City of Stirling
City of Choice

Trackless Tram Trial

2024

Prepared by :

City of Stirling

Acknowledgement of Country

Ngalak kaadatj Nyoongar nedingar wer birdiya, baalap barn boodja-k wer kaaratj boodja-k koora koora wer yeyi.
Ngalak kaadatj baalabang malayin wer nakolak baalap yang ngalany-al City of Stirling dandjoo Nyoongar moort-al kolbang koorliny.
City of Stirling kaadatj Nyoongar moort Nyoongar boodja-k Wadjak boodja-k, Mooro boodja-k.

The City of Stirling acknowledges the Wadjak people of the Nyoongar nation as the traditional custodians of Mooro country. We pay our respects to Aboriginal and Torres Strait Islander Elders past and present, for they hold the memories, the traditions, the culture and the hopes for Aboriginal Australia.

The City is committed to forging stronger relationships and a deeper respect for Aboriginal and Torres Strait Islander Australians. By acknowledging and respecting the diversity and history of our Aboriginal and Torres Strait Islander community, we will continue to realise our vision for reconciliation.

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Introduction

Over the past ten years the City of Stirling has been working on one of the largest urban regeneration projects in Australia to drive change in the Scarborough Beach Road Activity Corridor. The aim is to create a vibrant urban centre with increased housing, additional jobs, and better connectivity for our community. Aligning with our vision of a sustainable City with a local focus, this project will link the Perth CBD, Stirling City Centre, and Scarborough Beach by implementing a Trackless Tram system.

The Scarborough Beach Road Activity Corridor extends 7km from Glendalough Station to Scarborough Beach. The City of Stirling's planning framework for the Scarborough Beach Road Activity Corridor is in place, developed in partnership with the Department of Planning, Lands and Heritage, on behalf of the Western Australian Planning Commission (WAPC). This Framework provides an overarching transport and land use vision that, when implemented over time, will significantly improve the form and function of the road and its surrounds.

In 2021, the City of Stirling received $2 million from the Australian Federal Government to conduct a business case to examine the feasibility of introducing a Trackless Tram system. Results from independent and comprehensive research identified that the implementation of a Trackless Tram system would trigger a nationally significant revitalisation of the Scarborough Beach Road Activity Corridor, delivering the following transformational and sustainable benefits for the City of Stirling:

- Catalyse private sector investment in land use that will deliver increased housing and employment opportunities;
- Increase visitation, improve amenity, and stimulate economic development along the corridor;
- Improve public transport usage and reduce traffic and travel across the network – delivering reduced accidents and emissions;
- Support improved liveability and environmental outcomes through reduced urban sprawl and car dependence.

Central to mid-tier transport planning is addressing the needs of the communities that these transport modes will connect. Throughout the business case development, the City of Stirling has led collaboration with technical experts, government representatives, business stakeholders, and the local community.

The City of Stirling adopted an innovative approach to community engagement by conducting a Trackless Tram Trial (Trial) in November 2023. Together with its partners Infrastructure Technology Solutions Group (ITSG), CRRC, Shanghai Electric and Curtin University, the Trial provided the opportunity to showcase this mode of transit and improve awareness of the project. Bringing together industry experts permitted a comprehensive vehicle study and an understanding of community interest in response to the Trackless Tram.

The following report outlines the high-level outcomes of the Trackless Tram Trial.

The Change Imperative

The City of Stirling is the largest local government by population in Western Australia with over 243,000 residents. Over the next 30 years, the local population is expected to grow by up to 50%.

Over the last decade, the City of Stirling has been working on one of the largest urban regeneration projects in Australia, to ensure that the Scarborough Beach Road Activity Corridor can accommodate the predicted population growth and transform into a vibrant urban centre.

As one of the major transport corridors in Perth, the Scarborough Beach Road Activity Corridor experiences high traffic volumes, particularly during peak hours. Further traffic congestion and parking challenges are experienced at Scarborough Beach, the City's premier tourist precinct.

The overwhelming majority of trips (88%) within this area made by private cars (67% car drivers, 21% car passengers) due to the generous provision of road space for private vehicles, the lack of reliable and efficient public transport and the availability of free long-term parking. If current trends continue, car dependency will worsen, resulting in increased traffic congestion and a deterioration in amenity.

