OTTAWA LIGHT RAIL TRANSIT PROJECT

Track Assurance Report 1 – Tunney's Pasture to Tunnel Portal West

Prepared by:	Ben Venables, System Assurance Engineer – Track and Accessibility	
Reviewed by:	John Blowfield RAMS Team Lead	
Approved by:	Mary McGrath, Systems Assurance Lead	
Authorized by:	Derek Wynne, Systems Engineering and Systems Assurance Lead	
	Name, Title	Signature
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REVISION HISTORY

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1.0 BACKGROUND

Rideau Transit Group (RTG) was awarded the Concessionaire Contract to design, build, finance and maintain the Ottawa Light Rail Transit System (The Confederation Line).

The Confederation Line project involves design and construction of 12.5km of Guideway including:

- 2,5 km tunnel through the downtown core,
- 13 stations, including 4 underground stations;
- Vehicles maintenance and storage facility.

Associated works include installation of system wide power, communications and rails.
The project alignment is shown in Figure 1.

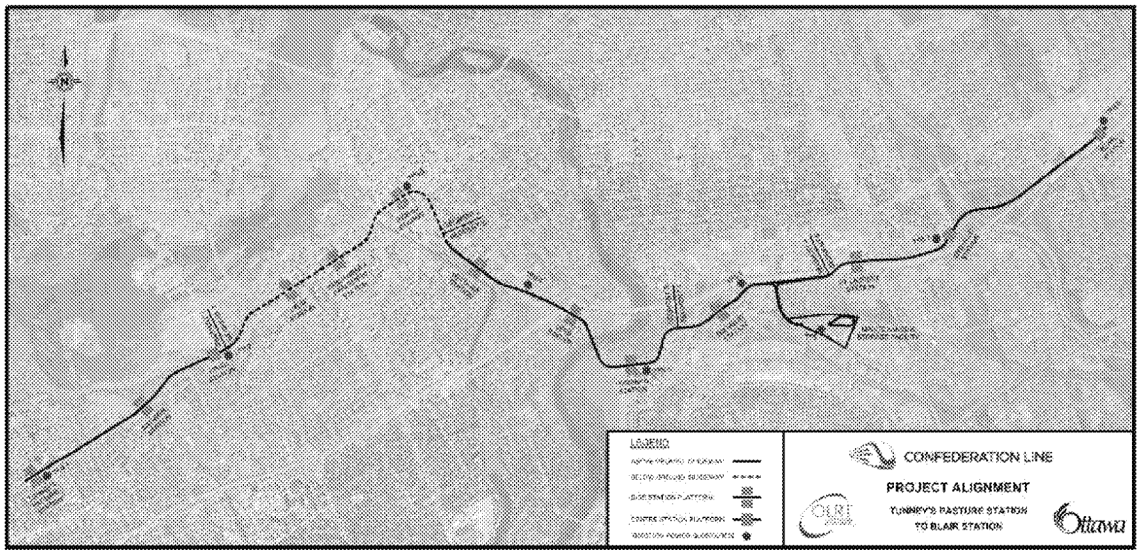


Figure 1: Project alignment

Rideau Transit Group assigned the Design-Build portion of the Contract to OLRT Constructors (OLRT-C) who in turn sub-contracted design work on key elements to the Rideau Transit Group Engineering Joint Venture (RTGEJV).

The division of responsibility between OLRT-C and RTGEJV is detailed in a Service Agreement, dated 2013 March 15.

Responsibility for safety certification of the Confederation Line project rests with OLRT-C; however, the Project Agreement identifies the standard on which certification shall be based which imposes implicit requirements on the design process which require to be satisfied by RTGEJV.

2.0 PURPOSE AND SCOPE

The purpose of this report is to document the track asset site validation activities undertaken as part of the OLRT system assurance works carried out by SEMP Ltd.

The scope of this specific report is the track to west of the main tunnel system. The limits of this report are defined as:

East bound Line: 98km 065.000m (end of line at Tunney's Pasture) to 100km 414.187m (mouth of tunnel)

West bound line: 98km 065.000m (end of line at Tunney's Pasture) to 100km 412.261m (mouth of tunnel)

The site inspections, undertaken on 29th September 2018, were focused on:

- Assuring that the Project Agreement core track "Requirements" had been met;
- The build quality of the track system;
- Identification of works that need to be addressed prior to passenger operations being introduced;
- Identification of works that need to be addressed during the initial 3 months of passenger operations, by the Maintainer.

This report needs to be read in conjunction with Track assurance reports 2 (Ref OLR-22-0-0000-REP-0002) and 3 (Ref OLR-22-0-0000-REP-0004).

3.0 REQUIREMENTS

Track requirements were defined in the Project Agreement, schedule 15-2, part 2. These have been collated and are listed in Appendix A of this report.

There is potentially one non-compliance identified. This relates to the maximum gap that would occur under broken rail conditions. The PA requirement states max of 50mm, but the designer report [Ref.03] declares that 55mm would be the maximum. This would only occur under the most extremely lowest ever recorded temperature of -38°c. This non-compliance will need to be accepted by RTG.

4.0 REFERENCES

4.1 LEGISLATION AND STANDARDS CONTROL

The following hierarchy of legislation and track standards are applied and form the base-line of control:

1) The Project Agreement, Schedule 15-2, Part 2 Design and Construction Requirements – Guideway
2) AREMA Manual for Railway Engineering
3) Transit Cooperative Research Program – TCRP Report 57: Track design handbook for Light Rail Transit

4.2 OLRT DESIGN DOCUMENTATION AND REPORTS

The following documents have been used as reference material to aid the site inspection activities:

Item	Title	Reference	Version
Ref.01	Design Brief Trackwork	RES-22-0-0000-DBC-0003	0.0
Ref.02	Design Brief Vehicle/Platform Relationship	RES-22-0-0000-DBC-0006	0.0
Ref.03	Design Brief Rail Break Analysis	RES-22-0-0000-DBC-0007	B
Ref.04	Design Brief Vehicle Clearance Analysis	RES-22-0-0000-DBC-0103	1.0
Ref.05	Track Alignment and Geometric Design	RES-22-0-0000-DCI-0001	0.0
Ref.06	East Bound trackwork chart 98+065 to 98+500	RES-22-1-0000-DRD-1001	2.0
Ref.07	East Bound trackwork chart 98+500 to 99+100	RES-22-1-0000-DRD-1002	3.0
Ref.08	East Bound trackwork chart 99+100 to 99+700	RES-22-1-0000-DRD-1003	2.0
Ref.09	East Bound trackwork chart 99+700 to 100+300	RES-22-1-0000-DRD-1004	4.0
Ref.10	East Bound trackwork chart 100+300 to 100+900	RES-22-2-0000-DRD-1005	3.0
Ref.11	West Bound trackwork chart 98+065 to 98+500	RES-22-1-0000-DRD-1101	2.0
Ref.12	West Bound trackwork chart 98+500 to 99+100	RES-22-1-0000-DRD-1102	3.0
Ref.13	West Bound trackwork chart 99+100 to 99+700	RES-22-1-0000-DRD-1103	2.0
Ref.14	West Bound trackwork chart 99+700 to 100+300	RES-22-1-0000-DRD-1104	4.0

Ref.15	West Bound trackwork chart 100+300 to 100+900	RES-22-2-0000-DRD-1105	3.0
Ref.16	Switch Heaters Test Report – Zone 1	OLR-16-8-0000-SAT-1R1007	0.0
Ref.17	Rail Arrestor	RES-22-0-0000-DRD-4009	2.0
Ref.18	London Trackwork Inc – Installation and Maintenance Manual – supply of Buffer Stops to OLRT	No reference (email from K.Vokey, dated 27/09/18)	

5.0 TECHNICAL REVIEW

This report has approached the track asset system by evaluating the key headings of the Project Agreement. This is to align the reading of this report against the PA content.

5.1 HORIZONTAL ALIGNMENT

The horizontal alignment has been installed to a high visual quality.

As there are no specific datum reference makers to undertake actual dimensional checks, the assessor has taken a pragmatic approach and assessed by looking for the visual integration of the design elements.

The assessor notes the following:

All platforms have straight "tangent" alignments that aid the level accessibility into the trams;

The alignment across the ballast to slab and slab to ballast transitions are robust, and do not present any ride quality concerns. This includes the entry and exit into the main tunnel system;

Transitions from tangent track into regular curves are smooth;

The track centres are in tolerance to design [Ref.06 to Ref.15]. Sample checking during the inspection has not identified any concerns.

Photo no.1 (left): West bound track, looking facing traffic, from Bay View towards Pimisi

Photo no. 2 (right): East bound track, looking with traffic, at the end of the plinth system (98km 752m) towards Bay View.

The assessor does note that there is no marking of track geometry details on site, and therefore it has not been practicable to fully validate the exact length of transitions or curves and the application of design cant (superelevation) and cant deficiency (unbalanced superelevation) values.

