandurah residents want to go to Perth, not Joondalup
- direct Mandurah/Clarkson service is logical
- direct Clarkson/ Mandurah link would increase employment opportunities in northern and southern suburbs

e. Development of West End

- City commercial development is moving west already
- need to rejuvenate central city is more pressing than West Perth
- western end of town needs a boost
- western station would not be used, there is already a station at West Perth
- western station will capture new commuters from the west end of the city
- Parliament house station will encourage politicians to use public transport (they should do so twice per week)
- no need for station at parliament house

f. Patronage

- stations where people want to go will encourage patronage
- good to provide extra transport in West Perth
- please make rail/bus happen before we are dominated by the car
- link to busport, convention centre likely to attract more patronage
- Central route has more patronage, and more efficient use of trains
- goal is to get people out of their cars - central option is better for this (higher patronage estimates)
- system needs to encourage people to use it (security, universal access etc)
- Central option avoids additional travel, picks up many commuters
- Central route has a greater catchment area, better long term option

g. Northbridge

- support underground rail between Perth and Northbridge
- railway needs to be sunk between Perth and Northbridge, bus station should be replaced with parkland
- lowering of railway through Perth is long overdue
- support for Central option - potential to sink the railway between Perth and Northbridge

h. City loop

- Western route provides basis for future rail loop
- Central could form spine of future underground loop
- suggest combining both to form a city loop
- suggest terminating at Busport, then light rail city loop
- need for CBD loop, need access for people living in the city, not just immediate CBD

i. Cost

- Western option uses existing infrastructure
- should connect with Armadale line to save money
- Central option will be more disruptive and costly to build
- Kenwick route was cheaper, catered for greater catchment, no disruption to Perth
- Central route has greater patronage, thus greater revenue
- no need for a railway, buses are adequate

- money should be spent on health (MRI machines for PMH), or on building a pipeline to bring water down to Perth
- rail should go via Fremantle and via Kenwick: make use of existing infrastructure
- earthworks for Western option are already there (Freeway)

j. General

- concern for rail to be built ASAP
- why call for comment now, and not when re-routing the railway
- route needs to be straightest and fastest
- enhancement of Central City Station is important given existing investment in it
- not wise to duplicate central station
- existing Perth station is old and at capacity
- Terminate at the convention centre to avoid risk, and people could transfer using CAT buses
- this route is much better than Kenwick
- suggest both are built
- station near the convention centre could be added to the Western route
- totally opposed to rail along the freeway (money already spent on Kenwick route)
- option 2C should have been put forward for public comment
- At this stage no specific comment on the disruption plans has been received.

Conclusion

Those responses supporting a Western Option were concerned with the disruption to William Street and the impact of the Central Option on the foreshore. Contrary to the committee's findings, many consider that the Western Option costs less, is a practical first stage of a city loop and enhances West Perth.

The responses supporting a Central Option emphasised that it serves more people, provides a direct link from the NSTS to the SWMR and offers better access to a variety of destinations including the Western side of the CBD, the foreshore, Barracks Square, the PCEC, Busport and ferries. Many noted that it was a better long-term solution but that disruption to business had to be kept to acceptable levels.