The State Government and the City of Stirling have identified that the Scarborough Beach Road Corridor is critical to achieving the required infill and population targets, outlined in the *Perth and Peel @ 3.5 million* land use planning framework.

Planning for the urban regeneration area is centred on a long-term vision for light rail within a mid-tier transit system. The City of Stirling has developed preliminary business cases for light rail, however recent technology in Trackless Trams has emerged as a suitable alternative.

Failing to address recognised issues will compromise the liveability and economic viability of the Scarborough Beach Road Activity Corridor. This will pose cascading challenges in achieving balanced growth, functionality, and sustainability of the wider Perth metropolitan area. To identify a solution, the City of Stirling is developing a business case to assess the feasibility of implementing a mid-tier transport system in the area.

The Western Australian Government is delivering Perth's largest public transport project, Metronet. Planning is focused on complementing and connecting the heavy rail network to the broader community, by integrating mid-tier transit solutions.

Mid-tier transit encompasses light rail, trackless trams, and bus rapid transit, offering greater reliability and efficiency than current buses, better value for money, and quicker implementation compared to heavy rail. Mid-tier transport plays a crucial role by linking railway stations, activity centres and housing, enhancing connectivity and transport options for local communities. Several Australian Cities, including Adelaide with trams and Sydney, Canberra, and the Gold Coast with light rail, have already successfully adopted mid-tier transit.

The City's role

The City of Stirling's 10-year Strategic Community Plan, *Sustainable Stirling 2022-2032,* sets out an ambitious and achievable vision to be a sustainable City with a local focus. To ensure that we connect our community through sustainable and integrated transport systems, the City's role is to advocate for improved public transport options, enhancing activity and reducing reliance on vehicle use.

Under the Public Transport Authority Act 2003, the Public Transport Authority is responsible for the operation of public transport in Western Australia. As key stakeholders, the Public Transport Authority, the Department of Transport and Main Roads have been engaged throughout the development of the Trackless Tram Business Case and the associated Trial.

To advocate for improved public transport in the Scarborough Beach Road Activity Corridor, the City has developed a Trackless Tram Business Case and conducted a Trackless Tram Trial, funded by the Australia Federal Government.

Trackless Tram Trial

Trackless Trams are relatively unknown in Australia, so the City conducted extensive research to inform its business case and better understand this innovative transport technology. The findings indicate that Trackless Trams can support the vision for the Scarborough Beach Road Activity Corridor. To further explore this technology, the City of Stirling adopted a unique approach, involving the community in the learning process.

Together with project partners, Curtin University, CRRC, Shanghai Electric and ITSG, the City of Stirling conducted an Australian first Trackless Tram Trial in November 2023. For the Trial, a trackless tram was shipped over 7,000 km from Shanghai, China. Upon arrival, it underwent three weeks of extensive configuration and testing at the City's Administration Centre prior to the commencement of the Trial.

To ensure safety and avoid road closures, the City conducted the Trial in its Administration Centre car park. A map of the Trackless Tram route is found below. A digital rail track with more than 400 sensors was installed in the road surface to guide the tram through the route and a replica station was constructed to ensure safe entry on and off the tram.

