A Submission in Response to

THE SYDNEY CBD SOUTH EAST LIGHT RAIL (CSELR): ENVIRONMENTAL IMPACT STATEMENT

By

Greg Sutherland

Greg Sutherland –

- holds degrees in Electrical Engineering and Arts (majors in Physics and History) from Sydney University.

- is a Fellow of the Institution of Engineers, Australia and Member of the Australian Institute of Management.

- has extensive experience in Transport and Logistics and the design, operation and maintenance of large facilities operating 24/7.

- has held positions at senior level in the NSW state public sector including major technical, management and policy roles.

- is the author of the NSW Transport Department's publication "Light Rail: Its Evolution and Potential for NSW" (ISNN 1037-6305).

- has served as a Senior Transport Adviser to a former NSW Minister for Transport.

- has a significant knowledge of current light rail practice based on ongoing contacts with experienced light rail professional practitioners both in Australia and Overseas and an extensive program of international visits and local discussions extending over a considerable period. Cities and tramway/light rail systems covered include:

  Adelaide, Barcelona, Basel, Bergen, Berlin, Bern, Bonn, Bordeaux, Boston, Bratislava, Bremen, Brest, Brno, Brussels, Charlotte, Calgary, Chicago. Dallas, Denver, Dijon, Dortmund, Dresden, Dublin, Dusseldorf, Edmonton, Frankfurt, Geneva, Goteborg, Graz, Grenoble, Hanover, Helsinki, Houston, Innsbruck, Karlsruhe, Koln, Kosice, Leipzig, Linz, Lisbon, London (Croydon), Los Angeles, Lyon, Marseille, Melbourne, Memphis, Milan, Minneapolis, Munich, Nantes, New Orleans, Nice, Norfolk, Norrkoping, Nurnberg, Orleans, Oslo, Paris, Phoenix, Portland, Porto, Potsdam, Prague, Salt Lake City, San Diego, San Francisco, San Jose, Seattle, St Louis, Stockholm, Strasbourg, Stuttgart, Tampa, Tacoma, Toronto, Trondheim, Vienna, Zurich.

- is a long standing Director of the Sydney Tramway Museum. (The Museum is Australia's largest and ranks in the top 10% of Tramway Museums worldwide.) He was the Project Manager responsible for the successful conversion of the Royal National Park railway line to an operating tram line subsequent to the NSW Railways ceasing services on this branch line.

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Executive Summary

The basic concept of and the policy backing of the CSELR is sound and the NSW Government is to be strongly commended for initiating and backing this welcome development. The project represents a sound investment in Sydney's infrastructure and will be an ongoing benefit for generations.

The CSELR already has the strong support of Councils in the proposed operational area and strong community support in general.

Unfortunately there are a number of shortcomings and failures to address world's best practice contained within the current proposal. There are opportunities to reduce costs, lessen the impact of construction disruption, improve the aesthetics and provide for more flexible operation of the CSELR. All of these opportunities will have a positive environmental impact on the CSELR proposal.

Currently the CSELR proposal, on which the call for comment has been based, would only achieve a 'C pass' in academic rating. There is a need to ensure that as part of the EIS process it is constructively modified to reflect modern day technology, design competence and operational procedures as practiced by leading edge operators of large scale, high passenger volume light rail systems worldwide. In addition, based on equivalent projects elsewhere, there would appear to be potential to reduce the construction time for the CSELR.

If this modification is carried out in an effective manner and implemented sensibly there is every reason to be confident the 'C pass' can be upgrade to 'A Plus'.

Without an effective and efficient CSELR Sydney will be unable to maintain its pre-eminence in public transport infrastructure and service in Australia.

Based on the need to enhance the level of light rail expertise associated with the CSELR project it is essential that any future consultancy and design works commissioned by and paid for by government need to be carried out by practitioners with demonstrable experience in modern and successful light rail systems.

The majority of consultancies these days are internationally based and there is a plethora of firms specialising in light rail rather than just the NSW bureaucracy's small pool of favoured and regularly used multinational firms. This latter grouping is essentially heavy rail practitioners who often tend to deliver a higher priced outcome more akin to long distance suburban trains than to the more economic street based light rail required for the CSELR.

It is imperative that any firms engaged be competency audited by an independent group selected by the government, rather than the bureaucracy, prior to their engagement and that this group should maintain a watching brief throughout the consultancy.

The Recommendations in the following pages are aimed at addressing the issues outlined above and improving operational robustness. Their implementation will contribute in a positive way to the environmental impact of the CSELR. They are strongly commended.

Recommendations

That, to ensure a proper operating environment and having regard for the technical deficiencies and operational limitations associated with current commercially available wire free LRV power supply systems, the initial construction of the CSELR be carried out with the provision of standard Over Head supply infrastructure throughout the CSELR system. Page 23

That it be a condition of the approval of the CSELR that TfNSW be required to draw up and issue basic standards for the CSELR prior to the commencement of the design and construction phase. This would include, but be not limited to, kinematic envelope, structure clearances, minimum structure gauge, maximum load gauge, permanent way structure gauge, maximum system gradients and permitted track vertical and horizontal curvature radii. This information be placed on the public record prior to the letting of any design and construct contracts. Page 28

That a condition attached to the approval of the CSELR proposal be that track construction:

(i) is based on proven Melbourne techniques.
(ii) is based on cost effective, operationally practical light rail standards rather than Sydney Trains heavy rail practice. Page 28

That prior to commencement of construction a technical audit based on Melbourne expertise be carried out to ensure that methods and form of construction proposed will ensure minimum disruption throughout the construction period. Page 29

That prior to commencement of construction a technical review be undertaken based on Melbourne expertise to ensure that construction is carried out in the most expeditious and economical manner to achieve the shortest possible construction time. Page 29

That, to ensure maximum positive environmental benefits, it be a condition of approval that grassed trackform be the preferred application in the Centennial Parklands, Randwick Racecourse, Moore Park and similar CSELR traversed areas. Page 31

That TfNSW be required to ensure that government expenditure is minimised by the appointment of a nominated "Informed Buyer" to oversight the selection and procurement of the Light Rail Vehicles. The person charged with this responsibility should be required to demonstrate <u>extensive light rail technical experience</u> relating to vehicle procurement. Page 35

That to ensure maximum environmental benefits with respect to appearance and safety a condition attached to the approval of the CSELR proposal be that the Over Head supply be single contact wire and that the more aesthetically acceptable European style of Overhead Design be adopted as the CSELR System Standard. The proposal not to affix OHW fixtures to existing structures along the route of the CSELR proposal should be rejected. **Page 48**

That, where practical and appropriate, centre poles be used for overhead support. Consideration should be given to replicating the original 1890s design in locations where this would be appropriate for the streetscape. **Page 48**

That Independent consultants, with demonstrated core light rail expertise and proven technical experience, be engaged to oversee and maintain value for money oversight of the CSELR project delivery. Given the crucial role to be played by these consultants they should be required to demonstrate, prior to engagement, extensive light rail expertise and experience in multiple engagements of this nature. **Page 50**

That to ensure minimum adverse environmental effects due to system operating disruptions a condition attached to the approval of the CSELR proposal be that appropriate turn back facilities be provided in the CBD and at suitable locations on the suburban legs of the CSELR to minimise the time and extent of LRV service shutdowns. **Page 57**

That to ensure minimum adverse environmental effects due to system operating disruptions a condition attached to the approval of the CSELR proposal be that to ensure adequate surge capacity on the system layovers be provided on level ground at Circular Quay and the suburban termini and that a passing (holding) loop be provided at the existing (Inner West) Railway Colonnade Tram Stop. **Page 57**

That to ensure minimum adverse environmental effects due to system operating disruptions a condition be applied to the approved EIS that in addition to the Alison Road track connection to the Randwick Racecourse stabling area, a double track link be provided from the Racecourse stabling area via Ascot Street to connect with the Anzac Parade trackage. **Page 57**

That, in approving the EIS in order to ensure an appropriate built environment for Depot and Service Buildings a condition be that Depot and Service Buildings be dealt with a sensitivity reflecting the "French Approach". **Page 59**

That, in order to ensure maximum positive environmental outcomes for light rail vehicles and road traffic moving through the Anzac Parade Alison Road junction, it be a requirement that the junction be grade separated. Page 61

Figures

This "lightness" of light rail – a combination of flexibility, low impact, modest cost, and environmental softness – is ephemeral. It must be carefully guarded. Ignorance or ineptitude during the planning, design, specification writing, engineering, or construction phrases of a project can lose the "lightness". Light rail's advantages can be diminished or even destroyed with overdesigned overhead; ugly, noisy, or difficult-to-maintain cars; poorly conceived alignments; or simply uneconomic applications.

Light Rail Transit Special Report 221 United States Transportation Research Board National Research Council p 92

The above sourced quotation can be found on page 63 of the NSW Transport Department's publication "Light Rail: Its Evolution and Potential for NSW" - (ISNN 1037-6305).