APPENDIX G

STAKEHOLDER WORKSHOP OUTCOMES

PERTH CITY RAIL ALIGNMENT PROJECT
STAKEHOLDER WORKSHOP 24 APRIL 2002

KEY QUESTIONS & ISSUES FOR PCRAC

- Ensure the long term rail service (loop) is addressed.
- Consider the city as a city; don't let transport efficiency dominate.
- Cost overrun in relation to budget is critical – will the service to the southern suburbs be compromised?
- Consider urban design issues – connectivity to the river, improvements to the foreshore, views from William Street, boxing in the Convention Centre.
- Ensure disabled access is considered and carry out more rigorous analysis of passenger catchments.
- How will design integrate with the Narrows Bridge?
- Consider the minimum cost options as the basis for comparison – extras such as sinking Northbridge rail and bridging the Freeway should be costed separately.
- Public viewing of the Graham Farmer Freeway model resulted in change to the project scope. The two models should be used for a similar purpose. If public consultation is not possible, the public should be invited to PCRAC discussions with the City of Perth and PURD.
- The best long term rail solution achievable for each option should be determined and evaluated.
- City amenity and vision must be taken into account – how much does each option add to or detract from the city's attractiveness.
- The City of Perth must clearly articulate its requirements for the foreshore.
- Investigate ways to make train turnaround more efficient.
- Sinking the rail at Northbridge is essential – if it can't be done, make sure Roe Street can still be developed.
- What are the impacts on Perth City Station if there is less movement through it?
- Consider safety and security for passengers, particularly for underground stations.
- Concerned at the use of numbers – are they comparative or absolute? What are the confidence levels?
- Confirm the cost of the Northbridge rail sinking.
- Don't delay the alignment decision – communities outside Perth need a commitment.
- What is the most important route for getting people on trains, creating a car free environment and with the most potential for growth of the whole public transport system?
- Preserve the integrity of the process – make sure the final PCRAC recommendation is indeed adopted by Government.
- What is the full development potential of the Elder Street proposal? What are the real costs of the two options?
- What is the total public transport package and what is its cost?

Perth City Rail Alignment Stakeholder Workshop, 24 April 2002
Building on the Viability of the Central Option

Opportunities	How they could be enhanced
Questionable value of station on the foreshore	What real value does this have? Just servicing an existing pattern which is already served by the current Perth Central Station
To have rail all the way from Narrows completely underground – but at what cost?	
Better integration for pedestrians between transport and Esplanade station – be honest with cost comparisons eg Western Option is $84m, new Central Option is $170m+++	Not an issue with Western Option
To drop the retaining wall on western side of Esplanade reserve?	Raise level of Riverside Drive Should be 2 lanes at grade Landscaped boulevard, not a freeway Not below grade Needs driver views of river and pedestrian crossing Need to review overall landscape / masterplan of freeway interchange Shift foreshore emphasis from road to recreation
To make the main arterial route on Mounts Bay Road (2 way) instead of Riverside Drive	
Cost effectiveness is much lower with this option	
Use precast culvert sections instead of in-situ cast sections	Faster delivery, less disruption/detours
Place buses in a tunnel alongside trains	Less vehicles/traffic pollution to see from Convention Centre
Don't put William Street to Freeway in a ditch, ie keep at grade	Pedestrians can cross
Incorporate design of Esplanade station into Convention Centre Busport complex	Better understanding of pedestrian movements during special events and tourist walking patterns.
Future long term City loop seems doubtful	Longer term planning horizon
Maintain viability of the loop by ensuring sufficient depth in Central Option	Preserve loop in both options
Sink railway along foreshore and under Mounts Bay Road (remaining at existing grade)	No certainty that this can occur within budget
International conventions, proximity of railway a disadvantage – even if blast proof	Study future growth pattern of City rather than historical growth. In terms of perceived centre of the City.

Opportunities	How they could be enhanced
Sink Railway at reasonable cost, once off Narrows Bridge	Isolate and eliminate costs to upgrade existing infrastructure to modern standards which are an unnecessary burden on the project budget (and not specific to the transport objective)
Enhanced property values through linking to adjacent office/shopping malls a la Singapore	Integrate adjacent buildings to stations
Subway retail Murray-Wellington Heritage Forrest Place pedestrian links / control over whole block	Between William / Central move tunnel east to avoid demolition of buildings William/Wellington G.L. links William-Forrest Place-Central and enlivening use of Commonwealth Bank, GPO etc
PCEC links/busport/train. Expand Wellington bus station Sinking Wellington Street railway (last opportunity	Shorten walk/interest/quality/travelator Is a G.L.-Mounts Bay Road walk possible? PCC pay for part and/or PPP
Riverside park	Tunnel road as well as railway
Sinking Northbridge lines to join the City and Northbridge	Cost to be isolated to be cost comparative for both rail options
Move new station closer to existing station	Change location of station – towards existing station in resumed land
Reduce disruption in William Street	Start bore tunnelling from station
Sink Southern William Street exit (vehicle) with bus lane to further enhance the foreshore.	
Reduces walking distances for projected patronage	
Lowering Northbridge lines	Rates income for City of Perth
Redevelopment opportunities – heritage enhancement eg. Boans, former “West Australian” building and building on site / William Street	
Economic analysis: $5.3m increase in retail (only $1.3m Western route)	Sunday trading
Rebadging – new places	
Linking train platforms and Roe Street	
Esplanade Station access to Foreshore and special events	Urban spaces and city design
Public transport integration of two busports with train stations	
I find that every claimed opportunity is in fact special pleading to cover up the deficiencies	Drop the Williams Street line