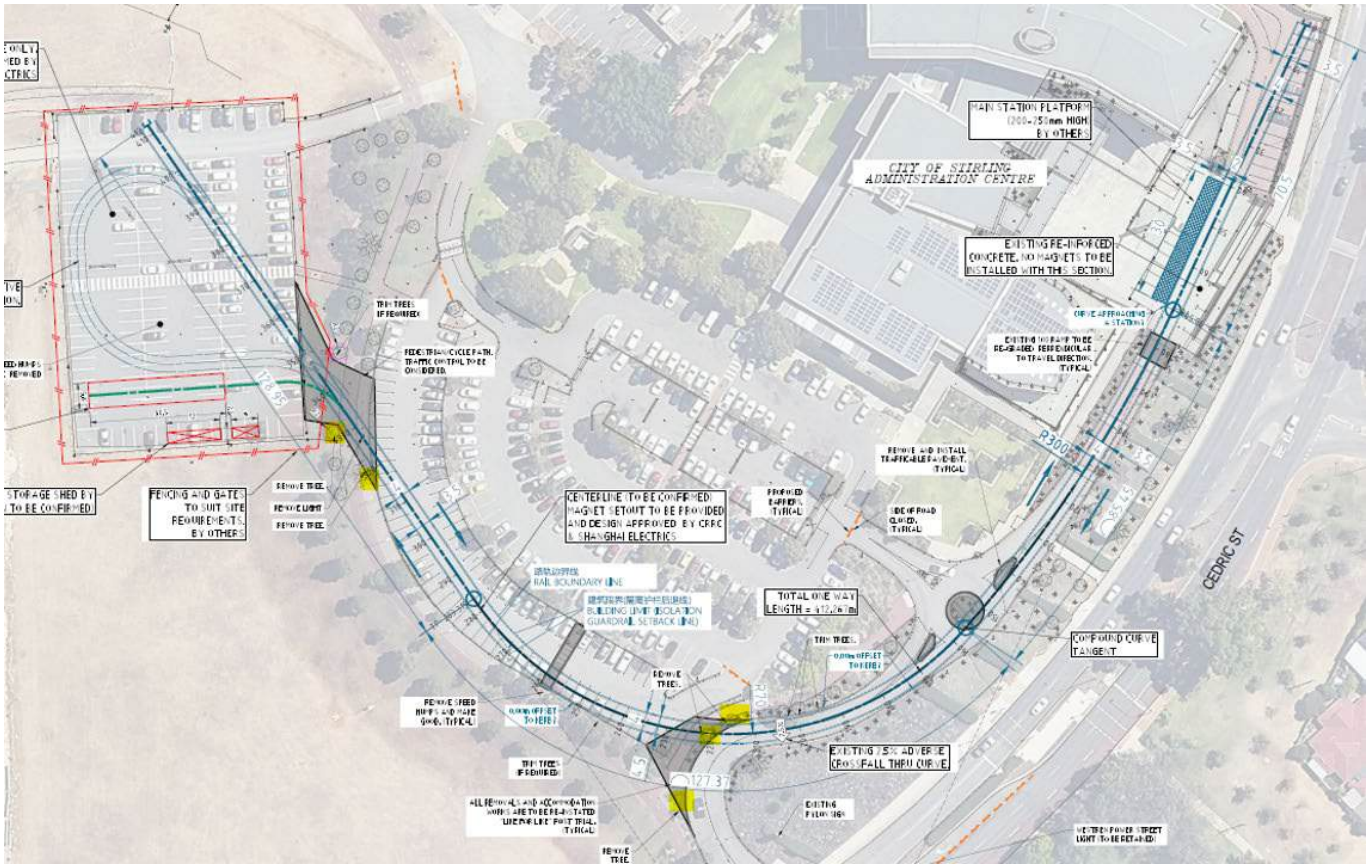

Figure 1 – Trackless Tram Route

The City collaborated with UON and Electrobase, Western Australian sustainable energy companies, who were instrumental in powering Australia's first trackless tram with renewable solar energy. This was crucial in demonstrating that the Trackless Tram could operate entirely off-grid, qualifying it as a true net zero emission vehicle.

Two events were held in conjunction with the Trackless Tram Trial. A Net Zero Transit Symposium held on 21 and 22 November at the Rendezvous Hotel, Scarborough brought together national and international experts to discuss the latest in mid-tier net zero transit options and provided the opportunity for attendees to view the Trackless Tram in action.

A Trackless Tram Community Showcase on 26 November enabled residents and visitors of the City of Stirling to jump on board the Trackless Tram and be involved in the Trial. The event was a major success with more than 1,200 people attending providing overwhelmingly positive feedback.

In addition to the positive community and industry sector response, the Trackless Tram Trial received significant media coverage with a cumulative potential audience reach of approximately 1,222,959 people. The advertising space rate (free media cost to the City) is estimated at $119,815.

The ripple effect of this endeavour is reshaping urban transit discussions across Australia. Recognition for the City of Stirling's role in delivering the Trackless Tram Trial is ongoing with the Mayor, Mark Irwin invited to speak at various conferences, at a state and national level. In July this year, the City of Stirling received the 2024 National Award for Local Government in the 'Productivity through Infrastructure' category for the Trackless Tram Trial.

This ground-breaking trial provided valuable insights into the potential benefits of implementing this innovative transport solution, enabling the City of Stirling community to play an integral role in the project and providing strong support to advance it.