Those who do not learn from history are condemned to repeat it

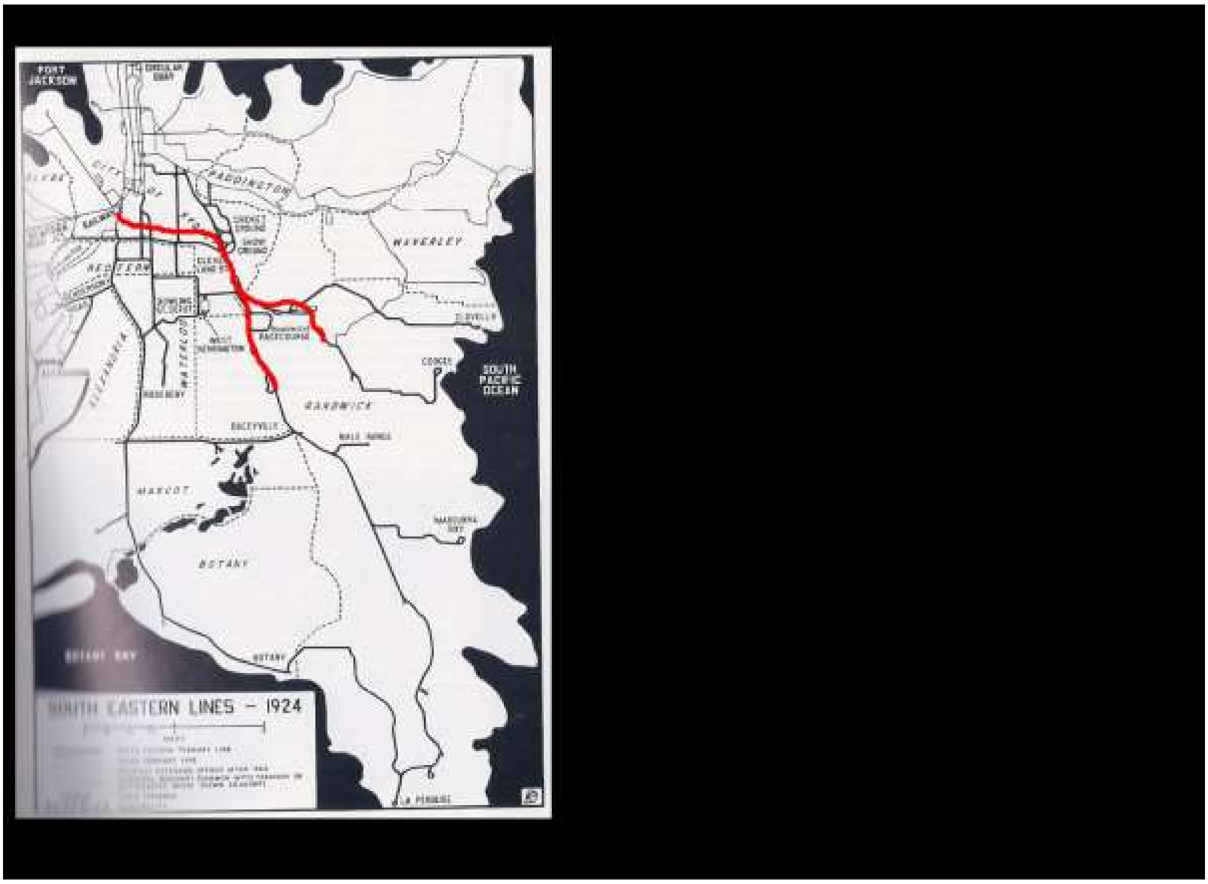
To an informed observer it would be obvious that in the preparation of the EIS documentation there is little evidence of an awareness of some significant historic salient points relating Sydney's CBD and South East public transit.

For example:

The role of the original tramway service in moving far greater passenger numbers, including to and from the Cricket Ground and Randwick Racecourse complexes, than are envisaged in the current CSELR proposal and the reasons for its ability to perform this task.

The fact that the 'busways' referred to throughout the EIS documentation were originally exclusive tramway reservations and that these reservations extended essentially all the way from Darlinghurst to La Perouse.

That there was a previous issue of EIS documentation entitled "Proposed Light Rail Extensions" released for public consultation on 22 October 1997. This documentation covered the CBD and the Inner West and incorporated detail that the recent information sessions associated with the current EIS were unable to provide.



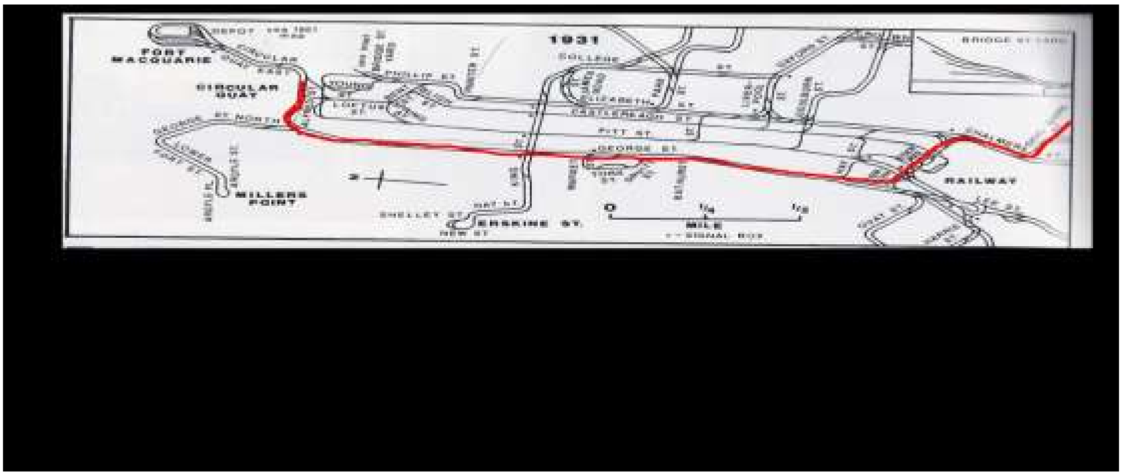


Figure 1 – Proposed CSELR tracks, shown in red, overlaid on the original tram lines in the CBD and South Eastern Suburbs

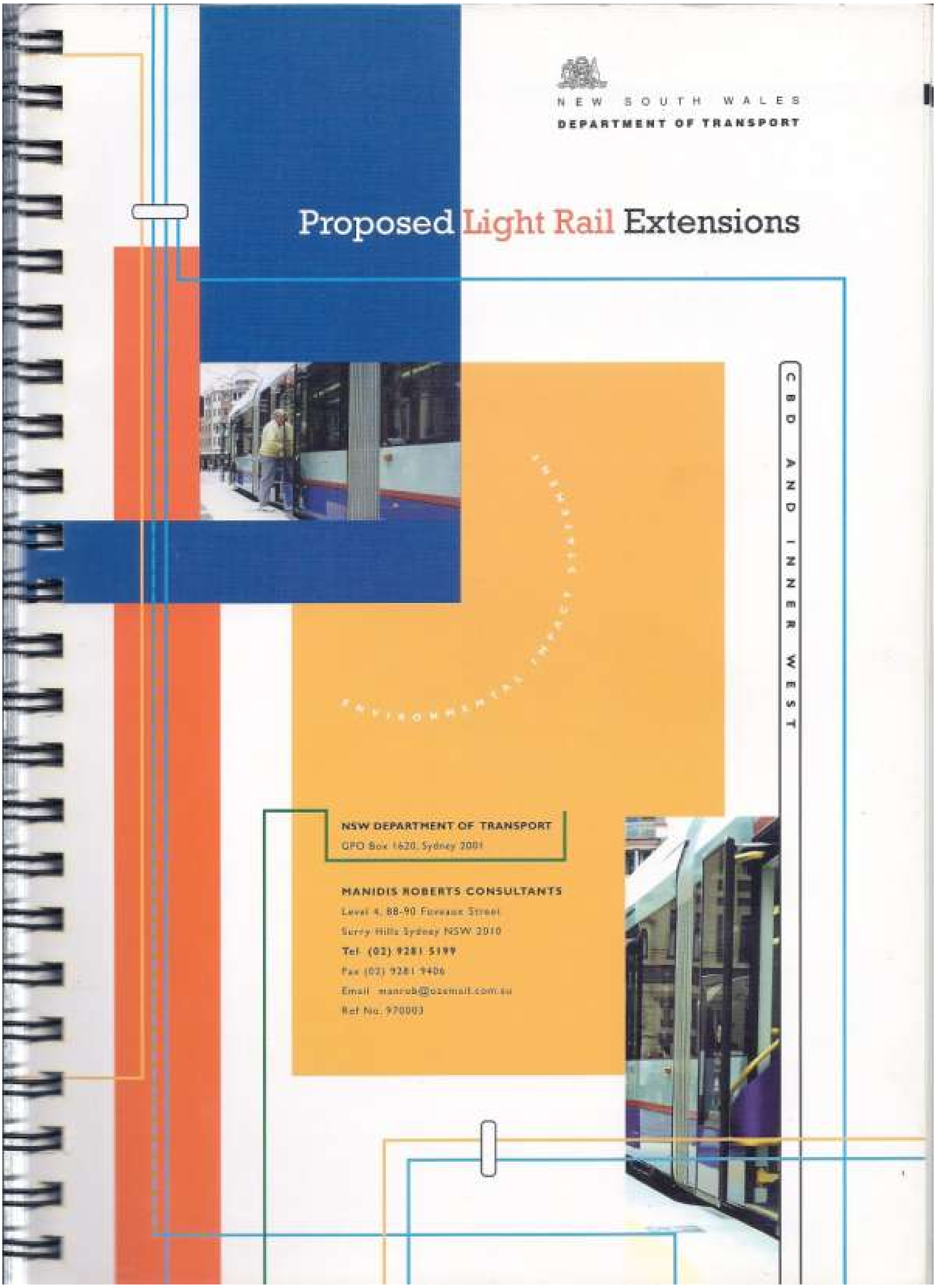


Figure 2 – Cover page of the 1997 EIS Document

Creating a Monument or a Functional Light Rail System?

It is noteworthy that there is a consistent theme running through the CSELR Environmental Impact Statement and that theme for the project is the building of a structure which the proposed CSELR will operate over. This is demonstrated by the heavy emphasis on infrastructure throughout the EIS documentation.

The reality is that for the CSELR to be a successful operating entity it is essential that the highest priority be given to ensuring an appropriate operational capability for the light rail system. Such a capability requires the early determination of significant operational requirements and constraints which must be addressed. Only then can the subservient process of designing and providing the supporting infrastructure be undertaken.

There are examples of significant shortcomings in the consideration of operational matters throughout the EIS documentation and in the comments that have been made in the Community Consultation Sessions that have been held to inform the general public. There is little evidence in the EIS documentation that the stated aim to "encourage participation to allow the development of the CSELR to benefit from stakeholder knowledge and understanding of specific needs" (page E5) has been given more than lip service.

Comments throughout the EIS relating to electrical and mechanical aspects of the project indicate a deficiency in the necessary level of light rail technical expertise that should be applied to a major project in the centre of Australia's largest city.

There is an obvious need to have the project reviewed by persons with a suitable level of light rail expertise prior to the commencement of construction. It appears, based on the EIS documentation, neither Transport for NSW nor their consultants on this project to date have been able to demonstrate the level of relevant expertise that an informed person would expect to see demonstrated on a project of such major State significance.