Constraints	How they could be addressed
Enormous cost (or at least considerable)	Proper costing must be a prime consideration
Huge re-organisation of foreshore – for what purpose?	A proper and full design exercise is needed
This is against all central area long-term pedestrian flows since 1960's-70's. Worst effects in Forrest Place.	
Demolition of ½ a block of heritage-listed buildings.	
Cost-effectiveness is much lower	
Lack of information/detail/artistic impressions of how it will work.	Show how pedestrian links between Stations will look and work.
Construction risks are high (cut and cover?) but this still exists with TBM method.	Can be priced into contract, especially in the geotech.
Need to negotiate with many owners re private property ie potential details.	Planning act can resume any properties at short notice – compulsory purchase.
Cost – TBM increases cost. Is this to be absorbed within the $1.2b budget? Will southern population be disenfranchised as a result?	Provide costings
Impact of derailment on Joondalup-Mandurah line. Does this close the N-S system?	Introduce system redundancy
Can we rely on PURD to deliver project in accordance with criteria?	Delivery of option shall meet all criteria and be protected by Legislation
Duplication of City Station unnecessary	Delete Esplanade Station and sink line through Northbridge with saving
Satisfy budget requirements (in central city)	Don't extend Railway to Mandurah in stage I. There is no significant demand there. Rockingham is preferred.
Duplication of bus routes and Railway Station. Alignment on Roe Street precludes development over and to station front	Move Station/curve south and/or come away from Roe Street
Cost of relocation control box/Telstra Heritage Facade Retention Disruption to Central train ops	
Lost opportunities for realignment of river foreshore due to a permanent "underground service"	
Connectivity of stations – distance between station and Busport	
The connection of Esplanade station and Busport – over or under connection	Pedestrian overpass is not a visual construction from William Street
Anchors (ground) in William Street that protrude in current tunnel alignment	Anchors need to removed in advance or they need to build the tunnel underneath
Safety and security for patrons	

Constraints	How they could be addressed
Confinement at the City. Does not "stretch" the City (see Jan Gehl)	
Uncertainty on cost and building risk	
Impact on existing retail structure (removes Joondalup flow through Forrest Place)	
Limits opportunities for public space development on the foreshore	
Unsuitable for persons with disabilities Visibility of interchange Distance of interchange	
Covered platform creates gaps	
Rail and wheel maintenance on tight curves	Opportunity to increase curve radii
Impacts on foreshore	Sink the line – put it in tunnel, not just earth-mound. Need to see a developed scheme. Outcome – no physical impact on the foreshore – no visual hindrance
Needs "perfect" fit with long term view of CBD and future transport need	William street should not inhibit a long term "loop"
Cost	Cost needs to be addressed on a long term opportunity – should not be only a short term solution Need to understand the 'bottom line' as now solutions are found $40m to sink rail has to be incorporated in total project cost; but will cost possibly more
Heritage conservation	Examination of solutions
Safety and security associated with "twinning" of stations	Security guards and design elements Ensure sense of place – shop/arcades – enliven the space
It fails to meet every one of the requirements of practically every town planning principle	Drop the William Street line

Key Findings – Central Option

1.	Very expensive c/f Western Option (seems to be twice as expensive). May be better to spend this difference on Northbridge sinking.
2.	PURD must come clean with costs.
3.	Very definitely the least-desirable option
4.	Do you align the rail system to the "centre" of the City or choose a visionary/desirable location to the west. Economics and world experience suggests the former.
5.	Must resolve the planning issues before working on more engineering solutions, ie focus on land use and planning issues
6.	Lowering railway through Northbridge must be included in the project
7.	You must query the cost
8.	Foreshore dislocation due to constructions inevitable, as is effect on built fabric of William Street and immediate environs. Completion of works adjacent Mounts Bay Road in time for PCEC opening.
9.	Does this appear to contribute to a long term plan for a city R.T. system?
10.	William St station should provide ground level links through to Forrest Place and Central Station. This opens opportunities for GPO, Commonwealth Bank etc to be utilised.