Vehicle testing

A trackless tram, also known as Digital Rail Rapid Transit (DRT), incorporates advanced technologies that combines the benefits of traditional trams and buses. Trackless trams are a high-capacity public transport vehicle with rubber wheels, and instead of using tracks on the road, autonomous digital guidance systems allow the vehicle to align with stations accurately and delivers smoother ride quality than buses. Trackless trams are an emission free vehicle, making them compatible with the Australian Federal Government's goal of achieving net zero emissions by 2050 and the City's vision of being a sustainable city with a local focus.

The Trackless Tram vehicle testing program that occurred prior to and during the Trial in November 2023 enabled technical experts and researchers understand:

- Charging capacity/battery performance
- Sensor reliability
- Obstacle detection
- Communications
- Manoeuvrability/turning circles
- User experience.

Comprehensive field testing of the Trial vehicle against the Australian Design Rules (ADR), Disability Standards for Accessible Public Transport (DSAPT) and Performance Based Standards (PBS) was conducted by Tiger Spider on behalf of the City's partner, ITSG.

The objective of field testing was to assess whether the Trackless Tram complies with all applicable ADRs, DSAPT requirements and PBS Level 1 requirements. These requirements cover the basic vehicle layout as well as low-speed and high-speed driving performance.

A copy of the summarised report can be found in **Appendix 1**. The findings in this report have been provided to the National Vehicle Heavy Regulator to progress vehicle certification.

Following the extensive testing during the Trackless Tram Trial, the City of Stirling has received 'In-Principle' approval by Main Roads Western Australia to conduct an on-road trial of a Trackless Tram on Scarborough Beach Road. This trial, subject to several conditions, offers a unique opportunity to evaluate the technology in a real-world setting before implementing this public transport solution.

Net Zero Transit Symposium

The Net Zero Transit Symposium held on 21 and 22 November delivered insights from industry experts on how advancements in transport technology are paving the way towards achieving net zero emissions. Participants were able to delve into the potential of these innovations to stimulate economic development, enhance connectivity, and rejuvenate our communities.

With its focus on sustainability and cutting-edge transit solutions attendees heard from speakers across Australia to highlight how sustainable mid-tier transit can positively influence the built environment, creating transport corridors that connect activity hubs and local neighbourhoods, and foster a stronger sense of community.

The program included:

- The latest mid-tier transit technologies, including vehicles, guidance systems, communications, and pavements.
- The potential of Trackless Trams as a new class of vehicle to provide Net Zero Corridors.
- Deployments, trials, and certification processes globally.
- The critical role of community and developer involvement in mid-tier enabled placemaking and net zero urbanism.
- Evaluation of the latest generation Trackless Tram at the City of Stirling.
- Case studies into the Caufield-Rowville Link in Melbourne and Sunshine Coast, some early proposals from Philadelphia, Bulawayo, and Accra, plus a range of other Australian local governments.
- Understand steps undertaken in State and Federal governments in Australia and internationally.
- Success and challenges of implementing mid-tier transit in other cities.
- Certification experts TigerSpider, Arup, ARRB, Stantec and other industry/developer experts.

Community Showcase

Throughout the business case process, the City has actively engaged with technical experts, government representatives and local businesses. To build a compelling case for change, the City of Stirling took a bold and innovative approach by involving the community in the journey. Aiming to foster local understanding of the project and ensure best-practice engagement, the City held a Trackless Tram Community Showcase on November 26, 2023.

Typically, trials of modern technologies are conducted in controlled environments by experts, with minimal public involvement. However, the City of Stirling took a unique approach and placed the community at the heart of its decision-making process, setting a new standard for public sector initiatives.

The City of Stirling recognised that the success of the Trackless Tram Trial relied on strong community support and involvement, making community members key stakeholders in the project. This was achieved through transparent communication, regular updates, and opportunities for community input and feedback via a series of strategic actions designed to engage the public at every stage.

The Community Showcase was pivotal in this regard, providing a platform for residents and visitors to engage with the project and voice their opinions. This direct engagement was crucial in gathering authentic feedback and fostering a sense of ownership among the community members.

The Trackless Tram Community Showcase held on 26 November 2023 was a highlight of the Trial and a major success. More than 1,300 people attended the events and the feedback was overwhelmingly positive with the following feedback collected on the day:

- **94%** said the ride quality was good to excellent.
- **98%** liked the look of the Trackless Tram.
- **92%** liked the accessibility of the Tram.
- **73%** said it was better than a bus.
- **82%** thought it was a good idea to implement the Tram down Scarborough Beach Road.
- **64%** said they would take the Tram instead of driving to Scarborough Beach.
- **71%** said it was likely or very likely that it would increase their use of public transport.