The following pages provide comment relating to the issues raised above and to other items of concern contained in the EIS documentation.

“Expertise” of the EIS Project Team

Appendix ‘C’ of Volume 1C of the EIS documentation lists - ***Interfleet*** - as the Operational Adviser – see Table C1

Interfleet states on their website:
http://www.interfleet.com.au/CorporateWebsite/Resources/Documents/AboutUs/AboutUs_2627163.pdf

“Interfleet’s heritage as British Rail’s Intercity Engineering arm provides unrivalled expertise and knowledge management. It has built on this core competence by developing its people and products and now offers a comprehensive service portfolio to the international rail industry. Since 1997 Interfleet has successfully delivered over 1,500 assignments to more than 190 clients in Australia and New Zealand.”

“Good Urban Transport is a critical attribute which differentiates great cities from good cities. A successful Urban Transport system seamlessly integrates different modes, Rail, LRT, Metro, Buses and Ferry, with active transport options – walking and cycling. An integrated network is achieved using passive and active measures including timetabling, way-finding, branding and service levels to contribute to achieving greater mobility and a positive customer experience.”*

- *Note: No comment relating to maximising the operational capability of the light rail despite this being a crucial aspect.

Given Interfleet’s expertise contribution to the project is as an ‘Operational Adviser’ there appears to be little light rail operational expertise demonstrated in the above, rather their stated expertise (see ‘heritage’ above) is in **British heavy rail, long distance engineering**. Such experience would be contrary to what should be expected in an Operational Adviser for a major, high capacity **light** rail operational role in the Sydney CBD. This is especially so as Sydney has a past record of introducing heavy rail engineering cost and operational disadvantages into light rail projects.

Wire Free Operation

It is incomprehensible that the EIS documentation appears to accept wire free operation as a 'given' for the Sydney CBD light rail when there is no system of wire free operation operating anywhere in the world that has successfully functioned under the operating conditions forecast for Sydney. The minute number of systems currently in use operate over essentially flat terrain (unlike the grades to be found in Sydney), do not have air conditioning or alternatively operate in cities with a lesser air conditioning load requirement than Sydney and operate over very short wire free distances and at extremely low speeds.

There can be significant doubt, given the above acceptance, that TfNSW and its technical and operational advisers are capable of properly and objectively evaluating the operational and cost implications of "wire free operation".

Wire free operation, if implemented, will introduce serious impediments into the successful operation and maintenance of the most critical section of the whole CSELR.

It will also lead to massive increases in initial construction costs, lock in the light rail system to additional costs for electricity including a surge demand surcharge (that is if the supply authority is prepared to even consider the type of supply that would be required to meet the fast recharge facilities which would be necessary to meet the operational parameters of a fast recharge installation).

Dwell time is a crucial factor in the performance of a light rail system. Given that dwell times of approximately 20 seconds will be the norm for a successfully operating CBD light rail system it will be necessary for the fast charge facility at each stop to be able to meet the following duty cycle – pantograph up, contact, switch on, fully charge, switch off, pantograph down – all within a 20 second period. Failure to meet this dwell time criteria will introduce delays and bottlenecks into the services and, in extreme cases result in the need to place more LRVs into service to maintain system schedules. Each additional LRV required to meet these constraints will add considerably to the cost and size of the LRV fleet with no service improvements to the travelling public.

Operational constraints that the system must be capable of dealing with require that a tram carries sufficient stored energy to cope with traffic delays, passenger emergencies, track blockages etc while maintaining full air conditioning load and providing sufficient power to maintain the safe operation of on board control and safety equipment throughout the time from when the tram first enters the wire free zone until it finally departs the wire free zone. This time would also have to encompass the waiting time the tram may have to incur whilst stationary at a terminus storage bay.

Should operational constraints due to a situation on the 'wired' section of the CSELR result in a significant delay to operations then any LRV within the wire free area will need to be able to have sufficient on-board energy to outlast the delay and, in a worst case scenario, also be able to tow a disabled (stored energy exhausted) LRV back to the wired zone.

In Section 5.2.6, p 5-63 under the heading Associated light rail infrastructure and services, the EIS states "*The energy demand for both wired and wire-free systems is similar*". This statement is just not true. It is another example of deficient technical expertise. In reality the addition of any additional electrical system equipment over and above the basic overhead supply system will generate additional energy demand, as well as introducing unnecessary 'peaking' into the supply authority's reticulation system.

It should also be noted that the 1997 EIS proposed 2 CBD substations while the 2013 EIS proposes 10 substations!

Given that in the Information Sessions to date covering issues raised above the mantra from TfNSW has been that these technical aspects will be left to "the market" the question arises "Is TfNSW capable of ensuring that the market delivers a practical outcome at a realistic price?"

Analysis of the feasibility of wireless LRV operation is available from credible, professional and knowledgeable sources, for example:

The historic City of Dublin and the steps taken by the Irish government to investigate the feasibility of joining two existing but separate CBD light rail lines by a line featuring wire free operation. The Irish government retained the services of a large European consultancy with demonstrated expertise in electric supply to transit systems to examine and advise on the wire free operation.

The consultancy's report and recommendations are available on the internet at

http://www.luascrosscity.ie/wp-content/uploads/2013/06/NA0004SystraReport.pdf

Page 27, paragraph 4.7 of the report provides Conclusions relating to the feasibility of wire free operation.

<u>Based on this report and its own in house expertise the Irish government has committed to providing full overhead supply to the third Dublin light rail line.</u>

But it must be admitted that Dublin knows how to design location sensitive overhead, as shown in the following photos.

Figure 3 – Dublin LRV passes historic Georgian Terraces in the City

Figure 4 – Dublin LRV crossing the River Liffey on the 1853 Bridge

With regards to historic city centres and LRV power supplies in recent light rail developments both Jerusalem and Edinburgh have adopted a similar approach to Dublin.

A further consideration is that selecting a wire free option from one manufacturer will lock the light rail system into a single proprietary technology forever. Once a charging station for a particular technology is included the system is locked out of buying trams from any manufacturer using an alternative technology. The opportunity for competitive bidding for the supply of additional vehicles at a later time is lost.

The 'proprietary technology' matter is an issue of major importance across all aspects of the CSELR and future light rail extensions for Sydney. As such it may involve cost penalties of $ Millions in the future

It should be noted that ‘overhead charging units’, that is the static infrastructure required to charge the on board unit, would be much more bulky than standard overhead supply infrastructure and would create a significant level of visual intrusion.

There is no evidence provided that a practical charging system which could meet the criteria “*If on-board power storage is used, this would be recharged while the LRV is at a stop*” is commercially available, or is even operationally feasible under the CSELR’s proposed operating regime.

“The (wire free) system would also recover the braking energy using a regenerative braking system”. Regenerative braking systems are used on most modern tramway/light rail systems where they depend on the overhead supply system to feed the energy back into the grid system. On board systems, in general, do not have this facility and also according to available literature have limitations as to the voltage at which they can operate which precludes effective system feedback even where feedback is possible. Overall the introduction of a wire free system will reduce the operational braking and potential energy recovery ability of the LRV.

A wire free section on a light rail system, no matter how short, introduces the need for all of the LRVs on the system to be fitted with appropriate ‘on board’ equipment involving a significant escalation in the initial cost of the LRVs. At all times the LRVs will be carrying a weight penalty coupled with reduced passenger space capacity. Both of these imposts will increase operating and maintenance costs, negative benefits which will last for the full operating life of the LRVs.

Safety issues associated with the safe containment of large amounts of stored energy in the event of an impact accident affecting the LRV would also need to be considered.

It also needs to be acknowledged that in Sydney overhead wires powering the trams ran along George Street from the early 1890s until 1960. The following historic photos provide excellent examples of how this was done.