5.2 VERTICAL ALIGNMENT

The horizontal alignment has been installed to a high visual quality.

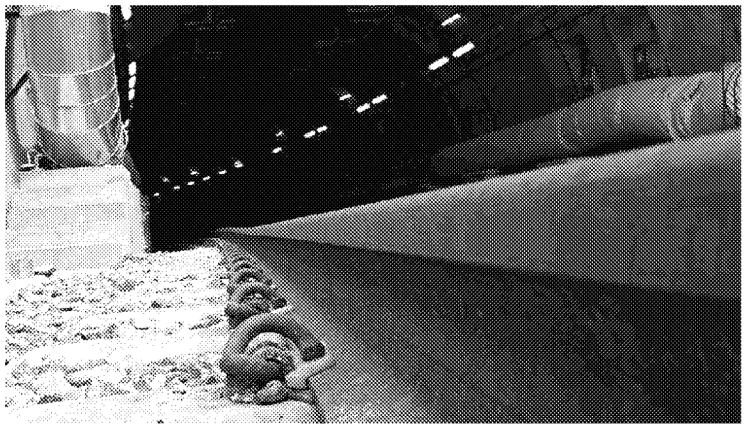
As there are no specific datum reference makers to undertake actual dimensional checks to the design [Ref.06 to Ref.15], the assessor has taken a pragmatic approach and assessed by looking for the visual integration of the design elements.

The assessor notes the following:

All transitions from gradient track to curved, via vertical curves are smooth;

The vertical alignment through the platforms is within PA requirement limits, and is not detrimental to safe accessibility onto the trams;

The alignment across ballast to slab and slab to ballast transitions are robust, except for the westbound exit from the main tunnel. This exhibits loss of design on both rails of approximately 5mm, as seen in photos 3 and 4 below:



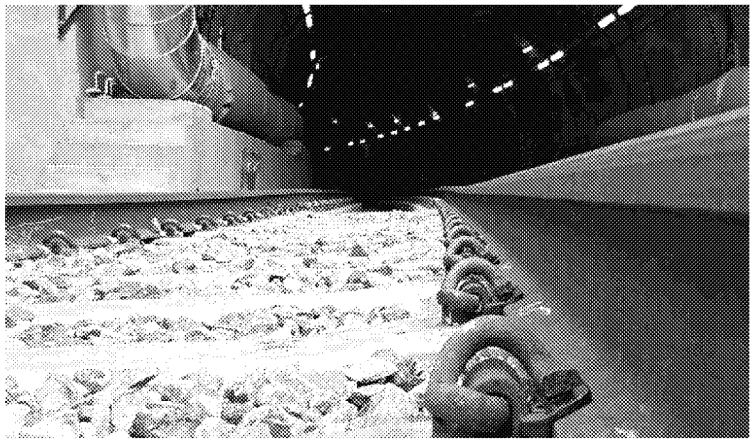


Photo no. 3 (top): westbound low rail looking towards the tunnel mouth at 100km 408m

Photo no. 4 (bottom): westbound high rail looking towards the tunnel mouth at 100km 408m

Both photos are taken facing towards traffic direction.

The assessor recommends that remedial action is taken to reinstate the design prior to the opening to passenger operations. All other ballast/slab transitions are robust, and do not present any ride quality concerns.

5.3 SPECIAL TRACKWORK

There is only one area of special trackwork within the limits of this report. These are 301 – 304 points scissors crossover at Tunney's Pasture station. The whole group are installed on slab track form.

The assessor notes the following:

Horizontal and vertical alignment of the special trackwork is tangent and to one constant gradient;

The special trackwork is installed to a high quality and does not provide any ride quality concerns;

The location at Tunney's Pasture is 26m clear of the platform limits, and complies with the PA requirements;

The location is more than 50m from the nearest slab/ballast transitions, which complies with the guidance from TCRP Report 57;

All check rails, restraint blocks and drive mechanisms are installed.

Photo no. 5: West bound towards Tunney's Pasture station, taken from centre of 304 points towards 301 points.

5.4 OTHER ALIGNMENT REQUIREMENTS

It is inevitable that there is an overlap between horizontal and vertical design elements. By reviewing the trackwork charts [Ref.06 to Ref.15], and the track alignment and geometric design report [Ref.05], the assessor accepts that the overlaps have been undertaken without any detriment to safety of line-speed or impact on ride comfort.

5.5 CLEARANCES

The project has produced several comprehension reports on the approach to clearances. These cover the full requirement of vehicle, structural, passing and platform interface clearances.

Reports [Ref.01, Ref.02 and Ref.04] have been reviewed and are accepted as robust analysis of the clearance requirements. The design has mandated a minimum 100mm clearance to the dynamic envelope of the tram. This has been demonstrated as achieved, values greater than 100mm being seen as surplus clearance (I.E increased safety).

West Portal 140 mm
East Portal 112 mm
West MSF Lead Tracks 107 mm
East MSF Lead Tracks 107 mm
Mainline Eastbound 119 mm
Mainline Westbound 125 mm
Station Columns 121 mm
Table 3.3.1 – Summary of Minimum Clearances at Physical Elements

Extracted from report Ref.04

During the site inspection, the assessor undertook random sampling of structural, passing and platform clearances. In addition, a modified tram was observed in Tunney's Pasture, that has been fitted with temporary polystyrene blocks to mimic the dynamic clearance. This approach to validate actual clearance is supported.

There are no areas of concern raised with respect to the achieved clearances by the assessor.

The assessor recommends that datum plates are established on all structures and OCS masts to capture the design clearance values, to aid future monitoring on clearance values.

Photo no.6 (left): Citadis Tram with polystyrene blocks to mimic minimum clearances

Photo no. 7 (right): typical clearance to obstacles installed in the track centre area.

5.6 TRACK TYPES

5.6.1 General

The design has specified a 1435mm track gauge. The design information supports this requirement.

The assessor has not been able to validate track gauge on site due to a lack of a calibrated track measuring instrument. Manual measures using a box ruler have indicated values of close tolerance to the design. Therefore, gauge can be accepted as compliant.

The requirements have specified that "all mainline rails shall be electrically isolated from the ground."

The site inspections noted that, in general, every fastening clip has been installed with an appropriate rail insulator. There are a few minor exceptions where either the insulator is partially damaged/broken by the installation process, or that the clip and insulator are both missing. The OCS system appears to have been bonded to the rails, with comprehensive bonds fixed to the rails at the limits of each isolation section.

The assessor recommends that any damaged or missing insulators are installed during the initial 3 months of passenger operations, by the Maintainer.

5.6.2 Ballasted Track

Generally, the condition of the installed ballast is of sufficient angularity and size as to comply with AREMA ballast specifications, and that the ballast shoulder fulfills the requirements of the PA.

The assessor notes the following:

Localised loss of ballast shoulder on the east bound line between Pimisi station and the tunnel portal. This is primarily due the area being used by other OLRT contractors to store materials and plant, which has caused the migration of the ballast away form the sleeper (tie) ends. (see photo no. 8);

Localised contamination of the ballast around Hi-Rail access ramp areas;

Localised contamination of the ballast due to spillage or debris from other OLRT contractors (see photo no. 9).

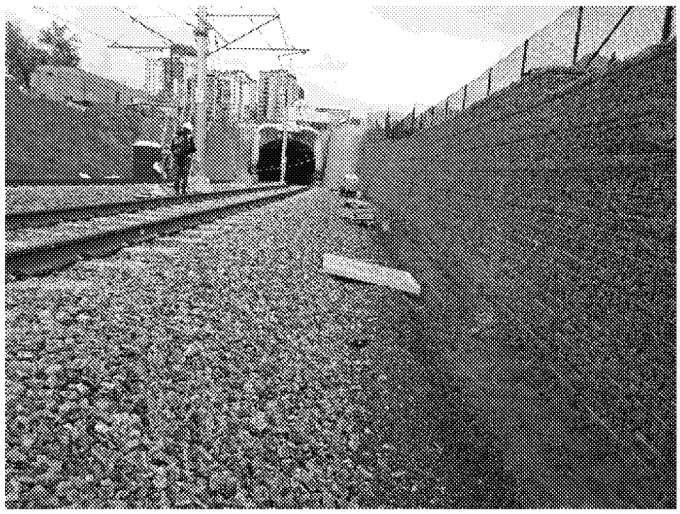


Photo no. 8 (left): loss of ballast shoulder approaching main tunnel from Pimisi station. Note the storing of materials and plant at this location.

Photo no. 9 (right): localised contaminated ballast on east-bound line, approaching the tunnel portal, at 100km 410m. This appears to be associated with the activities that have required the plant and materials to be stored nearby (in photo 8).

The assessor recommends that the ballast shoulder deficiency is corrected prior to the start of passenger operations and the contaminated ballasted removed within 3 months of the start of passenger operations.