Appendix 1
Tiger Spider - 2024 Field Testing Report

DRT 2024 Field Testing Report

Summary of DRT vehicle ADR and PBS Field Testing in July and August 2024

Prepared for
Infrastructure Technology Solutions Group (ITSG)
Sydney, Australia

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Issue 1

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Version Control

Issue	Date	Author(s)	Change Description
1	12 September 2024	Marcus Coleman, Brendan Coleman, Cas Kent, Shawn Ye	First issue

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Marcus Coleman

Managing Director

Dated: 12 September 2024

1. Introduction

This report summarises field testing of the CRRC DRT vehicle against the Australian Design Rules (ADR), Disability Standards for Accessible Public Transport (DSAPT) and Performance Based Standards (PBS) conducted by Tiger Spider for Infrastructure Technology Solutions Group (ITSG).

The DRT is a 30.5 m long, bi-articulated, 8-axle Trackless Tram. The DRT is bi-directional with driver's compartments in units MC1 and MC2, refer Figure 1-1.

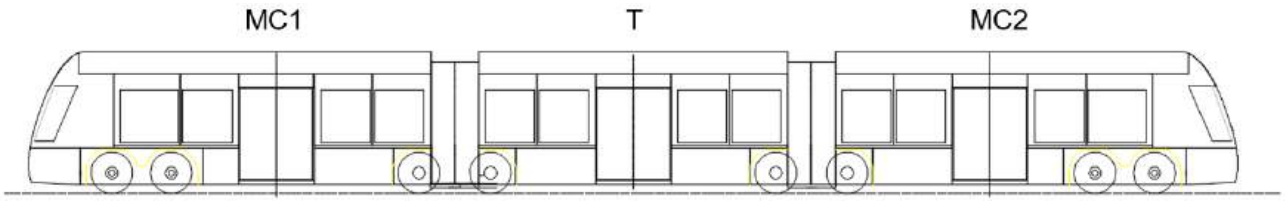

Figure 1-1 DRT vehicle units

Field testing was carried out from Thursday 25th July to Tuesday 6th August 2024 at the National Automobile Quality Supervision and Test Center (NAST), Xiangyang, Hubei, China.

2. Objectives

The objective of the field testing was to assess whether the DRT complies with all applicable ADRs, DSAPT requirements and PBS Level 1 requirements. These requirements cover the basic vehicle layout as well as low-speed and high-speed driving performance.

3. Results

The DRT was tested against all applicable ADRs, DSAPT requirements and PBS metrics, refer Table 3-1. Additional crabbing tests were also conducted.

Table 3-1 Field testing results

Standard	Test	Performance Measures	Results
ADR 3/04 Seats and Seat Anchorages	Seat anchorage test	Strength of seat anchorage	Driver's seat anchorage withstood the specified forward and reverse loads without showing signs of failure.
ADR 14/03 Devices for Indirect Vision	Rear vision cameras – Class II devices	Field of View	Some field of view areas not visible with Hikvision cameras fitted.
			Entire field of view visible with RongSheng cameras fitted.
ADR 18/03 Instrumentation	Dashboard Speed Accuracy Test	Speed Displayed on Dashboard	True speed lies within allowable limits at 40 km/h, 48 km/h and 56 km/h as displayed on dashboard.
ADR 35/07 Commercial Vehicle Brake Systems	Service Brake Effectiveness Tests	Deceleration	Deceleration meets specified limits with service brakes fully functional, both unladen and laden.
	Secondary Brake Tests	Deceleration with EBCU off or Electric Brake off	Deceleration meets specified limits with brake control unit failures in each carriage, both unladen and laden.
	Brake Partial Failure Tests	Deceleration with ABS off or Air Bag not working	Deceleration meets specified limits with anti-lock brake system failures in each carriage, and with brake proportioning failure, both unladen and laden.