Figure 5 – George Street c1901 at the Queen Victoria Building

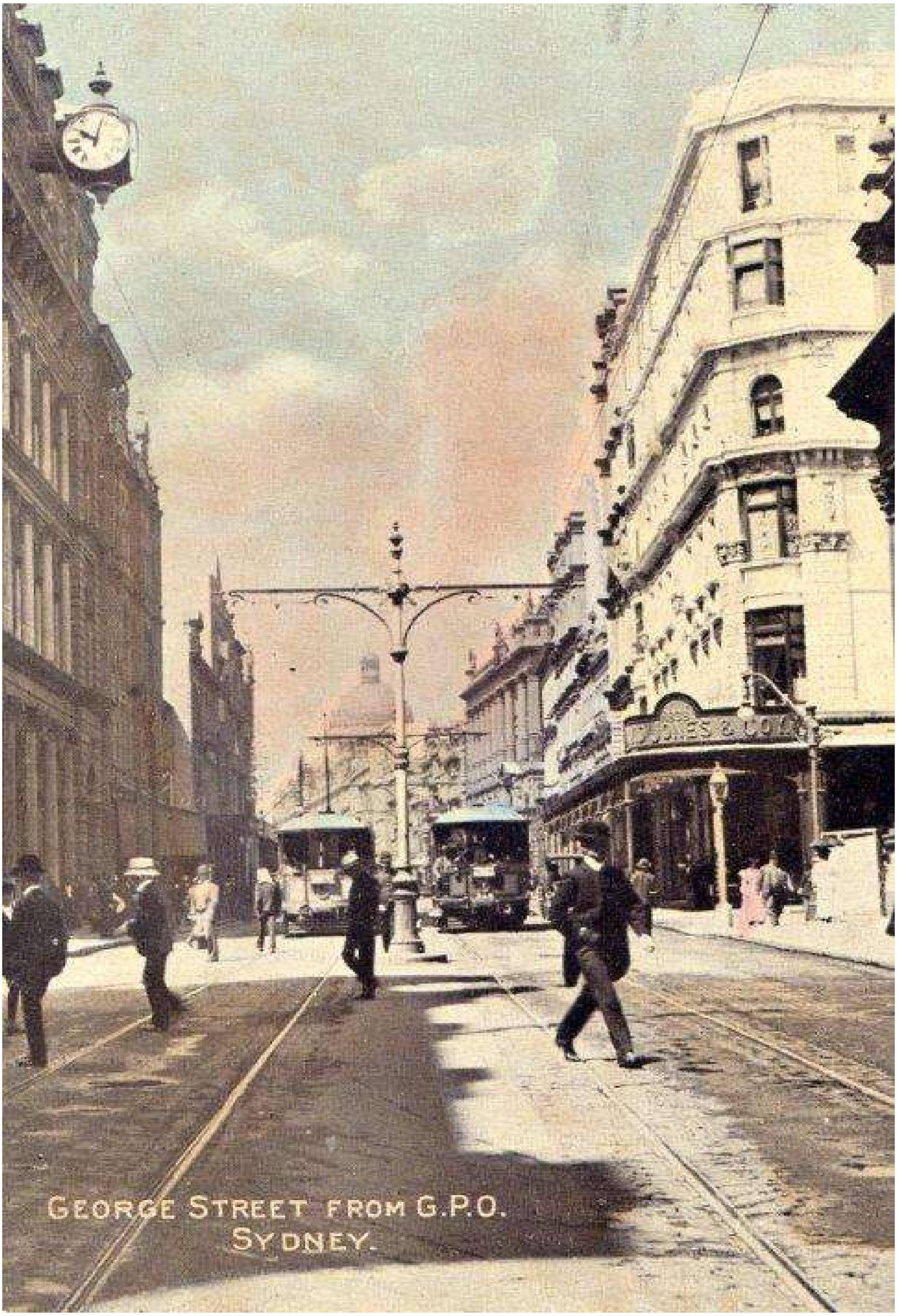


Figure 6 – George Street at Barrack Street c1905

Figure 7 - George Street c1909 at Martin Place
(note Centre Poles have been removed, much of the overhead is now supported directly off buildings to minimise the number of street poles)

Figure 8 - George Street near Hunter Street c1912

Further relevant commentary is contained in the August 2013 issue of "Today's Railways Europe" which, commenting on the current state of wire free technology, reports inter alia *"End of catenary still over the horizon .... still work to do"*.

There can be little doubt that given the current state of development of wire free technology attempting to implement any form of wire free operation on the CSELR would involve the NSW Government in financing ongoing development experiments.

This situation would also mean that the most critical operational section of the CSELR would also be the least reliable due to the current limitations of wire free technology. Even short term enforced downtimes would be operationally unacceptable. Any long term downtime would be a disaster.

Recommendation:

That, to ensure a proper operating environment and having regard for the technical deficiencies and operational limitations associated with current commercially available wire free LRV power supply systems, the initial construction of the CSELR be carried out with the provision of standard Over Head supply infrastructure throughout the CSELR system.

Melbourne

Without being aware of the background of the compilers of the EIS documentation the content of the EIS appears to indicate little if any attempt to seek to incorporate information or expertise or make constructive comparisons with the largest tramway operation in the English speaking world.

Melbourne is internationally known for being at the forefront of tram and light rail track design and construction expertise. There are numerous examples of Melbourne undertaking track extensions and rail replacement at rates 10 times faster than equivalent North American and UK light rail systems.

Track design in Melbourne features an understanding that light rail track does not have to be identical to heavy rail practice capable of carrying the equivalent of a Hunter Valley coal train (four locomotives hauling 60 or more 100 tonne load wagons) but rather that considerable cost savings can be achieved by designing to the low axle load required for a light rail system. A similar comment could be made concerning European design teams but it is notable that in the US and the UK many 'designers' take the costly and overbuilt approach of following heavy rail standards.

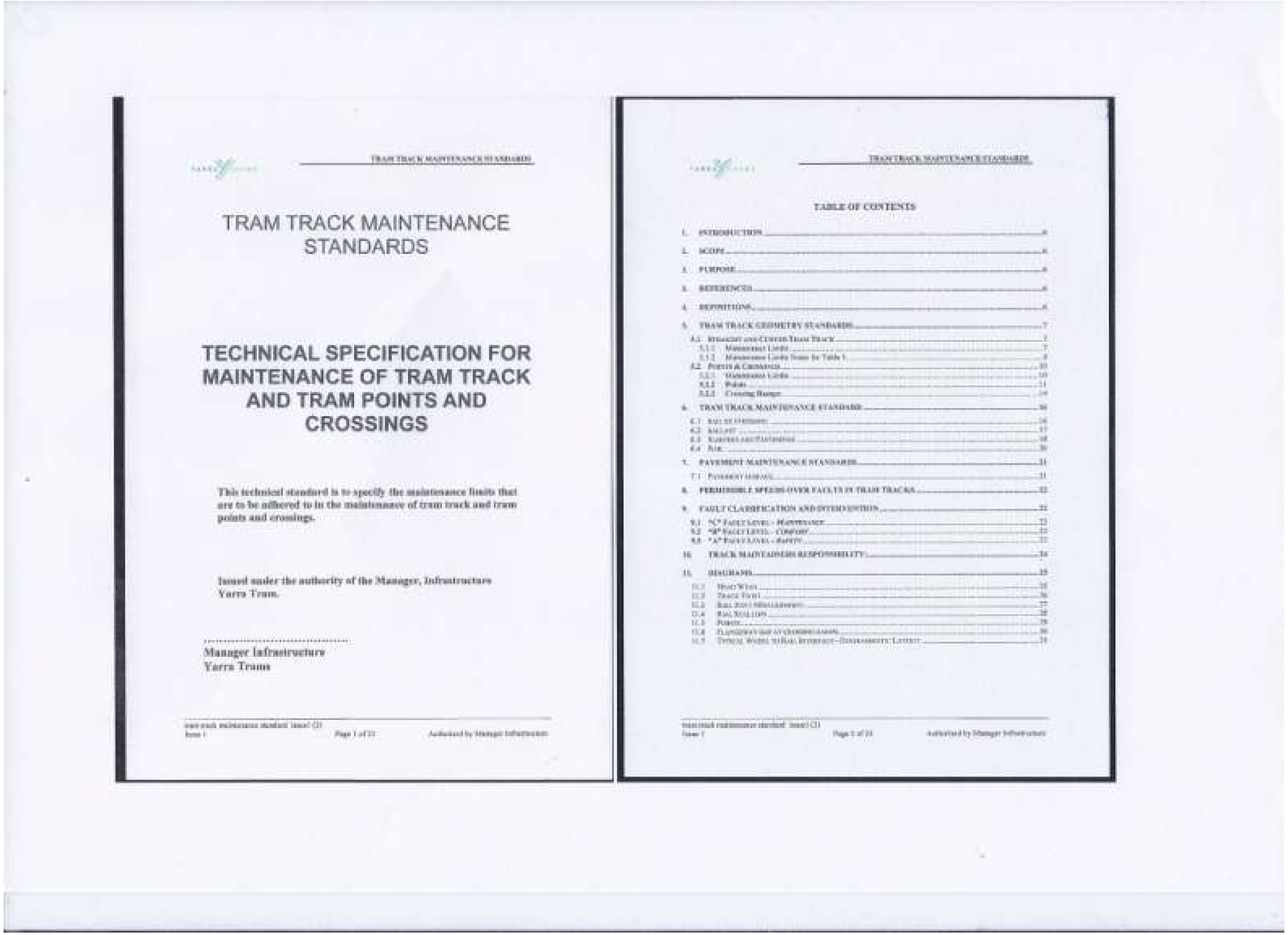
There appears to have been no attempt to establish a System Standard for Sydney based on the Systems Standards for Yarra Trams which would enable the development of an Australian Standard which would have considerable and ongoing benefits for Light Rail in Sydney.

It would appear that the EIS compliers would rather reinvent the wheel at great cost to the NSW taxpayer even though they could learn a lot from the practical and well experienced practitioners working for Yarra Trams.

A similar comment could be made with regard to NSW Tramway Standards where the work of Dr. John Bradfield, of Harbour Bridge renown, was a solid foundation for the planning of any tramway/light rail required for any properly developed and functional light rail system.

In Australia, the Melbourne operators (Yarra Trams) have the proven expertise to undertake the type of work outlined above. As an alternative European tram company related consultants would also possess the required expertise.

Examples of this essential documentation outlined above are provided on the following pages:



TRAM TRACK MAINTENANCE STANDARDS

TECHNICAL SPECIFICATION FOR MAINTENANCE OF TRAM TRACK AND TRAM POINTS AND CROSSINGS

This technical standard is to specify the maintenance limits that are to be adhered to in the maintenance of tram track and tram points and crossings.

Issued under the authority of the Manager, Infrastructure Yarra Trams.

....

Manager Infrastructure
Yarra Trams

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Figure 9 – Yarra Trams – Specification for Maintenance of Tram Tracks

Important and Highly Relevant Information is also readily available from the Internet to those with a real understanding of current light rail issues.

For examples DDA Tram Stops

The following comments are included in the EIS documentation:

Chapter 5 –World Square Stop

p5.28

World Square stop

The World Square stop would be located to the north of Liverpool Street servicing the cinema entertainment and retail precinct, the northern section of Chinatown, and the World Square complex of restaurants, commercial towers and residential apartments.

The World Square stop would consist of a single, approximately 4.4-metre wide, 45-metre long central island platform within the centre of George Street, approximately 20 metres to the north of the intersection of George Street and Liverpool Street. The existing pedestrian crossings of George Street at Liverpool Street and Central Street (to the north of the proposed stop) would be maintained as part of the design of the stop, to allow pedestrians to access the island platform.

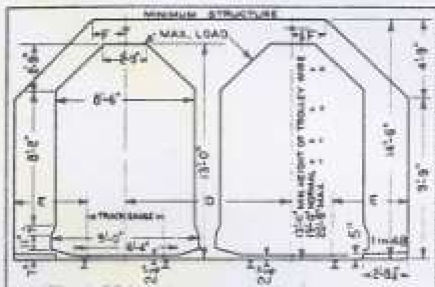
The existing street gradient means that street regrading would be necessary to accommodate a fully DDA compliant stop. The light rail tracks would be raised at the Liverpool Street and George Street intersection, to minimise the extent of cut into the existing road level. The island platform and tracks would be at an approximately 2.5 per cent gradient, would be cut into the existing road level up to approximately 330 millimetres, then tie back into existing street levels.