There have been numerous temporary track access mat locations used to enable construction materials and vehicles to gain access to site. The assessor recommends that where these mats have been installed they are removed before the start of passenger operation and that the ballast is checked/cleared of any debris and contamination.

5.6.2.1 Concrete Sleepers (Ties)

In general, the site inspection can validate that the design sleeper spacing has been achieved during the installation process. There is evidence of isolated damage to the sleepers, either through installation mis-handling or through tamper damage. There is evidence that repairs of such damage are being carried out.

Photo no. 10: Evidence of local repair to damage to sleepers

5.6.2.2 Line Side

In general, the site inspection can validate that line side fencing is provided along this section of the route. There are a few localised areas where works are ongoing, such as Pimisi Station, where the fencing is not yet fully installed.

There are some locations where the adequacy of the fencing is not sufficient and provides and easy climb trespass opportunity to the guideway.

Photo no. 11: Evidence of inadequate fencing protection leaving an easy climb trespass opportunity.

Photo taken east bound facing Pimisi Station at 100km 050m.

The condition of the cess at the bottom of the ballast shoulder is adequate to enable general drainage.

There is a section of cable trough route installed between Pimisi station and Bay View station that presents a walking at heights issue. The trough units are 600mm deep and on the fence line side of the route there is no support. Any track workers walking along the route could fall over 800mm into the cess. The assessor recommends that either a handrail is installed or that the cess is built up behind the trough to reduce the fall dimension, subject to ensuring that any improvements do not increase the risk of trespass. This evaluation of fall risk should be carried out on all cable trough route on the guideway.

Photo no. 12: lack of support/embankment behind cable trough presents a fall risk.

Photo taken of the east bound cess at 99km 900m, taken facing Bay View. This applies to the west bound cess as well at this location.

5.6.3 Direct Fixation Track

The project has adopted several different solutions for direct fixation along the OLRT guideway. Within the scope limits of this report, only one method has been adopted for plain line track, the use of plinths with baseplates. For special trackwork areas, direct slab methods have been applied, see photo no.5.

The plinth method adopts a standardised plinth dimensions that support 2 base-plate under one rail. The depth of the plinth has then been locally increased to support the vertical alignment design. This then allows the open flow of water/snow etc during the winter months.

Photo no. 12: West bound approach to Tunney's Pasture station, taken from 304 points looking toward Bay View.

Site inspection checks has generally found the plinths to be in robust condition and the fixing of the base-plates in good order with adequate concrete cover to the retaining bolts to avoid break-out under normal operational loads.

Although this approach will aid winter management of snow and water, the core support slab and associated areas must be kept clear of debris and vegetation.

Photo no. 13: Excessive vegetation growth along side the track at 98km 550m, west bound side.

The assessor recommends that such areas are cleared before the opening to passenger operations.

5.7 TRACK MATERIALS

5.7.1 Rail

The project has, by requirement of the PA, installed 115lb RE rail that complies to the technical details of AREMA manual. The design contractor has then specified that all rails are a minimum of 310 Brinell hardness [Ref.01]. This is a medium strength rail hardness that can reduce rail wear and prolong asset life if it is well maintain and is the minimum strength requirement mandated in the AREMA manual.

The site inspection has validated that this section is fully welded into CWR, as per the requirements of the PA, and that a limited number of site thermit welds have been installed. The majority of welds are of the flash-butt formed method, which will reduce the likelihood of weld failure. The alignment of welds, and the surface finishing of the rail-head are in good order and no obvious surface flaws were observed.

Photo no. 14: Evidence of rail branding marks for 115 RE rails

For the special trackwork layouts, the switch blade has been specified as UIC60E1A1 section, utilising 350 grade hardness. (see section 5.8 for further details on special trackwork)

5.7.2 Restraining Rails

Within the scope limits of this report, there are no sharp 154m or less curves that require restraining rails.

However, as part of good derailment risk management, restraining rails have been provided in Pimisi station on both lines.

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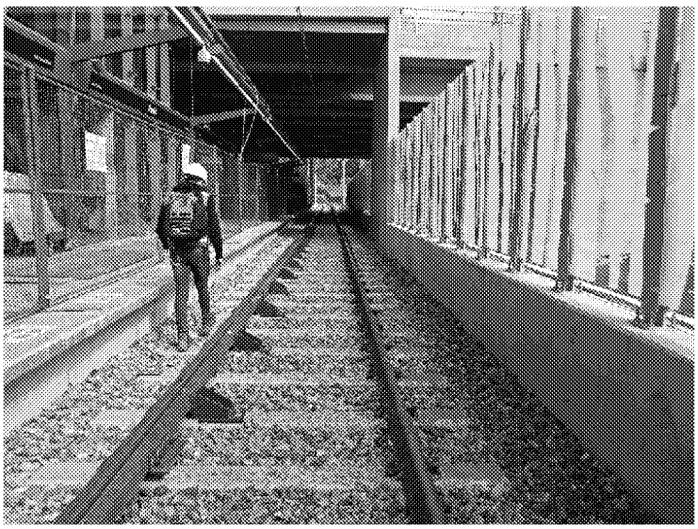


Photo 15 (left): Restraining rails in Pimisi west bound platform. Photo 16 (right): Restraining rails in Pimisi east bound platform.

Additionally, there is a long section of "Jordan Rail" (guard rails) track between Bay View and Tunney's Pasture.

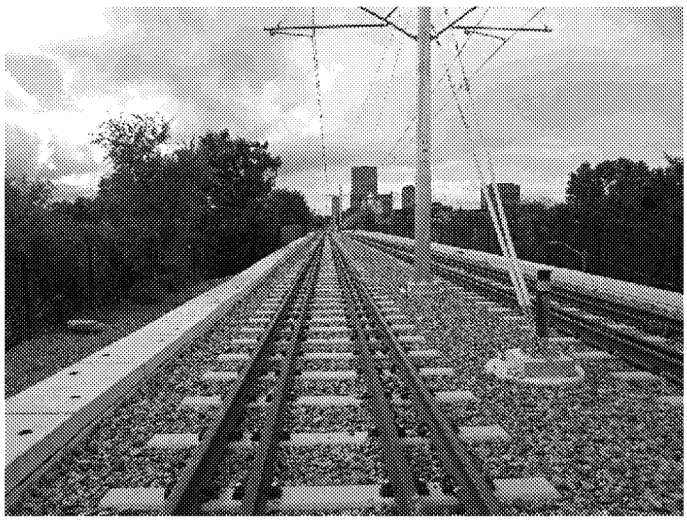


Photo no. 17 (left): start of Jordan rail protection west bound into Bay View station.

Photo no. 18 (right): view of Jordan rails on both lines, taken 99km 350m looking towards Tunney's pasture.

The assessor has provided a separate report OLR-22-0-0000-REP-0003 into derailment mitigation measures, so therefore has not debated the issue in this report.

5.7.3 Direct Fixation Fasteners

The PA has made numerous requirements upon the supply of the fastener system. In addition to these requirements, the design contractors brief [Ref.01] has added:

- the need to limit gauge widening under crush load (AW4) conditions;
- prevent rail over turning; and
- to achieve longitudinal resistance of 18.5kN/mm.

These extra factors help to evaluate the technical solutions of varying fastener types and enable the installed fastener to achieve the core requirements. All plain line in this section has Pandrol e2056 clips throughout.

The special trackwork has utilised a Vossloh based fastener. (see section 5.8).

The project has undertaken detailed rail break analysis [Ref.03] to demonstrate that the combined technical specifications of the rail fasteners, the grade of rail, the spacing of sleepers (ties) will control the risks associated with an extreme low temperature rail break to no more than a 55mm opening. The PA requirements has requested that this be limited to 50mm, but the report demonstrates that the extra 5mm, which is a worst-case scenario not an everyday occurrence, is not detrimental to tram safety, IE the extra 5mm will not cause the tram wheel to fail to bridge the gap. This report is accepted as a demonstration that rail break hazards have been considered and mitigated to an ALARP level.

From this analysis, the assessor supports the type and strength of fasteners provided and believes the requirement criteria have been met to a practicable level.

5.7.4 Rail Joints

As noted in section 5.7.1, the core rail system is CWR, which means there are no common rail joints. The PA has made requirements for the provision of insulated rail joints as protection to the special trackwork layouts.

These have been validated as installed as part of the site inspection. See photo no.12 above for an example at 304 points.

5.7.5 Rail Bonding

The basic bonding of the rail system for protection to the OCS has been observed during the site inspection and no comments raised. This includes the bonding of the insulated joints at the special trackwork. (see photo no.12 for evidence).

5.7.6 Switch Clearing Device

The proposed method of clearing snow and ice from the switch operating area is new to the assessor, and therefore has no past experience of the effectiveness of this system.

A review of "4P" document management system has indicated that in-situ tests of the system have been carried out [Ref.16] and that adequate air-flow was measured at the switch heel (limit of switch slide plates).