Perth City Rail Alignment Stakeholder Workshop, 24 April 2002
Building on the Viability of the Western Option

Opportunities	How they could be enhanced
Opens up the Western end of the City Creative, enriching opportunities for land area along Elder Street and on the western side	
Less disruption in construction stage in terms of the City itself	
No detrimental effects on trading patterns in the City	
Half the capital cost of the Central Option – not counting costs to operators, users, traders etc	
Risk factors lower than Central Option by a considerable amount	
Does not need demolition of a city block	
Provides an opportunity to lower the tracks and link to Northbridge by using the money saved on the Central Option	
Opportunity to upgrade Narrows Interchange to improve aesthetics and functionality	
Offset station in private property to the east side of Elder Street	Add commercial development overhead. Minimise disruption to SB on ramp less than the present 26 months
Elder Street Station further south ie between Murray and Hay Street	Lower bridge approach south of Mounts Bay Road
Tunnel bore from north of Narrows Bridge into private property (FIA land)	Creates opportunity to locate station on west side of Freeway and build genuine western alignment near Havelock Street
Must include lowering of Fremantle lines and link Northbridge to City	Extend the cut and cover tunnel through Entertainment Centre car park
Sever Riverside Drive to create pedestrian link / local traffic access to the City and close Freeway access	This will eliminate the need for Riverside Drive to Hay Street westbound off ramp from Freeway but not essential that Hay Street off ramp be removed
Allows the loop to be implemented without any future complication	By making a commitment to undertake a genuine mass transit long term picture for the City Investigation should be made to allow loop connection into Busport and further east from the outset
To revitalise Parliament and the wasteland around it	
To promote land development where land is more attractive towards West Perth	
To promote equity of access with significant additional catchment in west section of the City	

Opportunities	How they could be enhanced
To keep the cost relatively low compared to the Central Route	
Convenient to access the Convention Centre say 400m, at St George's outlet	
Does not duplicate the Central Station	
Better for the strategic planning of the City	
Stretching the City, opening up E-W growth patterns. Civic rejuvenation at head of St George's Terrace Commercial opportunities as well Commercial return along Malcolm Street, Parliament Precinct	Think of Kings Park / KPR as part of the CBD Bridging Malcolm-Hay Streets PCC streetscape enhancement
Free up foreshore as much as possible Future City loop, brings Thomas St into equation	Freeway is more central to this
Close Elder Street Station (a/h-security?) and carry through to Central	
To avoid issues of construction start tunnel on Freeway south of Mount Street	Starting of tunnel prior to Mount Street
Development of new situation in the West. Encourages development.	Enhances development, promotes the West End
To sink Northbridge lines. Join Northbridge and City. Northbridge sinking – set up separate authority that may incorporate private and public enterprise to maximise return and benefits.	Cost should be isolated to be cost comparative so both rail options can include this. Opportunity of federal funding for enhanced tourism. Station to function at ground level To allow for an at grade link between City and Northbridge rail lowering between King Street and lower Milligan Street – for City and Northbridge connection
Wellington Street carpark	Resolution on improvement and design of car park/land
Move tunnel south of Mount Street overpass to assist with traffic congestion during construction	Bored tunnel instead of a cut and cover tunnel – no disruption
Tourism precinct development Kings Park, Parliament Hill	Broader list of stakeholders Tourism Commission Define linkages and how they work
Reconnecting Parliament to the people Establish Parliamentary Offices closer to Elder Street Station	
Reinstate Hay Street connection West Perth-City Enhance streetscape	
Development of patterns of pedestrian movement in West Perth	