Northbound and southbound traffic lanes adjacent the stop would remain at their existing levels, and traffic barriers would be provided to maintain safe conditions for vehicles and pedestrians.

The compliers of the EIS should have been aware of the following (from the public record on the internet):

Client Design Requirements for Accessible Tram Stops
http://ptv.vic.gov.au/assets/PTV/PTV%20docs/Client%20Design%20Requirements/ClientDesignRequirements-TRAM-Dec2010.pdf

straight track and another on the curve leading to or from the branch track. Another typical example is where the minimum clearance, normally desirable from the side of a tramcar at footboard level, may be permitted, as in Sydney, for the whole depth of the car, when this occurs only momentarily, such as at the extreme corners or on the tapered ends of the car on curves, thereby obtaining increased length of car and, consequently, increased passenger accommodation. In Sydney many years ago the acceptance of this variation led to the use of 80-seat cars instead of 70 seat cars. These



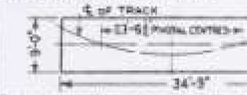
MIN. STRUCTURE GAUGE. No portion of any structure shall project within the limits of the min. structure outlined above under any circumstances, including wear & depression of rails, permanent way must clear the underside of the max. load gauge.
MAX. LOAD GAUGE. No portion of any rolling stock or load shall project beyond the max. load outline shown above & the overhang on curves must not exceed the max. permissible dimensions shown on the adjoining table.
Under any circumstances, including wheel & bearing wear, together with spring deflection no portion of a car shall be closer to rail level than 2½ plus the necessary amount to provide for vertical grade easement.
The exceptions to the above paragraph are the car wheels & when in operation, the trolley collecting gear.
In designing tramcar outlines all parts must be kept within both the volumes generated by two cases of solid figures symmetrically pivoted on the centre line of track 23'-6¾ apart, of the following dimensions viz:
CASE 1. A solid having a cross section similar to the max. load with a length of 34'-9" the vertical corners of the 9'-0" wide portion to be rounded to a radius of 4" as shown on the adjoining sketch.

CASE 2. A solid having a length of 35'-6" & a cross section similar to the max. load, with the exception that the area provided for the footboards is omitted as shown on the adjoining sketch.

No provision is to be made for relative movement of parts of car & track due to clearance or wear in determining lateral dimensions of rolling stock to conform to the load gauge. Provision of this nature must be made however with regard to vertical dimensions as stated on the min. structure-max. load diagram. In these cases spring deflection shall be assumed to be that due to crush load plus an allowance of 25% for oscillation, crush load being taken as 150% of the seating capacity for "O" & similar cross seat type cars & 280% for the "R" type car.

PERMANENT WAY					ROLLING STOCK	
RADIUS OF CURVE AT ℄ OF TRACK	DIMENSIONS			TRACK GAUGE FOR T. RAILS	MAX. PERMISSIBLE OVERHANG OF CAR ON CURVE FROM ℄ OF TRACK	
	D	E	F		OUTER SIDE OF CURVE	INNER SIDE OF CURVE
Straight	10'-0"	4'-6"	2'-0"	4'-8½"	4'-6"	4'-6"
12 Chains	"	"	"	4'-8[illegible]	"	"
8 "	10'-2"	4'-7"	2'-1"	"	4'-7"	4'-7"
7 "	10'-4"	4'-8"	2'-2"	"	4'-8"	4'-8"
6½ "	"	"	"	"	"	"
6 "	"	"	"	"	"	"
5½ "	10'-6"	4'-9"	2'-3"	"	"	4'-9"
5 "	"	"	"	"	"	"
4½ "	10'-9"	4'-10"	2'-4"	"	4'-9"	4'-10"
4 "	"	"	"	"	"	"
3½ "	10'-0"	4'-11"	2'-5"	"	4'-10"	4'-11"
198 Feet	"	"	"	"	"	"
180 "	"	"	"	"	-	"
165 "	"	"	"	"	"	"
150 "	11'-0"	5'-0"	2'-6"	"	4'-11"	5'-0"
132 "	11'-2"	5'-1"	2'-7"	"	5'-0"	5'-1"
120 "	"	"	"	4'-8[illegible]	"	"
110 "	11'-6"	5'-3"	2'-9"	"	5'-1"	5'-3"
100 "	"	"	"	4'-8[illegible]	"	"
90 "	11'-8"	5'-4"	2'-10"	4'-9"	5'-2"	5'-4"
85 "	11'-10"	5'-5"	2'-11"	4'-9[illegible]	5'-3"	5'-5"
80 "	"	"	"	"	"	"
75 "	12'-0"	5'-6"	3'-0"	4'-9[illegible]	5'-4"	5'-6"
70 "	"	"	"	"	"	"
66 "	12'-2"	5'-7"	3'-1"	4'-9[illegible]	5'-5"	5'-7"
60 "	12'-4"	5'-8"	3'-2"	4'-9½	5'-6"	5'-8"
55 "	12'-8"	5'-10"	3'-4"	4'-9[illegible]	5'-8"	5'-10"
50 "	12'-10"	5'-11"	3'-5"	4'-9[illegible]	5'-9"	5'-11"

MIN. STRUCTURE GAUGE. For the purpose of designing track layouts not covered by the limiting dimensions shown on the structure diagram, the maximum outline of a tramcar shall be assumed to be a rectangle 34'-9" long & 9'-0" wide symmetrically pivoted at two points on the track centre line 23'-6¾ apart, as shown on the sketch below.



Based upon this assumption the estimated minimum clearance between cars at junctions shall be not less than 7".

Fig. 1.—Minimum Structure—Maximum Load Diagram.

features cover the reasons for some of the explanatory notes given in Fig. 1. It may be found also that considerable advantage is obtained in the overall size of a tramcar by permitting the side of the car at the four outer corners and at the level of the roof fascia, to encroach beyond specified load gauge limits as the risks at that level are small. Other instances of encroachment may occur in connection with the location of tracks where it would be too costly to provide the specified minimum clearance from existing structures and some lower standard is acceptable at the location in question. All such encroachments should be subject to approval and recorded for general information.

Width of Car.—A desirable width or, in other words, the maxi-

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Figure 10 – Sydney Tramways – Structure Gauge

It is essential if a proper call for design and build of the CSELR is to issue that the basic standards be drawn up before bids are called. These standards MUST be set out by the responsible authority, that is TfNSW.

__Recommendations__:

That it be a condition of the approval of the CSELR that TfNSW be required to draw up and issue basic standards for the CSELR prior to the commencement of the design and construction phase. This would include, but be not limited to, kinematic envelope, structure clearances, minimum structure gauge, maximum load gauge, permanent way structure gauge, maximum system gradients and permitted track vertical and horizontal curvature radii. This information be placed on the public record prior to the letting of any design and construct contracts.

That a condition attached to the approval of the CSELR proposal be that track construction:

(i) is based on proven Melbourne techniques.
(ii) is based on cost effective, operationally practical light rail standards rather than Sydney Trains heavy rail practice.

Construction Disruption Minimisation and Time Review

The CSELR trackwork and associated infrastructure needs to be constructed with minimal disruption and as quickly as possible to provide for light rail operation as soon as possible. This is an area where Melbourne experts can advise on world's best practice and how to achieve it.
This expertise should be called upon, at least for advice, rather than trusting to inexperienced contractors and contract supervisors as was the unfortunate case with construction of the initial street running section of the SLR line. People familiar with that period will recall the inordinate time taken for the tracks to be laid across George Street at Hay Street and the less than ideal street surface resulting at this location

When the original EIS was issued in 1997 it was estimated that the construction period involved would be 21 months. The current EIS now has this period set at 6 years which, having regard to current similar new light rail projects both in Australia and overseas, appears excessive. Possibly this is due to the time estimate being based on heavy rail projects and their much more extensive excavations and network integration requirements.

There is always a need to minimise local disruptions in city and inner urban areas. An investigation into possible ways to reduce the construction period for the CSELR would therefore be prudent. It would be appropriate to seek the assistance of Melbourne expertise to assist with this investigation.

Videos illustrating the "Melbourne Approach" are readily available. For example:

Time lapse footage of the TRAMSformation of a stop in St Kilda Road to a new, accessible platform stop
http://www.youtube.com/watch?v=ETUNrl5R1oo

Spencer Street tram works time lapse footage - Five days of works in three minutes
http://www.youtube.com/watch?v=Wb27YbIjdqM

During Easter 2008, Yarra Trams completed a major upgrade of tram infrastructure at Melbourne's busiest intersection, Flinders and Swanston Streets
http://www.youtube.com/watch?v=_XL76BGhXN4

Recommendations:

That prior to commencement of construction a technical audit based on Melbourne expertise be carried out to ensure that methods and form of construction proposed will ensure minimum disruption throughout the construction period.

That prior to commencement of construction a technical review be undertaken based on Melbourne expertise to ensure that construction is carried out in the most expeditious and economical manner to achieve the shortest possible construction time.

Grass Track

The following comments are included in the EIS documentation:

Chapter 14 – Local impacts: Moore Park Precinct

p14-39 14.7.5

"Impacts during operation

The key visual impacts during operation of the CSELR within the Moore Park Precinct would generally include the proposed Moore Park stop, light rail infrastructure and tunnel portal design, including:

- *introduction of two light rail tunnel portals associated with the proposed tunnel under the Moore Park playing fields and Anzac Parade*
- *provision of a two level light rail stop and associated concourse for the Moore Park stop*
- *light rail tracks within the currently grassed areas adjacent to the existing busway and across the intersection of Lang Road*
- *overhead wiring along the length of the proposal route*
- *removal of a number of trees along Anzac Parade."*

And in:

Environmental Impact Assessment Noise and Vibration
Technical Paper 11 p51
5.9 Potentially Reasonable and Feasible Mitigation Options

"
- *Absorptive paving trackforms – at this stage, no examples of constructed embedded light rail tracks incorporating absorptive paving materials have been identified. It is normal for other vehicles to be able to drive over the embedded tracks meaning standard road surface paving materials are more common with embedded rail systems. Some porous concrete type sound absorptive products that can be driven on by maintenance vehicles are available for use in tunnels or on slab track, but as these would normally be installed on segregated rail lines the durability of the products is unknown for the purpose of use in a road context. Away from intersections in the affected area of Devonshire Street the requirement for other vehicles to drive on the light rail tracks would be minimal, so durability equivalent to standard paving may not be required. The feasibility of this option and the potential noise benefit would require more investigation during the detailed design stage.*
- *Vegetated trackforms – these are essentially a form of absorptive paving, that has been proven to be feasible in Europe but is not in common use elsewhere. Research indicates vegetated tracks are inherently quieter than paved track. The potential noise attenuation*

achieved would be dependent on regular upkeep of the vegetated track to maintain the absorptive surfaces during all seasons. Concerns on feasibility and reasonableness have been raised about high maintenance requirements, watering requirements in Australian conditions and the options for irrigation systems on sloping track along Devonshire Street. The feasibility of this option and the potential noise benefit would require more investigation during the detailed design stage."