Therefore, the core requirement to provide switch clearing devices has been met.

Photo no.19: switch heaters at 304pts (silver unit in 4ft pointing towards the switches)

5.7.7 Switch Machines and other Turnout Appliances

The inspection has not specifically looked at the switch drive mechanisms.

The assessor has noted that a dual drive system has been installed, which gives adequate redundancy for the safe operation of the switches. There is an obvious manual over-ride method.

The basic requirements appear to have been met, but specific in-situ system testing of the switches from the route control centre must be the final validation.

5.7.8 End of Track Devices (Buffer Stops)

This section of track has two main line buffer stops at Tunney's Pasture.

The assessor has been provided with the design remit [Ref.01]and manufacturer's drawings [Ref.17 and Ref.18]. These were sufficient to demonstrate that the risk of tram running off the end of the track has been mitigated, and that the requirements of the PA are validated.

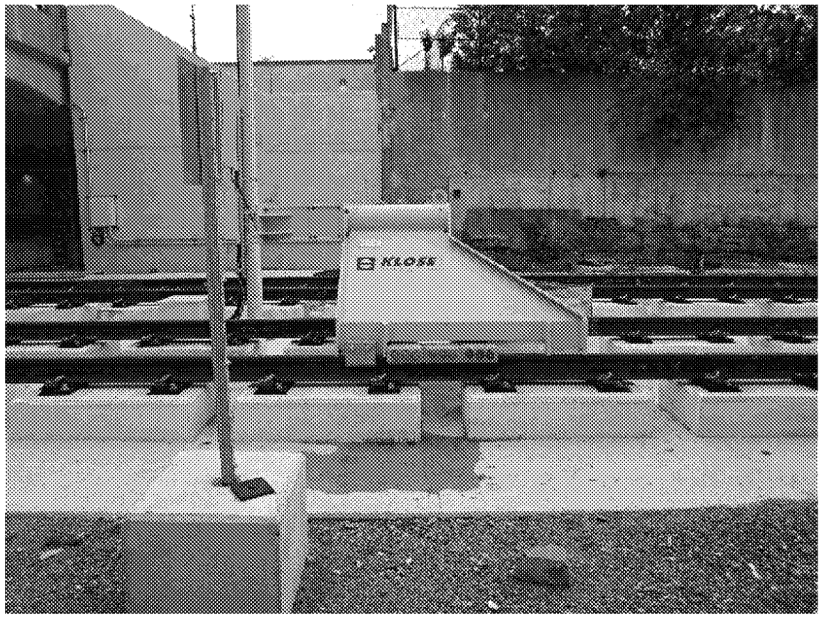


Photo no.20: Installed buffer stop at Tunney's Pasture, with compliant friction resistance devices.

5.7.9 Rail Expansion Joints

There are no rail expansion joints within the scope limits of this report.

5.7.10 Noise and Vibration Management

There are no specific areas of noise or vibration control required within the scope limits of this report.

5.8 SPECIAL TRACKWORK

The special trackwork installed has utilised AREMA manual requirements and is based upon everyday products used on other railway systems.

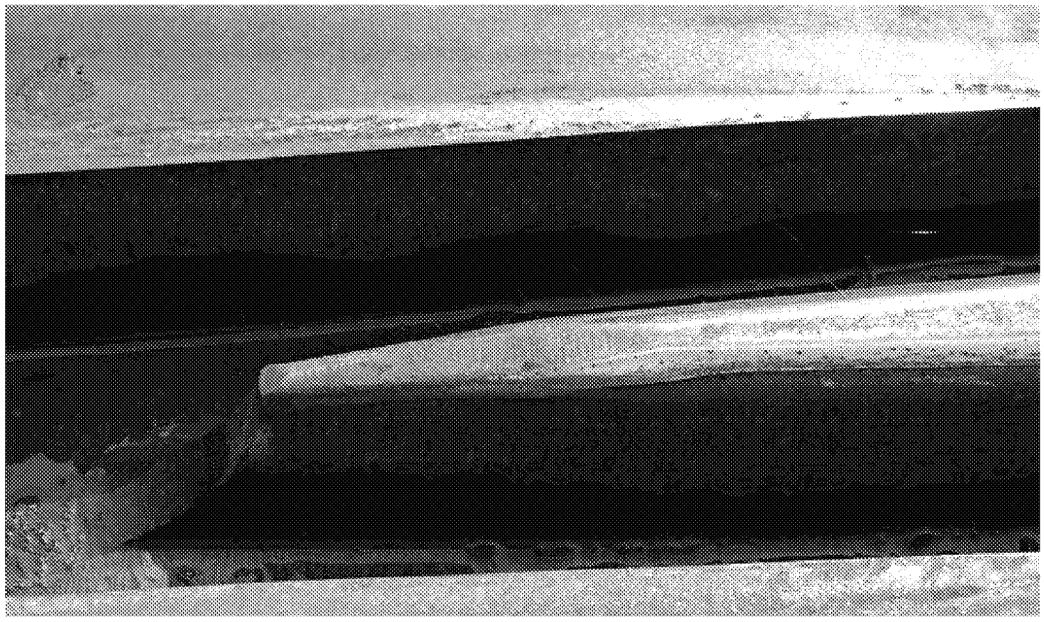
The assessor notes the following:

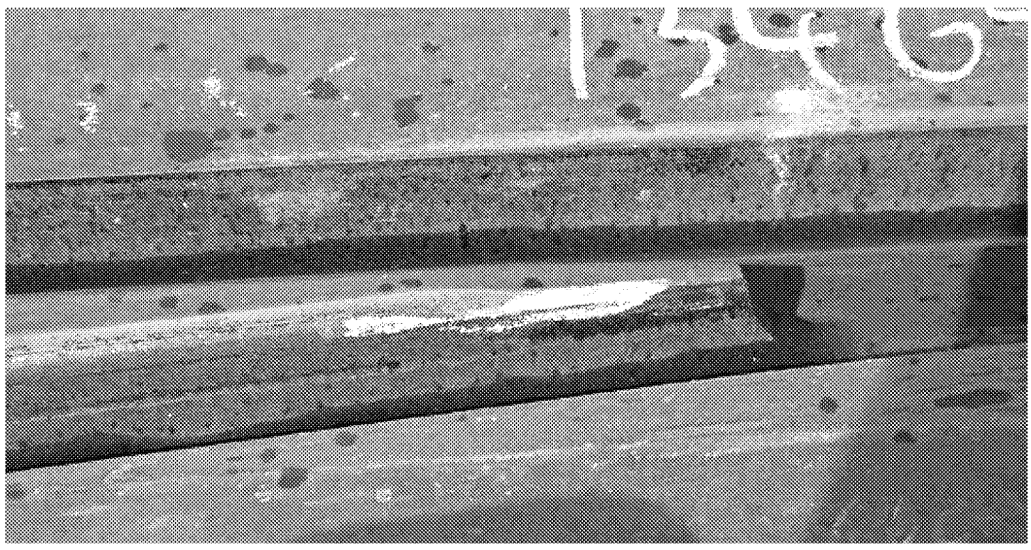
The rails are fastened by a Vossloh type fastener rather than a Pandrol fastener, as used on the plain line track. The assessor accepts that differing fastener systems are required, and that the system used is appropriate for the safe operation of the special trackwork. The assessor did observe that some fasteners were either loose or missing and need to be installed and tighten to the correct torque value within 3 months of passenger operation.

Switch blades have started to demonstrate initial lipping at approx. 3.5m to 4.5m from the switch toe. This is normal behaviour, but the lipping must be ground off before significant defects and cracks start to form within the metal. As the grinding and profiling of switches is a specialist skill, the assessor recommends that all remedial works are undertaken by the OLRT track Maintainer within the first 3 month of passenger operation (on a risk-based priority approach).

As the switch blade is a harder metal than the stock rail, the risk of differing wear rates and patterns is a hazard that must be transferred to the OLRT maintainer.

The crossing units (frogs) have started to demonstrate initial lipping and deformation under Hi-Rail vehicle and tram movements. This is normal behaviour, but the lipping must be ground off and any deformation rebuilt before significant defects and cracks start to form within the metal. As the grinding and profiling of switches is a specialist skill, the assessor recommends that all remedial works are undertaken by the OLRT track Maintainer within the first 2 month of passenger operation (on a risk-based priority approach).





Photos no. 21 (top) and 22 (bottom) are taken of 304pts and 303pts respectively.

Some temporary rail holes have been left in-situ through the layouts, as part of the installation and stressing process. None of these holes were observed to be within 150mm of a thermit weld.

5.9 TRACK CONSTRUCTION TOLERANCES

As previously stated, the assessor did not carry a track gauge to undertake actual measurements of gauge or cant values, and with the lack of any locational geometry markers or datum plates to define designed clearances, it has not been practicable for the assessor to validate final compliance to design and tolerance.