Opportunities	How they could be enhanced
Opens opportunity for development of a stagnant section of the City	
Transit oriented development (supports current planning paradigm)	
The Western Option provide the greatest range of development	Adopt Option
It leaves the Foreshore untouched and available for future people-friendly development	Adopt Option
It allows the languishing western ends of Murray Street and Hay Street to be reviewed and developed	Ensure exits/entrances to Freeway station must have access to Murray St/Hay St/St George's Tce
It helps to "stretch" the city east-west	Supports City of Perth's "stretch the City" policy
It does not inhibit the possibility of a loop system over the next 25 years	Review and institute studies along lines suggested by the Wilbul Smith Report 1974 on City Rail commissioned by WA Government
It is flexible and does not force an underground system but will fit a railway sinking if desired	Adopt Option
It does not "steal" value from Perth City Rail Station but creates new value	Do not have William Street option
Is aesthetically and amenity as seen from Mt Eliza far superior	Cooperate with PCC on foreshore development
Encourages new office development along Western End of St George's Terrace	This has been the natural trend - station will reinforce
Provides an unrivalled opportunity to bring Parliament to the people by covering over the Freeway	Cooperate with Perth City Council and Parliament to resuscitate the original idea of the Parliamentary vista.
High-density development potential	
Incentive for development bridge over freeway and Parliament, civic space	
New bus interchange / transport / bus hub.	
Stretch the City (if "build it and they will come" holds)	

Constraints	How they could be addressed
Temporary deviation of Freeway – MRWA	? no easy solution, good PR
Long term railway planning lacking doesn't have a future proofing re higher frequency trains	More platforms Double decker trains but acceleration is poor Stability of trains on narrow gauge
System reliability as a result of configuration Higher tech demands at Perth Station	
Longer journey times	Delete Elder Street Station and make Perth Central the main/only Station
Provision for lay by of buses at Elder Street conflicting with pedestrian areas over Freeway and costs	
Freeway disruption	Careful staging
Open cut through centre of freeway will take 4 lanes	Move portal closer to river
Through-running	Review the necessity of constraint. Do economic analysis of this.
Road Safety between Riverside Road to Hay Street West	Upgrade Market Street – stop entry to Hay Street West via Riverside Drive. Vehicles to exit from Market Street Reassess cost of Cloverleaf Retain bus lane overpass on Freeway
Residents between Elder and Wellington Streets	
Reduces opportunities for through working of trains	3% through patronage would suggest this is not a significant issue
Severs link between Riverside Drive and Hay Street	Address other multiple routes Implement Perth Access recommendation to sever the link
Additional travel time to/and in Central Station	
Capacity and reliability constraint	Increased staffing
Short term issues and catchments at Elder Street and location	Increased redevelopment
Bus integration is poor	Rescheduling of buses (but little demand unless redevelopment occurs)
Residents in Elder Street	Boring option for Wellington Street section – if possible
Traffic disruption on freeway – what is the level of constraint – pinch point in road system	Disruption will be spread – cause changing vehicle use patterns
Cost of sinking railway in Northbridge – increases vis a vis William Street	
Does not provide passenger direct routing north to south	Re-examine policy on crossovers flying or otherwise

Key Findings – Western Option

1.	Cheaper (1/2 the cost – at least). Must get accurate costing
2.	Less disruption
3.	Creates better balance of station creations within CBD – contrary to claims of PURD team
4.	This is the best option on all counts
5.	Creation of the Graham Farmer Freeway has created an opportunity to upgrade/enhance the Foreshore/Riverside Drive and remove link to Freeway, but retain Freeway to Hay Street off ramp
6.	Must focus on land use and planning issues to determine preferred alignment
7.	Lowering railway through Northbridge must be included in the project
8.	Can't overlook likely cost savings (cf Central)
9.	Don't under estimate value of the Foreshore
10.	This appears to offer the potential for contributing to a future City R.T. System, such as to the East and to West Perth, Kings Park and beyond.
11.	Potential for value adding to the City: Commercial Streetscape (a catalyst) Residential