Here again we have evidence of a lack of subject expertise.
Absorptive paving trackforms – at this stage, no examples of constructed embedded light rail tracks incorporating absorptive paving materials have been identified.

Melbourne has used varying means of embedded light rail construction including a finishing level of asphalt to improve noise attenuation.

Vegetated trackforms - Concerns on feasibility and reasonableness have been raised about high maintenance requirements, watering requirements in Australian conditions.

Grass track has been used in a significant proportion of new light rail systems in Europe, including countries such as Spain and Portugal, these countries as well as light rail systems on the Mediterranean Coast and in Israel have climatic conditions basically similar to those in Sydney. Indeed Barcelona's rainfall is 640mm per year, on an average of 55 days per year. Sydney by comparison is 1217mm of rain, on an average of 138 days per year.

It would be interesting to know the source of the *Concerns on feasibility and reasonableness.*

There is no doubt that grassed track would be the most appropriate trackform in the vicinity of the Centennial Parklands, Randwick Racecourse, Moore Park and similar CSELR traversed areas. Doubtlessly Centennial Parklands and other associated bodies would be able to provide advice on maintaining grass surfaces in Australian conditions.

The use of grassed track would also enable the current 'busways' (former exclusive tramway corridors) to be returned to their original non asphalted condition, thus giving a significant improvement to the visual impact of these corridors.

Recommendation:

That, to ensure maximum positive environmental benefits, it be a condition of approval that grassed trackform be the preferred application in the Centennial Parklands, Randwick Racecourse, Moore Park and similar CSELR traversed areas

Figure 11 – Grass track in Porto, Portugal as proposed for Moore Park/Centennial Park

Figure 12 – Grass track in Barcelona, Spain

Light Rail Vehicles - Specification

The following is an extract from the EIS documentation:
5.4.1
Light rail vehicles (LRVs)

"The new vehicles would be procured using proven 'off the shelf'-type rolling stock technologies. The rolling stock would be standard full, low-floor design LRVs with overhead traction power similar to the existing fleet. Each of the LRVs would also contain technology to allow them to operate without overhead wires in certain locations, such as the proposed wire-free zone between Hunter Street and Bathurst Street"

The key specifications identified for the proposed CSLER LRVs are summarised in Table 5.4.

***Table 5.4 Typical rolling stock specifications** p5-77*

ELEMENT	*SPECIFICATION*
Vehicle capacity (minimum)	*300 (approximately 80 seated and 220 standing passengers)*
Vehicle length	*45 metres (approximately)*
Design vehicle height	*Approximately 3.6 metres (excluding pantograph)*
Number of passenger decks	*Single*
Nominal height of floor above rail	*350 to 360 millimetres (approximately)*
Door configuration	*Six double doors and two single doors per side of the LRV Near level boarding any door – wheelchair access at nominated double doors*
Driver positions	*A driver cab at each end*
Door entry height	*300 millimetres (approximately)*
Vehicle width	*Approximately 2.7 metres (maximum)*
Maximum speed	*70 kilometres per hour*

Items worthy of note (can also be compared to the 1997 EIS below)

- No Dynamic Envelope specified – this is the essential dimension involved in track layout design.
- Number of Passenger Decks? Not applicable to light rail. A heavy rail issue.
- "Near level boarding any door – wheelchair access at nominated double doors" should be 100% low floor, boarding all doors.
- Door entry height is meaningless unless specified "above rails".
- No specification of minimum radius curve or track gauge, both essential dimensions in track layout and vehicle design.
- No specification for acceleration rate, a critical operational factor.
- The word approximately should NEVER appear in a specification

In all there would be a total fleet of 20 trams in operation, 13 in addition to the seven already in operation. The vehicles' critical specifications are as follows:

Length	29 metres
Dynamic envelope for tram (without mirrors) moving in a straight line including closed circuit TV	3.00 metres
Roof height	3.407 metres
Door entry height (above rails)	300 millimetres approximately
Weight (empty)	36,000 kilograms
Seating capacity	approx 70
Capacity (full load)	approx 200
Maximum speed	80 kilometres/hr
Minimum radius curve	20 metres
Track gauge	1.435 metres

Figure 13 - Rolling Stock Specification from 1997 EIS documentation

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Also from:

5.4.1 Light rail vehicles (LRVs)

"The new vehicles would be procured using proven 'off the shelf'-type rolling stock technologies. The rolling stock would be standard full, low-floor design LRVs with overhead traction power similar to the existing fleet. Each of the LRVs would also contain technology to allow them to operate without overhead wires in certain locations, such as the proposed wire-free zone between Hunter Street and Bathurst Street."

<u>Comment</u>

It is impossible to designate a "standard full low-floor design LRV" without being aware of the system operating criteria (track gauge, speed, acceleration, kinematic envelope, track curve radius, maximum operating grade, voltage level and supply limitations, etc).

The "traction power" associated with the current LRV fleet is a design that was introduced almost two decades ago. There have been significant advances made in power electronics and other features of traction power during this period. It is poor practice to suggest that suppliers should provide traction power systems similar to the existing fleet.

There is no 'standard' for the "technology" to enable operation without overhead wires.

Given those responsible for these comments are not in a position to detail the "technology" it follows that they cannot provide any capital cost factors nor operational or maintenance costs associated with this "technology" and its incorporation in the operational LRVs on the CSELR. It is extremely poor project management to introduce unknown cost issues into a specification, to do so risks high and unnecessary cost overruns and questionable reliability for no tangible benefit, especially if the "technology" supplier ensures that they have a development cost clause in the contract. Further comment relating to "Wire Free Operation" can be found on page 16 of this submission.

Overall it is a matter of concern that it appears that the procurement of the light rail vehicles for the CSELR will not be overseen by an "Informed Buyer" whose prime responsibility is to ensure that cost to the taxpayer is minimised.

Recommendation

That TfNSW be required to ensure that government expenditure is minimised by the appointment of a nominated "Informed Buyer" to oversight the selection and procurement of the Light Rail Vehicles. The person charged with this responsibility should be required to demonstrate <u>extensive light rail technical experience</u> relating to vehicle procurement.

Overhead Wiring

The following is an extract from the EIS documentation:
p 5-63

"Associated light rail infrastructure and services

Overhead wiring

The OHW structure types would depend on specific site characteristics along the length of the CSELR proposal. Within the constrained CBD streetscape, the OHW structure types would be predominantly cross span wire attachments from side poles. Typically, it is not proposed to affix OHW fixtures to existing structures along the route of the CSELR proposal.

Overhead wire-free operation between Circular Quay and Town Hall stops

Overhead wire-free operation would be provided between the Circular Quay stop and the Town Hall stop, negating the need for overhead wires and poles for the power supply between these stops. This would provide for an improved public domain in the George Street pedestrian zone between Hunter Street and Bathurst Street.

Overhead charging units for part of the length of the 45-metre platforms would be necessary to charge any on-board LRV power storage at each stop within the wire-free zone

If on-board power storage is used, this would be recharged while the LRV is at a stop. The system would also recover the braking energy using a regenerative braking system. The detailed design of the system would not preclude the addition of further lengths of wire-free operation should improved technology permit this in the future"

Comment

There are a number of issues identified in the 1997 EIS documentation that have a bearing on the CSELR overhead considerations.

1997 EIS p50 – "the overhead would be suspended either from the side of buildings, or from poles. They may be integrated with street lighting in some cases, in order to minimise footpath clutter and visual intrusion."

1997 EIS p164 – (Mitigation Measures for Urban Design in the CBD) – "Overhead wire supports should be attached to buildings where possible to minimise street clutter.

Support poles, where used are to be integrated with light poles wherever practical."

1997 EIS p207 – (Impacts on CBD heritage items) –

"*Significant actual or potential impacts are*
- *Visual intrusion and clutter created by introduction of additional pole supports;*

Some relatively minor impacts include:
- *Visual intrusion created by the Light Rail wirescape;*
- *Alterations to facades of heritage items by the addition of attachments to provide support points for wires."*

From the point of view of aesthetics, practicality and cost there can be little doubt that the authors of the 1997 EIS got it right.

The current EIS view "*Typically, it is not proposed to affix OHW fixtures to existing structures along the route of the CSELR proposal*" represents heavy rail thinking which introduces additional and unnecessary capital costs, and results in avoidable visual intrusion.

This effect can be seen in the current Inner West extension where the use of additional poles rather than attachments to the rock face in cuttings has resulted in additional costs which could be estimated to be well above $100,000.

Figure 14 – View of current Inner West Extension west of Lilyfield showing Overhead Support Poles in the Rock Cutting

Figure 15 – Close up of Unnecessary Heavy Rail Style Overhead Pole in Cutting where Direct Attachment of an Overhead Support Crosswire to the Cutting Walls would have been simpler, more elegant and cheaper.

The European approach to direct attachment to affix OHW fixtures to existing structures along the route is illustrated in the following pictures:

Figure 16 – Dijon Attachment Detail

Figure 17 – Dijon View of Supporting Building and Streetscape

Figure 18 - Dublin

Figure 19 - Dublin

Figure 20 - Nice

Figure 21 - Berne

Figure 22 - Bremen

Figure 23 - Bremen

Figure 24 - Brussels

Figure 25 - Milan

Figure 26 - Paris

Figure 27 - Zurich

The foregoing represent a cross section of European cities but there are many more where the approach of direct attachment to affix OHW fixtures to existing structures is commonplace.