However, the assessor does record that the visual appearance of the track system is in good order, and the only area of concern to tolerances is noted in section 5.2.

6.0 SUMMARY AND CONCLUSIONS

The assessor concludes that the general quality of site installation is of a very good standard and there are only a few minor items that should be addressed prior to authorising passenger operations on this part of the system.

The designer has undertaken specific analysis for rail break consequence, as required by the PA requirements. Although the conclusion of the report is a non-compliant value (see section 3 and Appendix A), the assessor agrees with the methodology of the analysis, the rationale for not achieving full compliance and supports the final conclusions made that the system would remain safe with a break gap of 55mm.

The following tables provides a summary of the comments made within the core report, and the recommended remedial timescales.

Section of Report	Comment	Remedial Timescale	Action
5.1	There are no "datum" referencing plates to enable manual checks for loss of alignment	This is recommended as good practice; therefore, it is up to OLRT to decide if they want to fund such controls.	If funded, this would require the fitting of a reference plates to all OCS support masts, to close clearance structures (such as the platforms, bridge columns etc) and to the tunnel walkway. Distance between reference plates to be no more than 20m on long structures.
5.1	There is no marking of the design geometry data on the track sleepers/slab.	This is recommended as good practice; therefore, it is up to OLRT to decide if they want to fund such controls.	If funded, this would require every change of geometry for horizontal alignment (cant values, radius etc) to be marked on the sleepers or slab. This would aid the accuracy of track inspection checks.

5.2	Reinstate track vertical profile to design values on west bound line at tunnel portal west (100km 406m to 100km 412m)	Prior to opening to passenger operations	Track tamp or manual lift and pack of sleepers
5.6.1	Missing and damaged insulators and fasteners	Within 3 months of opening to passenger operation	Remove all damaged insulators and replace. Insert any missing insulators and fasteners manually.
5.6.2	Ballast shoulder profile not compliant	Prior to opening to passenger operations	Either manually reprofile or add extra ballast with Hi-rail.
5.6.2	Ballast contaminated on east bound line 100km 410m	Within 3 months of opening to passenger operation	Manually dig out contaminated material and replace with new ballast
5.6.2	Ballast contamination at temporary Hi-Rail access points	Within 3 months of opening to passenger operation	Manually check and clear debris/contamination after temporary access mats are removed.
5.6.2.2	Working at Height "fall risk" from line-side cable troughing	Prior to opening to passenger operations	Undertake hazard evaluation of all cable troughing for fall risk and carry out mitigations.
5.6.3	Debris and vegetation in slab area	Prior to opening to passenger operations	Manually clean slab area of debris and vegetation
5.8	Loose or missing Vossloh fasteners in special trackwork	Within 3 months of opening to passenger operation	Manually install missing fasteners and torque all fasteners to correct value
5.8	Start of lipping wear of switch blades	Within 3 months of opening to passenger operation	Task to be undertaken by skilled operator of OLRT Maintainer team
5.8	Start of lipping wear on frog crossings	Within 2 months of opening to passenger operation	Task to be undertaken by skilled operator of OLRT Maintainer team

Document Ref:		Document Title:	
OLR-22-0-0000-REP-0001		Track Assurance Report 1 – Tunney's Pasture to Tunnel portal west	
Revision 0	Date: 22/10/2018	Owner: B.Venables	

APPENDIX A: TRACK REQUIREMENTS MATRIX

The following matrix is the DOORS extracted PA requirements (from OLR-90-0-0000-CMP-0002), with the assessor's comments appertaining to compliance for this part of the track walk. There are two further reports that will input to the total compliance stance for the track system.

Colour Coding for Compliance:

	Compliant		Assessor believes work to be compliant but Contractor will have unique evidence to validate (ie in-situ test results)
	Will need input from other Engineers		Generally compliant, but construction not completed.
	Construction completed but Not Compliant		Generally completed, isolated none-compliance

id	Clauses	Assessor Review comment from Site Inspections
93589	**Schedule 15-2 Part 2 to Project Agreement**	N/A
93590	**Ottawa Light Rail Transit Project Execution Version**	N/A
93591	**TABLE OF CONTENTS**	N/A
93592	CONFIDENTIAL AND PROPRIETARY Page 1	N/A
93593	OTT01: 5456518: v3	N/A
93594	**SCHEDULE 15-2 DESIGN AND CONSTRUCTION REQUIREMENTS**	N/A
93595	**PART 2 DESIGN AND CONSTRUCTION REQUIREMENTS – GUIDEWAY**	N/A
93596	**ARTICLE 1 INTRODUCTION**	N/A
93597	**1.1 General Description of the Guideway and Guideway Requirements**	N/A
93598	(a) The Guideway shall:	N/A
93599	(i) Provide for two Tracks for approximately 12.5km from Tunney's Pasture Station in the west to Blair Station in the east; between Train Station and St. Laurent Station provide two tracks that shall branch off the mainline for approximately 0.8km to provide connections to the proposed MSF;	This report is one of three track reports that validates. Whole section has been walked in both directions

93600	(ii) Generally follow the existing BRT alignment between Tunney's Pasture Station and Blair Station, the exception being for approximately 2.7km through the Downtown Area between Lebreton Station and Campus Station where the Guideway will descend underground and be in a Tunnel below Queen Street, Rideau Street and Waller Street crossing under the Rideau Canal near the National Arts Centre and the Rideau Centre, the Alignment shall be within the right of way of Queen Street from Bronson Avenue to Metcalfe Street; and	This report is one of three track reports that validates. Whole section has been walked in both directions Only difference is that some stations have now been renamed
93601	(iii) Provide an MSF connection that shall branch off of the mainline west and east of Belfast Road crossing Tremblay Road at the intersection with Belfast Road. The two Tracks shall stay within the Lands of Belfast Road from Tremblay to the Bridge over the VIA railroad, then cross the VIA rail tracks adjacent to the Bridge Structure and connect to the yard Tracks in the MSF.	N/A not in assessor review remit
93602	(b) The Guideway shall consist of:	Info only
93603	(i) Track sections built on the existing BRT;	Compliant – it is obvious between Tunney's Pasture and Bay view that the old BRT has been used.
93604	(ii) Track sections built off the existing BRT;	Compliant – it is obvious a new alignment has been built to meet up with the new tunnel portal west
93605	(iii) Track sections on Bridge Structures and Tunnel Structures; and	Compliant – site inspection has witnessed track on elevated structures at Bay View and down into the tunnel portal
93606	(iv) Track sections through Stations.	Compliant – site inspection has gone through Tunney's Pasture, Bay View and Pimisi on both lines
93607	(c) The Guideway shall include components for:	Info only
93608	(i) Traction Power;	Info only – noted as generally installed but not in BV remit
93609	(ii) OCS;	Info only – noted as generally installed but not in BV remit
93610	(iii) Communications ductbanks;	Info only – noted as generally installed but not in BV remit
93611	(iv) Signal and control Systems;	Info only – noted as generally installed but not in BV remit
93612	(v) Drainage systems and Stormwater Management; and	The inspections have shown some level of natural drainage and the occasional drainage pipe in this section. The assessor does not have the full scope of designed works to undertake any level of compliance. Therefore, this will need further inputs, but my site photos may help achieve this.
93613	(vi) Other appurtenances as required by Project Co's design.	Info only
93614	(d) The Guideway shall be fenced or otherwise enclosed for security.	The site inspection has shown that the fencing system is approx.95% installed with works still required around the three stations. The fencing that has been installed is generally adequate, but there are still some areas where trespass can be easily achieved due to poor design/installation.
93615	(e) The Guideway shall not have continuous lighting. Lighting shall be limited to areas of Passenger interactions with buses and Stations and in other areas requiring lighting for Safety or operational needs.	Info only
93616	(f) The property limits for the Guideway are defined as the Lands.	Info only
93617	**ARTICLE 2 ALIGNMENT AND GEOMETRIC DESIGN CRITERIA**	
93618	**2.1 Horizontal Alignment**	
93619	(a) General	