APPENDIX H

SUMMARY OF PUBLIC SUBMISSIONS

Name/Organisation	Summary of Submission
Railway Technical Society of Australasia	– Concerned that decisions affecting Perth's long term future are being made without adequate study of rail options. – Believes key issues of journey flexibility, special train services, impacts on Perth Royal Hospital, disabled passengers, passenger security, Perth Station capacity, train noise, spoil removal, impact on buildings, train turn around times, passenger catchments, interoperability, Northbridge-city links, engineering issues, rail shutdown requirements, cost estimation, disruption analysis and alignment geometry require further analysis. – Provides assessment of key issues for each option – suggests Central option is disadvantaged in terms of flexibility of service, passenger security, train noise, spoil removal, impact on buildings and passenger catchment. – Argues that rail operating advantages of the Central option are not as significant as claimed.
Professor Martyn Webb (2 submissions)	– Recommends adoption of the Western option as proposed by the City of Perth, with all work on the central option to cease. – Cites Western option advantages of less tunnelling, reduced disruption and visual intrusion on the foreshore, passenger access, development opportunity and compatibility with a future rail loop. – Believes the Central option is disruptive, environmentally and socially constrained, does not offer flexible services and does not contribute to a future rail loop. Believes the Eastern option (2C) is too expensive, is indirect and compromises the effectiveness of a future loop. – Recommends city rail loop be adopted by Government as a long term planning concept. – Urges Government to reconsider the Kenwick route for SWMR.
Water Corporation Mr Graham Cargeeg, Regional Business Manager, Perth Region	– Advises that each option in the March 2002 PCRAC has a major impact on Water Corporation infrastructure which would need to be addressed in planning, design and implementation. – Has no preferred option.
Mr Bruce Power	– Recommends the adoption of a city loop constructed in two stages, with Stage 1 represented by the Western option and Stage 2 represented by the (possibly extended) Eastern option.
Mr Herve Calmy	– Provides a comparative assessment of land development opportunities for the proposed Elder Street and Esplanade stations. – Concludes that land area with potential for development is 10 times greater for the Elder Street station, with available floor space 5.6 times greater.
Wyllie Group Pty Ltd (Perth Convention Exhibition Centre) Mr Stuart Price, Property Director	– Questions the value of air rights above the proposed William Street station. – Expresses concern at security risk to Convention Centre posed by a station in close proximity. Suggests a footbridge over Mill Street could provide access from Elder Street to the Convention Centre. – Believes Western option offers better growth potential for the city.
Mr Bob Pritchard Engineering Consultant	– Suggests there are less expensive, viable alternatives to bored tunnelling for the William Street option. – Believes there is a case for increased passenger amenity by reducing tunnel length. – Believes the Central option offers better connectivity between the city and river.

Name/Organisation	Summary of Submission
Australian Institute of Landscape Architects Mr Tony Blackwell	– Expresses concern at uncertainty surrounding scope of the Central option proposal and states preference for the Western option. – Believes the Central option is deficient is respect of foreshore impacts and connectivity, impact on views from William Street, compatibility with a future rail loop, Heritage impacts and cost.
Australian Institute of Urban Studies	– Identifies strengths of Western option as reduced construction risk and disruption to rail services, Perth Station, the foreshore and Convention Centre, rail service flexibility, provision for future bus service integration and reduced cost. Believes the Elder Street station has a better passenger catchment and encourages development. – Considers that the Central option is more expensive, has greater construction risk and does not address connectivity issues at Perth Station. Believes Esplanade station-Busport integration is not vital, the station's passenger catchment is duplicated and development potential is low. – Believes the Western option is a better long term solution for the city. Urges Government to ensure that overall SWMR project scope is not compromised if cost for the city alignment increases.
CityVision Mr Ralph Stanton & Mr Ken Adam	– Believes the Central option is flawed due to foreshore impacts, incompatibility with a future loop, station duplication and limited flexibility of rail service. The Western option is less intrusive, complements a future loop, encourages development and offers a flexible service. The rail operating advantages of the Central option are questioned. – Suggests technical assessment criteria be separated from planning criteria to clarify the basis of PCRAC's final decision. – Believes compatibility with the long term transport solution and elimination of foreshore impact are imperatives. – Supports lowering of rail to link to Northbridge, identified separately for each option. – Recommends implementation of a designated planning authority to administer the project. – Is concerned at passive stance of the Western Australian Planning Commission.
West Australian Small Business & Enterprise Association Inc Mr Phillip Achurch	– Provides results of 35 responses to independent survey of small/medium business operators on the preferred alignment for SWMR. – 77% supported the Kwinana Freeway route to Perth. Of these responses, support for the Central option was 48% and support for the Western option was 44%.
Mr Peter Bruechle Engineering Consultant	– Draws attention to the significance of the decision faced by Government. – Supports the Central option on the basis of service to CBD and connectivity to NST. However, notes environmental, functional and appearance concerns of Central option opponents. – Suggests an alternative rail alignment option with bored tunnelling from Richardson Park in South Pert under Perth Water to William Street. – Identifies disadvantages of additional cost, limited local tunnelling experience and Aboriginal Heritage. Advantages are station location, removal of impact on South Perth peninsula and city foreshore and minimal construction disruption.