Unfortunately in America and the United Kingdom there appears to be a considerable shortage of good light rail overhead design expertise and inappropriate heavy rail practice appears to continue to often be the norm. It is essential that the heavy rail overengineering of light rail overhead support structures and associated contact wiring be avoided in the CSELR construction.

The need for improved Over Head Design was recognised in the early 1990s in the US (refer http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_07-a.pdf)- the report covers both light rail and trolleybus overhead systems) but even this document appears not to have generated the desired improvement in Over Head Design where the US continues to lag well behind European countries. The following image is from the TRB Report.

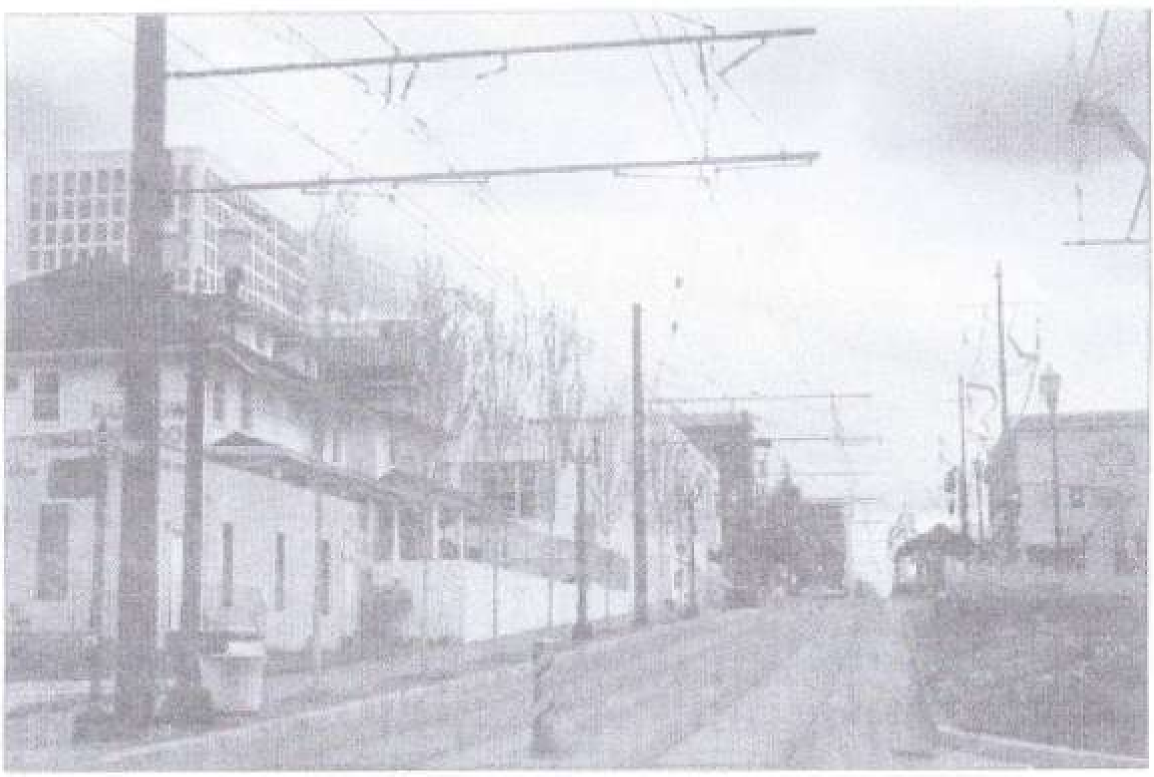

Figure 2-7. Intrusive catenary—Portland. A cluttered streetscape is produced by the use of (1) double-deck mast arms and catenary in an area where direct suspension is appropriate and (2) an excessive number of poles.

Figure 28 – Showing Poor OH Practice in Portland

In appropriate locations the use of single centre pole overhead supports should also be considered. The centre pole option would work well in a pedestrianised street and echo heritage as well. Examples of heritage support poles can be seen in Figures X and X and replication of these poles in suitable locations along George Street would enhance the city streetscape.

In sections of George St which retain motor traffic, attachment of overhead to existing buildings would be much safer and cheaper than purpose-specific poles.

Recommendations

That to ensure maximum environmental benefits with respect to appearance and safety a condition attached to the approval of the CSELR proposal be that the Over Head supply be single contact wire and that the more aesthetically acceptable European style of Overhead Design be adopted as the CSELR System Standard. The proposal not to affix OHW fixtures to existing structures along the route of the CSELR proposal should be rejected.

That, where practical and appropriate, centre poles be used for overhead support. Consideration should be given to replicating the original 1890s design in locations where this would be appropriate for the streetscape.

Estimated Cost of CSELR – Are we getting Value for Money

The estimated cost of the CSELR has been quoted at $ 1.6 Billion.

There are recent Australian and Overseas light rail infrastructure costs which need to be considered in relation to the CSELR Estimated Costs.

Melbourne tram extensions since 2003

2/5/2003 Mont Albert to Box Hill 2.2km – cost $28m = $12.7m/km.
In today's dollars, approximately $17.1m/km.
Involved very extensive road widening and reconstruction and a great deal of services relocation.

4/1/2005 Docklands Drive extension 0.95km long – cost $7.5m = $7.8/km.
In today's dollars, approx.$10.1m/km

23/7/2005 East Burwood to Vermont South 3.0km long – cost $30.5m = $10.2m/km.
In today's dollars, approx. $13.3m/km.

(There have been several extensions since 2005 but cost figures are not available.)

Recent Adelaide tram extensions:

The City West extension in the central CBD opened in October 2007 1.6km long – cost $31m or $19.4m/km.

The Entertainment Centre extension opened in March 2010 – 2.8km long – reputed cost $100m which cannot be verified.
If so, this would equate to $35.7m/km which could be correct as the project included almost total reconstruction and widening of Port Road over some 2.5km of the route's length.

Perth (**Heavy Rail Line**)

The Perth to Mandurah passenger line, opened in 2007, length 72 km, cost $1.66 billion or $23m/km.

Overseas

(From a paper presented to a light rail conference in Salt Lake City in November 2012):

The average of eleven recent French systems is US$29m/km, range $20.4 to $51.2m/km.

The average of seven recent US systems is US$35m/km, range $28.6 to $43.5m/km.

Sydney's CSELR proposal is about 12 km in length with an Estimated Cost of $1.6 billion – that is approximately $133m/km. If the cost of 26 LRVs at, say, $7 million each is deducted, the infrastructure cost is approximately $1.4 billion, or around $117m/km.

This infrastructure cost of $117m/km is *seven times as much* per kilometre as Melbourne's most expensive tram extension of recent years, and *more than double* the cost per kilometre of the most expensive recent projects in either the USA or France.

This could amount to the world's most expensive tram/LRV line by a large margin.

A question must be addressed – Has proper consideration been given to achieving the "lightness" of light rail – a combination of flexibility, low impact, modest cost" (refer p10 of this submission)?

Based on the comparative costs outlined above the answer would appear to be in the negative.

There is an obvious need to have the project costs controlled and construction standards reviewed by persons with a suitable level of light rail expertise prior to the commencement of construction and on an ongoing basis throughout the design and construct period. This is essential to protect the Government's and taxpayers' interest for the overall project.

To achieve this objective it would be necessary to ensure that independent consultants with demonstrated light rail expertise and proven technical experience, that is not financial or accounting based, be engaged to oversee and maintain value for money oversight of the CSELR project delivery.

Almost without exception this would require the engagement of overseas consultants with strong links to a light rail operating entity. This should be a crucial item in the consultant engagement process. These consultants to have no links to the consultants who have worked on the current EIS process nor to the consultants who may in the future be involved in the design and construction contracts for the CSELR.

Recommendation:

That Independent consultants, with demonstrated core light rail expertise and proven technical experience, be engaged to oversee and maintain value for money oversight of

the CSELR project delivery. Given the crucial role to be played by these consultants they should be required to demonstrate, prior to engagement, extensive light rail expertise and experience in multiple engagements of this nature.

Turnbacks, Surge Capacity and Capacity Limitations

The following comments are included in the EIS documentation:

Chapter 5 – Proposal infrastructure and operations

p5-1 5.1

- a highly reliable service with the capability to carry up to 9,000 passengers per hour in each direction

p5-13 5.2.1

Crossovers and turnouts

The CSELR proposal would provide a series of turnout points (a junction point where an LRV could change between two routes) and crossover points (a track crossing point that would enable an LRV to cross between two parallel tracks) along the length of the route. The layout of the proposed crossovers and turnouts would be finalised during the detailed design to provide sufficient light rail operations.

.p5-83 to 88 5.4.12

Event management

Table 5.9 lists the different types of special events operation scenarios envisaged for the CSELR proposal.

Table 5.9 Special events operation scenarios

(snip)

Special events at Moore Park

Special event operations for the Moore Park Precinct cover operations at both the start and end of each event. The movement of passengers to the event typically happen over several hours and would be able to be catered for by normal operations supplemented by special event operation shuttles as needed. The most intensive part of the special event would be passengers returning to the Central Station stop in the one hour following the end of an event. In advance of each special event 90-metre LRVs (i.e. two combined 45-metre LRVs) would be positioned on the system for quick deployment as needed. Locations for this staging would include:

- *Moore Park Precinct turnback*
- *Eddy Avenue turnback*
- *Randwick stabling facility.*

Special event LRVs would operate at approximately five minute intervals between LRVs in conjunction with a five minute regular service from Kingsford or Randwick.

Special events at Royal Randwick racecourse

In addition to race day events, large music festivals are staged at Royal Randwick racecourse on an occasional basis (once or twice a year). To cater for the potential events at Royal Randwick racecourse, the CSELR proposal has been designed to allow for the shuttling of passengers between the Central Station and Royal Randwick racecourse stops with track turnbacks at both Royal Randwick racecourse and Eddy Avenue.