93620	(i) The horizontal Track Alignment shall be designed in accordance with the requirements of Schedule 15 – Output Specifications, and shall be such that all of the Works is contained within the OLRT Lands.	Having reviewed the PA and the Designers trackwork design brief [Ref 01] and walked the track, I am confident that the alignment has been designed to the requirement parameters listed in the next entries, and has been installed to good tolerance. I have not been provided with any site as-built reports or trace evidence. (EoR to provide trace evidence as per section 3.0 as final compliance)
93621	(ii) The maximum Track design speed for the mainline and the MSF connection shall be 100km/h and 30km/h, respectively. Project Co shall Design the mainline Track so as to maximize the operating speed.	The assessor has not seen a final line-speed profile. Design drawings indicate a maximum curve speed of only 80 km/h [Ref 06 to Ref 15]. design brief confirms max system speed of 100 km/h. Site inspections confirm 40 km/h into MFS. (EoR to confirm final speed profile)
93622	(iii) The horizontal alignment shall be tangent through station platform limits and for a minimum of 15m beyond the end of platforms. If site conditions do not provide sufficient length, then the spiral transition curve may begin closer to the platform provided sufficient running clearances between the selected LRV and Platform are achieved.	Design drawings confirm this requirement is met. Site inspections confirm stations are straight with more than 15m clear each end and each side.
93623	(iv) All non-track related construction details shall be related to or dimensioned from the centreline of the eastbound Track, unless otherwise noted.	Info only
93624	(b) Track Centres	
93625	(i) The typical Track centre spacing is 4500mm. The mainline Track centre spacing may be reduced to an absolute minimum based on the selected LRV dynamic envelope and provided sufficient running clearances and tolerances under all operating conditions are maintained.	The design drawings state that the normal track centres in 4000mmm, with areas of variability, especially through the tunnel. Report [Ref 04] provided calculation from TCRP 57 on acceptable minimum track centres. This justifies 4.0m as the norm. Compliant
93626	(c) Horizontal Curves	
93627	(i) Circular curves shall be defined by the arc definition of curvature and specified by their radius in metres to three decimal places.	Design report [Ref.05] confirms the correct definitions that are to be adopted in the design process. Compliant
93628	(ii) For mainline Tracks, the curves shall be designed to maintain the maximum possible operating speed as dictated by existing topography, permanent physical features, property, and Alignment constraints. The absolute minimum radius used shall accommodate the turning capability of the selected LRV.	Minimum radius of a tram is 35m. Minimum design radius is 110m. Compliant
93629	(d) Reverse Curves	
93630	(i) All locations that require a reversal in alignment shall be separated by a tangent.	Review of design drawings [Ref 06 to Ref 15] indicates that all limited distance reverse curves have transitions. Compliant.
93631	(ii) The minimum tangent length between reversing curves shall be 25m.	Compliant – minimum in this section is 27.7m west bound at Pimisi
93632	(e) Compound Curves	
93633	(i) Compound curves may be used on the mainline Track Design.	For this section of the report, there are no compound curves in the design. N/A
93634	(ii) Where two or more circular curves will be connected into a compound curve, the circular curves shall be joined by a spiral curve. The superelevation of each circular curve shall be adjusted to ensure that the maximum permissible speeds for all parts of the compound curve are identical.	N/A
93635	(f) Spirals	

93636	(i) Spiral transition curves shall be used on all mainline and MSF connection Tracks to connect circular curves to tangents, with the exception that spirals are not required where both actual superelevation is zero and unbalanced superelevation is less than 50mm.	These have been applied in the design. Compliant
93637	(ii) The minimum length of a spiral transition curve (L, m) shall be calculated using the actual superelevation (Ea, mm), unbalanced superelevation (Eu, mm), and design speed (V, km/h) and shall be determined by selecting the greater value of the following formulas:	Info only
93638	A. L = EaV/108; and	Design report [Ref.05] defines the formula have been adopted into the design
93639	B. L = EuV/180.	
93640	(iii) The absolute minimum length of spiral shall be 10m.	A minimum transition spiral length of 20m has been used in this section of the design. Compliant
93641	(g) Superelevation	
93642	(i) Superelevation shall be linearly attained throughout the full length of the spiral curve by raising the rail farthest from the curve centre, while maintaining the top of the inside rail at profile grade.	Design report [Ref.05] confirms this approach has been adopted. Compliant
93643	(ii) For mainline Tracks, the maximum actual superelevation shall be 150mm for ballasted Track and direct fixation or embedded Track. The maximum unbalanced superelevation shall be 115mm. These values may be modified for the selected LRV provided the 0.1g limit that passengers can tolerate comfortably is achieved. The total superelevation (E, mm) shall be based on the design speed (V, km/h) and equivalent radius (R, m), per the formula E = 11.83V2/R.	Design shows max superelevation of 75mm and max unbalanced superelevation of 78mm. Both are compliant.
93644	**2.2 Vertical Alignment**	
93645	(a) General	
93646	(i) The vertical Track Alignment shall be set to respect constraints such as clearances over roads and fixed elevations such as at Station Platforms and other adjacent Infrastructure. The vertical Track Alignment shall be designed in accordance with the requirements of this Schedule 15 – Output Specifications. All references to profile in the vertical Alignment shall represent the top of the low rail for a given Track.	This item is subjective, but in BV's opinion the design rationale is generally in-line with these principles.
93647	(b) Grades	
93648	(i) The maximum allowable grade through Stations shall be 1.5%.	The max gradient in this section for a station is -1.00% at Bay View. Compliant
93649	(ii) No changes in grade or vertical curves shall encroach within the limits of Station Platforms.	The design confirms no change in gradient through any of the platforms. Compliant.
93650	(iii) A minimum distance of 15m shall be maintained between Platform limits and any point of vertical curvature. If site conditions do not provide sufficient length, then the spiral transition curve may begin closer to the Platform provided sufficient running clearances between the selected LRV and Platform are achieved.	For the 3 stations in this section, the minimum distance in the design is shown as 16m at Bay View. Compliant

93651	(iv) The maximum grade for mainline and MSF connection Tracks shall be 4.5%, where unachievable the absolute maximum grade for mainline and MSF connection Tracks shall be no greater than 6%.	The max design gradient in this section is -4.15%. Compliant
93652	(c) Vertical Curves	
93653	(i) Parabolic vertical curves shall be provided for all grade changes.	Design report [Ref.05] confirms this as a design principle. Compliant
93654	(ii) The length of a vertical curve shall be as long as practicable, but no less than shown below.	Info only
93655	(iii) The minimum length of vertical curve (LVC, m) for mainline and connection Tracks shall be determined by the following equations:	Info only
93656	A. LVC = 0.005AV2, for crest curves; and	Design report [Ref.05] confirm the formula is used & min length is Compliant for both types of curves.
93657	B. LVC = 0.003AV2, for sag curves.	
93658	**2.3 Special Trackwork**	
93659	(a) Special trackwork shall conform to AREMA requirements.	Design report [Ref.01] confirms that AREMA principles have been used for all special trackwork. Compliant
93660	(b) The horizontal Alignment shall be tangent through special trackwork and for a minimum of 5m ahead of the point of switch and beyond the last long ties. In constrained conditions, the tangent shall extend a minimum of 2m beyond the heel of frog.	The only special trackwork in this section is at Tunney's Pasture. All points are on a long straight and long gradient. Compliant
93661	(c) For profile Design, all turnouts shall be located on a constant grade that shall extend a minimum of 3m beyond the point of switch and beyond the last long ties.	
93662	(d) A minimum tangent length of 20m shall be inserted between the back to back switch points where the turnout arrangement may entail a reverse movement through turnouts.	N/A
93663	(e) Special trackwork shall not be located within 15m from the end of the Station Platform and not within a Station Platform.	Special trackwork is 26m clear of Tunney's Pasture station. Compliant
93664	(f) Special trackwork shall not be located within 50m of the transition between ballasted and direct fixation Track as outlined in the TCRP Light Rail Handbook. Project Co shall provide for special accommodations to mitigate the effects of different Track modulus under various geometric conditions.	Nearest ballast/slab transition is 274m from the special trackwork. Compliant
93665	**2.4 Other Alignment Requirements**	
93666	(a) Combined horizontal and vertical curvature: Overlapping horizontal and vertical curvature shall be avoided where possible. Where this situation is unavoidable, Project Co shall include justification in its Trackwork Design Report with reference to alignment Safety at the design speed.	The design report [Ref.05] confirms that any overlapping of design elements will be avoided where practicable. There is some over lap approaching Bay View station Accepted as Compliant.
93667	**2.5 Clearances**	
93668	(a) Vehicle Clearances	
93669	(i) Horizontal clearance dimensions shall always be measured perpendicular to the Track centreline accounting for any superelevation in the Track.	Design reports [Ref 02 and Ref 04] confirms this method is used Compliant