APPENDIX I

COST ESTIMATE DETAILS

The Western Australian Government Railways Commission

Perth Urban Rail Development Office

Your re
Our ref: 02/0003
Enquiries: 9213 2799

May 21,2002

Stuart Hicks
Chairman
Perth City Rail Advisory Committee

Dear Stuart

PERTH CITY RAIL OPTIONS – COST ESTIMATES

Below are details of the cost estimates for the Central and Western route options into / through Perth. However, firstly I need to describe some important basic parameters regarding contingencies and costs for project management and engineering.

Contingencies

There are no contingencies allowed in any of the elements that constitute the Master Plans that have been prepared. Justification for this is based on the thoroughness of the master planning approach for railways in this State. These are not mere desk top studies. Master planning is based on carefully developing the basic supply and demand equation.

Firstly the patronage demand is established, then the services required to satisfy that demand. The function and quantification of the infrastructure and rollingstock needed to provide the services is defined. Then the conceptual drawings and major elements of the work breakdown structure are developed – much attention is given to identifying the full scope of work. Careful attention is given to integration of the system with town planning, other parties services and requirements, and the environment. Preliminary risk analysis is undertaken. Preliminary work programs are prepared. Only then are cost estimates for the system prepared.

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The estimates developed are not "rose coloured". They are based on a reliable data base of unit costs and due regard to past and current tendering practice and trends. The final estimates are what could be expected to fall within the mid range of the standard distribution curve, for the range of tender prices one could reasonably expect. Thus given the high development of the scope of work, there should be no great risk of deviation

either above or below the chosen mean value. Where there is likely to be a significant variation caused by latent conditions, a cautious approach is used by adopting prices towards the higher rather than lower range of the expected distribution of tenders.

Project management and Engineering Costs

PURD estimates are prepared under traditional railway capital classification headings and then the total estimate is structured under broader headings including geographical cost areas and those monies required to administer and manage the works. This latter category is known as Cost Area 1. There is currently within Cost Area 1, an allocation of $137 million. This is proportionally distributed to individual elements of the project. The distribution is based on, and added to the estimated cost, once that has been defined. For works associated with all of the routes through Perth, a figure of 15% is added to the estimated cost.

It is important to note that the estimates provided by this office so far **have not included these project management and engineering costs**. The mindset for this is that project management and engineering costs are already allowed in the budget. However, they <u>are</u> shown in the estimates provided below.

The Central Route

The "preferred route" along William Street announced by the Government in October 2001, was to cost $120 million. Please note that this was for the defined cost of the works at that time and did not include the cost of project management and engineering, that would have amounted to $18 million (15% of the estimated cost of works). The scope of work for the "preferred route" has been previously defined.

Following extensive ongoing development and additions, the essential elements of what is now the basic Central route are;

- Approximately 670 metres of double track railway in a cut and cover concrete box from just east of the Kwinana Freeway, along the Perth Foreshore to Mounts Bay Road, the top of which is at ground level. It includes a station at the northern extremity.
- From Mounts Bay Road to a portal in the railway reserve roughly in line with Lake Street, over a lineal distance of about 960 metres, there is approximately 390 metres of twin bored tunnels and 180 metres of twin track cut and cover structure that includes the main central underground station platforms
- There is then a structure of just under 200 metres to bring the railway out of the ground and link into the northern suburbs railway.

The estimated cost of all the activities associated with this basic option is $181 million. To this must be added $27 million (which is already covered in the PURD budget) for project management and engineering. Thus the full cost is $208 million.

A summary of the costs is given in Addendum One.

Please note that not included in Addendum One is the additional cost to remove the existing William Street road bridge on the Perth Foreshore. The cost to achieve this, including project management and engineering costs, is $12 million.

Western Route

A summary of the costs for the western Route is given in Addendum Two.

Peter Martinovich
Project Manager PURD
May 21, 2002

The Western Australian Government Railways Commission

Perth Urban Rail Development Office

21 May 2002

Stuart Hicks
Chairman
Perth City Rail Advisory Committee

Dear Stuart

Further to my letter of 14 May 2002.

Please find attached Addendum One May 21 2002, and Addendum Two May 21 2002, which summarize the amended cost estimates for the Central and Western route options into / through Perth.