Operation of special event LRVs for Royal Randwick racecourse events would occur at a frequency of approximately every five minutes in conjunction with a 10 minute regular service from Randwick and approximately five minute headways from Royal Randwick racecourse to the connecting point with the Kingsford branch. The Kingsford branch would continue to operate at 10 minute regular service.

5-86
There would be slight delays to regular services to and from Kingsford and Randwick of approximately one minute to achieve special event operations.

Special events on George Street north of Town Hall
Each year there are a number of special events that either require George Street to be fully closed or require George Street to be used as a major traffic and transport event by-pass (i.e. traffic is diverted onto George Street, or part of George Street, due to other road closers within the CBD).

These events and their current impact on George Street are described in Table 5.10.As a governing principle, the CSELR proposal would operate on the maximum part of the route possible during such events outside of the area of impact of the proposed event. This may be achieved through the strategic placement of track crossovers or turnouts enabling shortened services to be provided.

Table 5.10 CBD special events

(snip)

5-87
It is assumed that a majority of these special events would involve the closure of George Street somewhere to the north of Town Hall stop. As a result the proposed CSELR operations would seek to maximise normal services by running LRVs as far as Town Hall and turning back at this stop. Therefore, during special events within the CBD affecting George Street, no light rail operations would occur between the Town Hall and Circular Quay stops.

Further consideration of the management of these events, and the implications for the CSLER proposal, would be undertaken during detailed design and consultation with stakeholders.

5.4.13 - Disruptions to CSELR services and incident management

During operation of the proposal, unforseen incidents may disrupt CSELR services, preventing parts of the CSELR network from being operated. Such incidents could include:

- *road traffic accidents (including a collision between an LRV and motor vehicle or pedestrian)*
- *major fault or failure of an LRV, requiring police attendance to divert traffic until the disabled LRV has been recovered*
- *fire onboard an LRV*
- *infrastructure faults (e.g. track, overhead wires and signals)*
- *derailment of an LRV vehicle*
- *overhead power supply failure*
- *unruly or ill passenger(s).*

Preliminary operational contingency measures that would be implemented in the event of such incidents occurring on the CSELR network are outlined in Appendix J of this EIS. These contingency measures would be further refined and developed by the Operator, in consultation with all relevant stakeholders (including the Transport Management Centre).

Typically, incidents requiring the recovery of a disabled or damaged LRV from the network could involve the following:

-

Transfer of the disabled/damaged LRV to a suitable temporary storage location (e.g. Circular Quay, Eddy Avenue turnback, Kingsford stop turnback) for later recovery. During such events, the LRV service following the disabled/damaged LRV would be used to push or tow the disabled LRV to the temporary stabling location. This approach could be preferable during peak times on the network.

•

Recovery of the disabled/damaged LRV and directly returning it to the stabling facility for further attention. During such events, the disabled/damaged LRV would be pushed or towed to the stabling facility using another LRV or a dedicated road tow vehicle so that disruptions to other services are minimised. Situations where this approach may be required include derailment, seized wheel or fire onboard the LRV.

Recovery of a damaged/disabled LRV from the road network (e.g. from George Street) is anticipated to be a relatively simple operation due to the presence of level paved areas around the CSELR tracks that would allow ready access by a tow vehicle (truck). However, recovery from such an area would require police attendance to manage road traffic around the scene and, if the LRV is not located at a stop, the safe disembarking of passengers.

5-88
Recovery of a damaged/disabled LRV from areas away from the road network would not necessarily require police attendance due to the lack of nearby road traffic.

Where an unforseen incident prevents part of the CSELR from being operated, shortened services would be provided where possible (dependent upon the location and nature of the incident). If an incident causes an extended interruption to normal operations it may be desirable/necessary to implement shuttle services whereby LRVs continue to operate a truncated service either side of the incident site within the constraints of the available crossover locations.

The lack of firm information relating to the provision of the necessary infrastructure to minimise and limit disruptions to services contained in the EIS documentation as quoted above and elsewhere in the available literature is indicative of significant shortcomings in the operational planning of the CSELR at this juncture. At the very least it should be expected that the location of turnbacks throughout the system should have already been finalised, together with the definition of the service restrictions and adverse effects on potential passengers on the CSELR.

Maximising reliability is the key to a project like this and accidents do happen on city streets. For this reasons crossovers between Eddy Ave and Circular Quay are essential, to enable services to turn back in the event of an accident. Accidents are an inevitable part of tram operations in city streets, and it's important to design the infrastructure in a way which minimises their impact and allows services to continue efficiently.

To suggest that *"The layout of the proposed crossovers and turnouts would be finalised during the detailed design to provide sufficient light rail operations*." is indicative of a failure to plan the CSELR as an operating entity with the necessary flexibility to maximise system performance under operating conditions even when untoward and often unexpected adverse conditions occur.

An implicit acceptance that curtailment of the operation of the light rail service between Town Hall and Circular Quay should be a regular occurrence is unacceptable. This operational scenario would be unacceptable in Melbourne and indeed was no part of the operation of the Sydney Tramway system. It would require the operation of tram replacement buses during the shutdown and, given the realignment and pedestrianisation of

George Street, these buses would be incapable of providing an effective temporary replacement service.

Effective operation of a reliable light rail service demands that there be surge capacity available were reserve LRVs can be temporarily held to enable them to be quickly put in to service when passenger demand peaks. An example of this demand would be a capacity audience departing the Town Hall.

Major termini, such as Circular Quay, Central Railway, Randwick and Kingsford, will also require layover tracks where defective vehicles can be temporarily stabled, out of sequence vehicles can be reprogrammed and vehicles coupled and uncoupled. These locations would also need to be supplied with adequate staff amenities.

The current Circular Quay stop appears to be based on the heavy rail layout one would expect to see at Werris Creek for the overnight stabling of one or two country passenger trains. It is essentially unworkable for the demand levels associated with the proposed LRV frequencies of the CSELR.

The Circular Quay stop must be capable, as a minimum, of providing the same flexibility of operational arrangements as exist at the Melbourne University Terminus in Swanston Street, Melbourne.

Figure 29 - Melbourne University Stop

Similarly, the Randwick and Kensington stops require the ability to provide short term LRV storage to meet passenger demand surges at UNSW and cope with shift changes at the POW hospital complex.

At Central Railway the existing Inner West light rail service stop requires the installation of a passing loop on the Colonnade (as was the case on the original tram route) to provide operational flexibility.

Recommendations:

That to ensure minimum adverse environmental effects due to system operating disruptions a condition attached to the approval of the CSELR proposal be that appropriate turn back facilities be provided in the CBD and at suitable locations on the suburban legs of the CSELR to minimise the time and extent of LRV service shutdowns.

That to ensure minimum adverse environmental effects due to system operating disruptions a condition attached to the approval of the CSELR proposal be that to ensure adequate surge capacity on the system layovers be provided on level ground at Circular Quay and the suburban termini and that a passing (holding) loop be provided at the existing (Inner West) Railway Colonnade Tram Stop.

It is disappointing to note that the layout of the proposed trackwork/holding area at the Randwick Racecourse stabling area does not provide the full operational flexibility one would expect to be present at a crucial location in the CSELR network.

As currently proposed this layout provides a single point of entry/return from the stabling area to the CSELR. If an operating arrangement similar to the layout at this location in the Sydney tramway days was put in place LRVs entering and leaving service or being held over could separately access both the Kingsford and Randwick system legs affording maximum flexibility, reducing LRV dead running and provide alternative options in times of service disruption.

This can be achieved at minimum cost and without requiring additional land encroachment by the simple restoration of the former link from the Racecourse via Ascot Street to Anzac Parade.

Recommendation:

That to ensure minimum adverse environmental effects due to system operating disruptions a condition be applied to the approved EIS that in addition to the Alison

Road track connection to the Randwick Racecourse stabling area, a double track link be provided from the Racecourse stabling area via Ascot Street to connect with the Anzac Parade trackage.

Architectural Treatment of Depot and Service Buildings

All too often in modern light rail systems the system designers pay slight regard to the architectural treatment of Depot and Service Buildings. The result is, even in inner areas within a particular and sensitive environment, out of character "agricultural sheds" are inflicted on the area. This is an issue common to most of the English speaking countries.

The French however have addressed this issue with considerable success in cities such as Nice, Lyon and Orleans.

In order to maintain a appropriate standard for the built environment of the CSELR it is essential that Depot and Service Buildings be dealt with a sensitivity reflecting the "French Approach".

Figure 30 – Maintenance Area Nice Tram Depot

Figure 31 – Lyon Tram Depot

Recommendation:

That, in approving the EIS in order to ensure an appropriate built environment for Depot and Service Buildings a condition be that Depot and Service Buildings be dealt with a sensitivity reflecting the "French Approach".

Capacity of the Junction at Anzac Parade and Alison Road

The junction of Anzac Parade, Dacey Avenue and Alison Road was a significant congestion point in the days of the Sydney tramway system when there was a large passenger demand relating to the staging of special sporting events at the multiple venues in the area.

Today the area is marked by significant motor vehicle congestion in business peak hours, as well as when special events occur. It is an intersection famous for its frequent motor vehicle accidents.

Given the Government's stated objective of increasing the use of public transport by attendees at special events and also for general peak hour travel it will be necessary for close attention to be paid to both motor traffic and light rail traffic through this critical intersection. As it stands the current busy intersection represents a potential major source of delays and unreliability for both the light rail system and the road network.

The opportunity should be taken as part of the CSELR project to incorporate a road rebuilding project at this junction to ensure the separation of light rail and general traffic by grade separation. In conjunction with this work it would be appropriate for a grade separated light rail junction to be provided, so outbound Kingsford light rail vehicles could pass under inbound light rail vehicles from Randwick

Such an arrangement exists at St. Kilda Road Junction in Melbourne but perhaps the most relevant example of a grade separated light rail junction exists on the International Award Winning Light Rail System in Porto, Portugal.

Figure 32 – Porto grade separated light rail junction

<u>Recommendation</u>:

That, in order to ensure maximum positive environmental outcomes for light rail vehicles and road traffic moving through the Anzac Parade Alison Road junction, it be a requirement that the junction be grade separated.