93670	(ii) On tangent Track the typical side clearance shall be a minimum of 1690mm measured perpendicular from the Track centreline. The mainline Track side clearance me be reduced to an absolute minimum based on the selected LRV dynamic envelope and provided sufficient running clearances and tolerances under all operating conditions are maintained.	The design has used a general lateral clearance of 1837mmm measure from the centreline. In-situ checks carried out of sample OCS masts and other structures has validated this value Compliant
93671	(iii) Where no walkway is present, a typical minimum side clearance of 1890mm from Track centreline to any physical feature shall be maintained on tangent at-grade and retained cut Track. The mainline Track side clearance may be reduced to an absolute minimum based on the selected LRV dynamic envelope and provided sufficient running clearances and tolerances under all operating conditions are maintained.	The actual values on site vary depending on the combination of track geometry, structural position and OCS design. Values in excess of 1890mm have been measured, but as stated above the norm appears to be 1837mm. This gives in excess of 100mm tram clearance. Deemed compliant.
93672	(iv) Under cut-and-cover conditions, a typical minimum side clearance of 2150mm shall be provided from Track centreline. The mainline Track side clearance may be reduced to an absolute minimum based on the selected LRV dynamic envelope and provided sufficient running clearances and tolerances under all operating conditions are maintained.	N/A for this section of report
93673	(v) Where emergency walkways are present, tangent Track shall maintain minimum typical side clearances of 2300mm from the Track centreline to an outbound curb, railing fence, or other physical feature. The mainline Track side clearance may be reduced to an absolute minimum based on the selected LRV dynamic envelope and provided sufficient running clearances and tolerances under all operating conditions are maintained.	N/A for this section of report
93674	(vi) Additional clearances shall be provided on the inside of curves due to superelevation effects at the rate of 18mm for every 10mm of superelevation, to provide clearance for tilt-in. On curved Track the Vehicle side clearance shall be measured perpendicular to the superelevated Track centreline (axis of the Track measured perpendicular to the plan of the top of rails).	Design reports [Ref 02 and Ref 04] confirms this method is used. Compliant
93675	(vii) The typical horizontal clearance distance from the centreline of Track to the finished edge of Station Platform shall be 1405mm, or as otherwise required for the selected LRV such that a gap no greater than 75mm is maintained.	Design reports [Ref 01, Ref 02 and Ref 04] confirm this approach. Site sampling at each station has confirmed a range between 1394mm to 1405mm have been achieved. (EoR to provide as-built clearance for each platform, and site validation against a tram to be carried out)
93676	(viii) Vertical clearance dimensions shall always be measured in a vertical plane irrespective of any superelevation or profile grade. When superelevation is present, the top of low rail shall be used as the reference elevation when calculating vertical clearance.	Design reports [Ref 02 and Ref 04] confirms this method is used. Compliant
93677	(b) Other Clearance Requirements	Info only
93678	(i) Signal and trackwork equipment mounted on Track slab along the Alignment shall be kept clear of the under car clearance envelope of the Vehicle.	Design reports [Ref 02 and Ref 04] confirm checks to other line-side assets have been carried out and stated as clear. Site validation of the plinth slab area confirms all asset are clear.
93679	(ii) Temporary clearance requirements for construction shall be assessed on an individual basis.	N/A for final opening
93680	**ARTICLE 3 TRACKWORK**	
93681	**3.1 Order of Precedence**	
93682	(a) General	

93683	(i) The Design and Construction of trackwork shall be in accordance with the criteria contained in this Article, and all standards, regulations, policies, Applicable Law, guidelines or practices applicable to the Project, including but not limited to each of the following Reference Documents. If the event of a conflict between the criteria, commitments or requirements contained within one document when compared with another, the more stringent shall apply:	Info only
93684	A. Requirements of this Article;	Design report [Ref 01] confirms that this order of precedence has been applied. Compliant
93685	B. AREMA Track Standards, or equivalent; and	
93686	C. The criteria in TCRP Report 57.	
93687	**3.2 General Requirements**	
93688	(a) The scope of the trackwork includes all Works related to the Construction of a complete LRT System as specified herein.	Info only
93689	(b) The scope of the special trackwork consists of all Works related to the complete Construction of special trackwork as described in this Schedule 15 – Output Specifications. This includes, but is not limited to, the Design, supply, installation, and testing of special trackwork, including all turnouts, crossover components, adjoining trackwork, fastening components, and all other Track materials.	Design and installed track include the elements stated. Compliant
93690	(c) Project Co shall be responsible for control and any mitigation which may be a result of wheel-rail noise throughout the OLRT System in accordance with Schedule 17-Environmental Obligations.	The design states mitigations have been applied for noise and vibration. Site validation can be checked as mitigation are hidden below ballast etc. (EoR will need to make statement of final compliance)
93691	**3.3 Track Types**	
93692	(a) General	
93693	(i) The Track structure shall be built to 1435mm Track gauge. Direct fixation Track shall be used in Tunnels, on aerial structures. Ballasted Track or direct fixation Track shall be permissible through Station Platforms and at all other locations on the Alignment where performance is not compromised and maintenance can be achieved.	Design report [Ref 01] states 1435mm gauge has been applied. Site check through non-calibrated tape confirm gauge is very near to 1435mm. (EoR to provide as-built validation of actual gauge achieved)
93694	(ii) The running rails of all mainline Track, including special trackwork, shall be electrically isolated from the ground.	Design report [Ref 01] confirms the need for electrical isolation. Site inspections validate that rail insulators and pads have been installed. Compliant
93695	(b) Ballasted Track	
93696	(i) Ballasted Track shall utilize timber or precast concrete crossties with a resilient rail fastening system.	Design report [Ref 01] confirms the need for concrete ties or slab. Site inspections validate that slab or concrete ties have been installed. Compliant
93697	(ii) Crushed stone or other material shall conform to AREMA ballast specifications.	Design report [Ref 01] confirms the need for ballast to AREMA specification. (EoR to confirm material supply conformance documents have been provided)
93698	(iii) The particle size requirements shall conform to AREMA requirements in relation to the crushed stone ballast, class number 4A.	Design report [Ref 01] confirms the need for ballast to AREMA specification. (EoR to confirm material supply conformance documents have been provided)
93699	(iv) Minimum depth of ballast below the bottom of ties under the running rail shall be 225mm. Shoulder ballast shall extend a minimum of 300mm beyond the ends of ties before sloping at 2:1 to the sub-ballast.	Design report [Ref 01] confirms the need for ballast to 225mm min depth. Site inspection has not carried out any trial hole validation. (EoR to confirm actual depths achieved)

93700	(v) Ballast shall be well drained and shall not contact the running rails for mitigation of stray current and loss of shunting or calibration with signal systems.	Design report [Ref.01] confirms the need for ballast to be well drained. Site inspection has confirmed no ballast is in contact with the rail but cannot fully validate the ballast is well drained. (EoR to confirm achieved quality is acceptable)
93701	(vi) Track bed shall be of sufficient stability to permit operation of track circuits under all climatic conditions.	Design report [Ref.01] confirms the need for this to occur. Installed components appear capable of achieving. (EoR will need to provide final compliance)
93702	(c) Direct Fixation Track	
93703	(i) Direct Fixation Track	
93704	A. Direct fixation Track shall consist of a resilient direct fixation rail fastener system anchored or embedded into a concrete plinth or base slab.	Design report [ref.01] confirms need, design drawing [Ref.06-Ref.15] confirm where DFF has been installed. Site inspections has validated the limits and type. Compliant
93705	B. The direct fixation Track fastening system shall be designed to support required loading and avoid accumulation of runoff in the rail support areas.	Design report [ref.01] confirms need, design drawing [Ref.06-Ref.15] confirm where DFF has been installed. Site inspections has validated the limits and type and run-off principles. Compliant
93706	(ii) Track Transition Area	
93707	A. Transitions from ballasted Track sections to direct fixation Track shall use a 6m long variable-depth reinforced concrete approach slab to accommodate the change from the solid support of the Track slab to the semi-solid support of the change in Track modulus of the ballast.	Design report [Ref.01] states this requirement within the design principles. This was not validated during site inspections as no trial holes where dug. (EoR to confirm these have been installed)
93708	**3.4 Track Materials**	
93709	(a) General	
93710	(i) Materials identified in the following sections shall be used for all Track Construction.	Info only
93711	(b) Rail/115 lb RE	Design report [Ref.01] confirms the specification to be installed. Site inspection has validated this rail section has been installed. Compliant
93712	(i) Supply rail that meets:	Info only
93713	A. AREMA Volume 1, Chapter 4, Part 2; and	Design report [Ref.01] confirms the rail to meet these requirements. As rails are branded 115 RE they have to comply. Deemed Compliant
93714	B. ASTM A1.	
93715	(ii) Rail Lengths	
93716	A. Standard rail lengths shall be used wherever possible.	No specific value stated by PA. Design report [Ref.01] lists a range of standard rail lengths. Deemed compliant
93717	B. All rail shall be CWR.	Site validation confirms CWR provided throughout this section
93718	(c) Restraining Rails	
93719	(i) Project Co shall install restraining rails along the gauge side of the low rail for all mainline horizontal curves with a radius of 145m or less.	N/A for this section as no curves this sharp.
93720	(ii) Restraining rail shall be electrically isolated from running rail in order to maintain broken rail protection.	N/a for this section
93721	(d) Direct Fixation Fasteners	
93722	(i) Project Co shall provide DFF that shall meet the requirements of this Schedule 15 – Output Specification.	Info only
93723	(ii) The DFF shall be part of an engineered direct fixation system and shall be designed to meet the required rail loading.	Design report [Ref.01] defines the rail loading requirements. Site inspection confirms design drawing systems have been installed. (EoR to confirm final loading validation)