Please note that the currently approved budget for the PURD Project for infrastructure works and the project management and engineering of those works is $1003 million. The route through Perth will be funded from within this approved budget. The project management and engineering component of the $1003 million is $137 million (15.8%). The allocation for project management and engineering for the route through Perth will be drawn from the $137 million and has been set at 15% of the infrastructure cost as shown in the Addenda.

With regard to the Western Route, the infrastructure costs given above do not include the capital costs for the integrated bus network to substitute for the transfer amenity offered by the Central Route at the Foreshore Busport. It is understood these have been provided separately by Transperth.

All costs given in the Addenda are in April 2002 dollar values.

Please note that the cost given to the Government for the original William St Base Case of $120 million, was in 1998/99 dollar values. Since that time the Government has approved an amount to allow for cost escalation over the life of the project. This means that the April 1992 value of the original $120 million William St Base Case is approximately $132 million.

The cost differential therefore between the current Perth Central Route Base Case ($181 million) and original escalated base case of $132 million (ie the additional money to be found) is $49 million.

Please note there is no allowance for risk in the Addenda.

Yours sincerely

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Addendum One May 21 2002
Perth Urban Rail Development Office
Perth Central Route
Summary of Options and Cost Estimates – Dollar Values April 2002

Major Elements	Base Case	Option One - Stage One Underground to Milligan St	Option One - Stage Two Underground to Milligan St	Option Two - Stage One Underground to Lake St	Option Two – Stage Two Underground to Lake St
Esplanade Station	$14 million	$14 million	$14 million	$14 million	$14 million
Central Station	$50 million	$50 million	$50 million	$50 million	$50 million
Balance of Cost	$115 million	$124 million	$124 million	$115 million	$115 million
Stage One (Fremantle line on Surface)	Included above	Included above	Included above	Included above	Included above
Stage Two (Fremantle Line Sunk)	Not Applicable	Not Applicable	$35 million	Not Applicable	$19 million
Sub Total	$179 million	$188 million	$223 million	$179 million	$198 million
Project Management & Engineering (15%)	$27 million	$28 million	$33 million	$27 million	$30 million
Total Cost	**$206 million**	**$216 million**	**$256 million**	**$206 million**	**$228 million**

Notes:

1. Funds for Project Management and Engineering are already provided within Cost Area 1 of the PURD Budget.
2. The base case is as described in the body of the letter. The Portal is located just west of Lake Street.
3. Option One provides the maximum connectivity through Northbridge. It has the exit portal immediately west of Milligan Street, and the railway is below ground east of Milligan Street.
   - Option One, Stage One, provides 210 metres of additional twin track cut and cover tunnel above the base case with the Fremantle lines above ground.
   - Option One, Stage Two provides for sinking of the Fremantle lines and includes two ramps plus 480 metres of twin track cut and cover tunnel over and above Option One, Stage One.
4. Option Two, provides the minimum sinking through Northbridge with a portal just west of Lake Street and the railway is sunk east of Lake Street.
   - Option Two Stage One is as for the base case.
   - Option Two Stage provides for sinking of the Fremantle lines and includes two ramps plus 270 metres of twin track cut and cover tunnel.
5. The accuracy range of the cost estimates is +10% / -15%.

Addendum Two
Perth Urban Rail Development Office
Perth Western Route
Summary of Options and Cost Estimates

Activity	Cut and Cover On surface through Northbridge	Bored Tunnel On Surface through Northbridge	Cut and Cover Lowering through Northbridge	Bored Tunnel Lowering through Northbridge
Elder Street Station	$28 million	$35 million	$28 million	$35 million
Perth Station	$21 million	$21 million	$21 million	$21 million
Balance of Cost	$94 million	$135 million	$94 million	$135 million
Perth – Thornlie Platforms	$19 million	$19 million	$19 million	$19 million
Northbridge Lowering	Not applicable	Not applicable	$39 million	$39 million
Sub Total	$162 million	$210 million	$201 million	$249 million
Project Management & Engineering	$24 million	$32 million	$30 million	$37 million
Additional Railcars	$30 million	$30 million	$30 million	$30 million
Total	**$216 million**	**$272 million**	**$261 million**	**$316 million**

Accuracy of Cost Estimates is +15% / -20%

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