	Service Brake Fade Test	Successive Deceleration	Brakes were applied 18 times rather than the prescribed 20 times due to battery capacity limits. Deceleration meets required limits and all brake applications were completed within the time limit.
	Service Brake Fade Effectiveness Check	Deceleration after Brake Fade	Deceleration meets required limits immediately after 18 successive brake applications.
	Park Brake Test	Maximum Grade using Park Brakes	The DRT was loaded to 60,700 kg and remained stationary in both directions on a 16.6% slope with park brakes applied.
	Brake Timing Test	Brake Delay at Boosters	All brake lines reach the required pressure within the specified 600 ms time limit.
	Brake Failure Warning Indication Checks	Warning signals on dashboard	All required brake system failure warnings were visible on the dashboard during secondary brake tests and partial failure tests.
ADR 44/02 Specific Purpose Vehicle Requirements ADR 58/00 Omnibuses Designed for Hire and Reward	Emergency Exits Check	Compliance of Emergency Exits	The DRT is partially compliant with ADR 44/02 and ADR 58/00. Emergency windows must be fitted and labelled. Footrests must be installed below emergency windows. Interior and exterior manual unlocking switches must be fitted to each service door. Passenger stop signal buttons must be fitted.
ADR 65/00 Maximum Road Speed Limiting	Maximum Speed Test	Speed Displayed on Dashboard True Maximum Speed	The DRT complies with ADR 65/00 requirements for maximum road speed limiting. The maximum true speed of the DRT is 60 km/h, with a speed of 66 km/h indicated on the dashboard.
ADR 80/04 Emission Control for Heavy Vehicles	Label Check	Compliance of Labels	The DRT must be fitted with a label indicating it is a Battery Electric Vehicle (BEV). These labels are not currently fitted.
ADR 83/00 External Noise	Compressed Air Noise Test	Noise Releasing Air Compressors	The DRT complies with ADR 83/00 noise requirements for vehicles in motion and compressed air noise.
ADR 90/00 Steering System	Exit 50 m Radius Turn	Vibration	The DRT complies with all ADR 90/00 requirements for steering systems. However, the DRT production vehicles must be limited to 25 km/h maximum speed on turns radii less than 50 m turn.
	Release Steering at Half Lock	Self-Centring	
	Steering Effort	Steering Effort	
PBS	Low Speed Turn	Low-Speed Swept Path (LSSP) Frontal Swing (FS) Tail Swing (TS)	The DRT meets PBS Level 1 Low-Speed Swept Path and Frontal Swing requirements but may not meet Tail Swing requirements. Further Low Speed Turn simulations are required to assess Steer-Tyre Friction Demand and Pavement Horizontal Loading performance.
	Straight Line	Tracking Ability on a Straight Path (TASP)	The DRT meets PBS Level 1 Tracking Ability on a Straight Path requirements in simulation.
	Lane Change	High-Speed Transient Offtracking (HSTO) Rearward Amplification (RA)	The DRT meets PBS Rearward Amplification requirements.
			The DRT meets PBS High-Speed Transient Offtracking requirements in simulation.
	Pulse Input	Yaw Damping Coefficient (YDC)	The DRT meets PBS Yaw Damping Coefficient requirements.

DSAPT	Visual checks	Compliance with DSAPT clauses	The DRT is partially compliant with DSAPT requirements. A second wheelchair space must be installed. Priority seating must be designated. Boarding ramps need to be installed if the DRT floor is not level with the platform or there is a gap more than 40 mm between the DRT and the platform. If boarding ramps are installed, call buttons must be installed to allow passengers to request a ramp. Interior stairs are currently too high and too deep and must be converted to two stairs. Some handrails must be moved further from adjacent walls.
N/A	Entering / Exiting Platform	Distance from Platform Alignment of Vehicle	The DRT successfully drove in a straight line in crabbing mode. Future tests will be needed for entering and exiting platforms in crabbing mode.

4. Conclusion

The DRT meets all applicable ADR requirements in terms of driving performance. However, due to the unique nature of the DRT and turning circle limitations, there are some partial non-compliances which will need to be negotiated with the relevant regulators.

Minor changes to the DRT layout are required to meet all ADR 44/02, ADR 58/00, ADR 80/04 and DSAPT requirements, as outlined in Table 3-1.

The DRT meets all PBS Level 1 requirements that were physically tested, except for Tail Swing which meets Level 4 requirements. Further Low Speed Turn simulations are required to assess Pavement Horizontal Loading since it could not be measured physically.

Once the DRT stations have been constructed, field testing will be needed for entering and exiting the platforms in crabbing mode.

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