93724	(iii) Project Co shall design the DFF system to resist all slip forces as determined by design.	Design report [Ref.01] defines the rail fastener loading requirements. Site inspection confirms that type of fasteners used will prevent slip forces (as common for world usage). Compliant
93725	(iv) The DFF shall:	
93726	A. Provide vertical and lateral stability to the rail;	Design report [Ref.01] defines the rail fastener loading requirements. Site inspection confirms that type of fasteners used will provide rail stability (as common for world usage). Compliant
93727	B. Restrain the rail movement during rail break incidents limiting the rail break gap to 50mm;	Design report [Ref.01] provides detailed analysis of this requirement. The report considers that 50mm is the worst case (at a very extremely low temperature). Report confirms that 50mm is still safe to traverse with a tram. Therefore, condition is ALARP. The assessor accepts and supports the conclusion. Designer will need RT1 to accept this value as a non-compliance.
93728	C. Distribute rail loadings to the concrete support structures;	This a core design principle of railway engineering. If the load was not distributed the sleeper would break. Site validation has not seen any damaged sleepers or plinths under tram trial operations. Compliant.
93729	D. Electrically insulate the rail from the Guideway;	This is the same requirement as 93720. Compliant
93730	E. Accommodate CWR and structural interface forces;	Design reports [Ref.01 and Ref.03] confirm that the rails shall be CWR and capable of handling the required forces. Compliant
93731	F. Prevent rail buckling under high temperature conditions; and	Design reports [Ref.01 and Ref.03] define stress range of -38 to +58 rc. (EoR to provide stress certificates)
93732	G. Provide means for achieving a minimum of 12mm rail lateral adjustment in 3mm maximum increments.	Design of DFF baseplates does allow lateral adjustments. BV experience of these baseplates validates that the required values are achievable. Compliant
93733	(e) Rail Joints	
93734	(i) Project Co shall supply insulated glued joints for 115lb RE rail manufactured to AREMA standards.	Design report [Ref.01] confirms requirement. Site validation has seen insulated joints in 115 RE rail. Compliant
93735	(ii) Rail joints shall be electrically tested prior to and after placement in Track.	EoR to provide certificates of conformance from suppliers
93736	(f) Rail Bonding	
93737	(i) Project Co shall supply and install rail bonds that meet AREMA specifications in Volume 3, Chapter 33, Part 7 and 12.	N/A – not part of the track contractors contractual terms. Site inspections did observe rail bonds provided by others
93738	(ii) Rails shall be welded in continuous lengths and bolted joints shall be electrically bonded.	Site inspections confirm all rails are in CWR form. The only bolted joints are the insulated glued joints (still in CWR form) and they are bonded. Compliant
93739	(iii) At locations requiring insulated joints, the Traction Power direct current continuity of negative rails shall be maintained by use of impedance bonds.	The insulated glued joints are bonded for impedance needs. Compliant.
93740	(g) Switch Clearing Device	
93741	(i) Switch clearing devices shall be supplied and installed by Project Co at special trackwork locations. Project Co shall also provide conduits and junction boxes and other supporting Infrastructure for these devices.	Site inspection has validated that all points have switch heaters. SAT test results have been provided [Ref.16]. Compliant
93742	(ii) Project Co shall provide switch clearing devices that are proven in similar climatic conditions and meet accepted industry standards and do not compromise safety.	Relevant proven status to be validated by others
93743	(iii) No gas powered switch heaters shall be permitted in tunnels or enclosed areas.	N/A – no tunnel or enclosed area for points
93744	(h) Switch Machines and other Turnout Appliances	
93745	(i) Switch machines and other associated equipment shall be provided and installed by Project Co.	Site inspection can validate that all points have switch machines. Compliant

93746	(ii) Project Co shall provide for the location of trackside terminal boxes, which shall be located near the switch machine. Terminal boxes shall not be located within a position that would constrict the ability of Maintenance personnel to maintain or manually throw the switch.	Requirement to be proven by others
93747	(iii) Switch machines shall be able to be manually operated with minimal physical effort, as a backup to powered operation.	Site inspections confirm the ability to operate manual has been provided. Compliant
93748	(i) End-of-Track Devices (Buffer Stops)	
93749	(i) End-of-Track shock-absorbing devices for use at terminal station Tracks shall be included in the Trackwork Design Report and be which shall be submitted as part of the Works Submittals according to Schedule 10 – Review Procedure. These devices shall be mounted near the end of Track on both Station Platform Tracks. Project Co shall procure and install the approved end-of-Track devices as part of the Works.	Design report [Ref.01] confirms design parameters (loads/spacing etc). Design drawing [Ref. 7] and O&M manual [Ref. 9] to control installation. Site inspection validates design buffers have been installed correctly. (EoR to provide torque certification of achieved installation values)
93750	(j) Rail Expansion Joints	
93751	(i) The anticipated rail movement within the full range of rail temperatures shall be handled by the direct fixation assembly.	N/A – none required on this section
93752	(k) Noise and Vibration Mitigation	
93753	(i) Project Co shall install a site-specific Track structure where it is required to control levels of noise and vibration, as described in Schedule 17 – Environmental Obligations.	As per 93690. The design states mitigations have been applied for noise and vibration. Site validation can be checked as mitigation are hidden below ballast etc. (EoR will need to make statement of final compliance)
93754	**3.5 Special Trackwork**	
93755	(a) General	
93756	(i) All special trackwork shall be supplied and installed by Project Co. Special trackwork assemblages include all materials necessary for Construction.	Design report [Ref.01] states requirement to provide 30 points along the guideway. Site inspection validates that special trackwork has been installed. Compliant.
93757	(ii) All special trackwork joints shall be either butt welded in-field or thermite welded in-field or bonded joints. At these locations thermite welds performed in accordance with manufacturer's weld procedures are acceptable. Compromise welds shall be considered part of the mainline Track conditions and installation. No holes, for temporary joint installation, or otherwise, shall be permitted within 150mm of the weld location. All thermite welds shall be tested ultrasonically.	Site inspections can validate that all special trackwork are Thermit type welds. Back-hole drilling methods have been used a temporary fixing until welding occurred. Any drill holes are more than 150mm from the weld. Compliant.
93758	(iii) All turnouts shall utilize tangential geometry with curved switch points. All mainline special trackwork shall be configured with 115lb RE rail.	Design report [Ref.01] state design principles. Site inspections can validate 115 RE rail used, except for switch blades that are UIC60E1 (as per AREMA requirements). Compliant.
93759	(iv) Special trackwork components shall be based on AREMA specifications for turnout.	Design report [Ref.01] states compliance to AREMA requirements. (EoR to provide final validation)
93760	(v) All components shall be designed so that the specified tolerances can be maintained throughout the operating life of the special trackwork with minimal Maintenance.	Site inspection has seen good quality installation but had no datum point to confirm compliance to tolerances. (EoR to confirm compliance to tolerances through compliance to section 3.6)
93761	(vi) Crossover locations shall be integrated with signaling and OCS system designs.	Site inspection confirms signalling and OCS are provided. Final test & commissioning reports will validate whether this fully integrated.

93762	(vii) All mainline turnouts and crossovers shall be optimized to meet or exceed the Operations Performance Requirements outlined in Schedule 15-2 Part 1 Article 2.	N/A excluded from BV remit of assessment
93763	(viii) Locations for OCS poles shall be provided at all crossover locations.	Site inspection confirms OCS masts have been provided, but cannot validate if these are to design tolerance
93764	(ix) Tail Tracks and pocket Tracks shall be maximized to accommodate at least a minimum length consistent with additional length to improve approach speeds where feasible.	N/A excluded from assessor remit of assessment
93765	(b) Project Co shall undertake the Design of the OLRT Project and systems and shall provide the following minimum required operational Track facilities:	Info only
93766	(i) Tail Tracks west of Tunney's Pasture Station sufficient to facilitate the reversing of trains and to maximize approach speeds into the Terminal Station;	N/A excluded from assessor remit of assessment
93767	(ii) Optimized crossovers adjacent to the MSF west and MSF east connecting tracks that maximize operational flexibility into and out of the yard and minimize operational impacts to mainline revenue operations during loading and unloading of the line;	N/A excluded from assessor remit of assessment
93768	(iii) Tail Tracks east of Blair Station sufficient to facilitate the reversing of trains and to maximize approach speeds into the Terminal Station; and	N/A excluded from assessor remit of assessment
93769	(iv) Interlockings and special trackwork at locations necessary to meet or exceed the requirements of the Operations Performance Requirements (Schedule 15-2 Part 1, Article 2).	N/A excluded from assessor remit of assessment
93770	**3.6 Track Construction Tolerances**	
93771	(a) Verification of the Track installation shall include a Trackstar Geometry Test (or equivalent).	No as built documents provided. EcR to confirm methodology of validation
93772	(b) Clearances shall be verified by laser measurement using an L-Kopia vehicle (or equivalent).	

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