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Technical Note – TN 014: 2018

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Subject: Rectifying typo errors in Section 7.1.4 and Section 7.1.6 of T LR TR 10000 ST *Light Rail Track Requirements*, v1.0

This technical note is issued by the Asset Standards Authority (ASA) to notify a minor update to T LR TR 10000 ST *Light Rail Track Requirements*, version 1.0, which comprises rectifying typo errors in Section 7.1.4 and Section 7.1.6.

1. Section 7.1.4 Maximum superelevation

Interchange the words 'segregated' and 'separated' in the dot points, that is, the first dot point and second dot point shall read as follows:

- in segregated track environments where it is not expected that light rail vehicles will stop, the maximum applied superelevation shall be 120 mm
- in separated track environments where it is possible, but not likely that light rail vehicles will stop, the maximum applied superelevation shall be 75 mm

2. Section 7.1.6 Maximum superelevation deficiency

Interchange the words 'segregated' and 'separated' in the dot points, that is, the first dot and second point after the second paragraph under 'Plain line' shall read as follows:

- for segregated track areas, the maximum deficiency of superelevation shall be 75 mm
- for separated track areas, the maximum deficiency of superelevation should be 50 mm

Authorisation:

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T LR TR 10000 ST

Standard

Light Rail Track Requirements

Version 1.0

Issued date: 25 May 2017

Standard governance

Owner: Lead Track Engineer, Asset Standards Authority

Authoriser: Chief Engineer, Asset Standards Authority

Approver: Executive Director, Asset Standards Authority on behalf of the ASA Configuration Control Board

Document history

Version	Summary of changes
1.0	First issue

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Preface

The Asset Standards Authority (ASA) is a key strategic branch of Transport for NSW (TfNSW). As the network design and standards authority for NSW Transport Assets, as specified in the *ASA Charter*, the ASA identifies, selects, develops, publishes, maintains and controls a suite of requirements documents on behalf of TfNSW, the asset owner.

The ASA deploys TfNSW requirements for asset and safety assurance by creating and managing TfNSW's governance models, documents and processes. To achieve this, the ASA focuses on four primary tasks:

- publishing and managing TfNSW's process and requirements documents including TfNSW plans, standards, manuals and guides
- deploying TfNSW's Authorised Engineering Organisation (AEO) framework
- continuously improving TfNSW’s Asset Management Framework
- collaborating with the Transport cluster and industry through open engagement

The AEO framework authorises engineering organisations to supply and provide asset-related products and services to TfNSW. It works to assure the safety, quality and fitness for purpose of those products and services over the asset's whole-of-life. AEOs are expected to demonstrate how they have applied the requirements of ASA documents, including TfNSW plans, standards and guides, when delivering assets and related services for TfNSW.

Compliance with ASA requirements by itself is not sufficient to ensure satisfactory outcomes for NSW Transport Assets. The ASA expects that professional judgement be used by competent personnel when using ASA requirements to produce those outcomes.

About this document

This standard establishes high level design, construction and maintenance requirements that apply to any light rail network in NSW.

It also provides track design parameters to allow for the operation of the standard interoperable light rail vehicle.

This standard has been prepared by the ASA in consultation with TfNSW agencies, and industry and supplier representatives.

This standard is a first issue.

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1. Introduction

This standard establishes fundamental requirements for the design, construction and maintenance of light rail track so that Authorised Engineering Organisations (AEOs) or parties responsible for design, delivery and maintenance contracts will supply a system that meets the business requirements of providing a safe, efficient, reliable and effective transport network.

2. Purpose

The purpose of this standard is to provide high level design, construction and maintenance requirements that apply to any light rail network, beyond the fundamental requirements of any contract, in order to provide a safe, efficient and effective local transport product. An additional purpose is to ensure that track on those TfNSW networks where interoperability is required, is designed, constructed and maintained to allow the operation of the standard interoperable light rail vehicle.

The parameters provided by this standard are performance-based and designed in the interests of maximising benefits to users of the light rail networks.

2.1. Scope

This standard provides track design parameters that enable the operation of a light rail vehicle ('the standard interoperable vehicle'), which meets the requirements of the rolling stock standard T LR RS 00100 ST *LRU 100 series - Minimum Operating Standards for Light Rail Vehicles – General Interface Standards*. This standard also documents track design parameter limits that provide for the consistent safety and comfort of passengers using any light rail network, and provides some data management requirements to allow efficient asset management across all transport modes.

2.2. Application

For those tracks where interoperability is not required, no additional requirements will be placed on the design, construction or maintenance of the track other than a stipulation to supply a track system that meets the business requirements of providing a safe, efficient, reliable and effective transport network.

For those tracks where limited interoperability is required (that is, the route identified is capable of carrying the standard interoperable vehicle in non-revenue operation, typically to or from a shared maintenance depot), such parameters that are limited by the standard interoperable vehicle shall be applied.

For those tracks where full interoperability is required (that is, the route identified is capable of carrying the standard interoperable vehicle in revenue operation), all parameters shall be met, while complying with the maintenance concept definition for the designated life of the particular asset and network.

3. Reference documents

The following documents are cited in the text. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document applies.

International Standards

EN 14811:2006 Railway applications - Track - Special Purpose Rail - Grooved and associated construction

Transport for NSW standards

ESC 210 Track Geometry and Stability

ESC 215 Transit Space

T HR TR 13000 ST Railway Surveying

T LR EL 00007 ST Traction Power Supply Infrastructure and Light Rail Vehicle Interface

T LR RS 00100 ST LRU 100 series - Minimum Operating Standards for Light Rail Vehicles – General Interface Standards

T LR RS 00200 ST LRU 200 series - Minimum Operating Standards for Light Rail Vehicles – Common Interface Requirements

T MU AM 01002 MA Maintenance Requirements Analysis Manual

T MU AM 01003 ST Development of Technical Maintenance Plans

T MU AM 01006 ST Asset Reference Codes

T MU AM 02001 ST Asset Information and Register Requirements

Other reference documents

NSW Government 2012, Surveyor General's Directions No. 12 - Control Surveys and SCIMS

4. Terms and definitions

The following terms and definitions apply in this document:

AEO Authorised Engineering Organisation

ASA Asset Standards Authority

coordinated alignment the method of describing the geometrical elements that combine to produce four foot horizontal track alignment

four foot the area between the two rails of a single track

framepoint major track geometry points; for example, tangent point, transition point that defines changes in geometric components

gauge the distance between the inside running (or gauge) faces of the two rails measured between points 14 mm below the top of the rail head

keep the part of a grooved tram rail that forms the side of the groove away from the running surface; also known as the 'keeper', 'guard' or 'check'

(light rail) checkrail a rail placed inside the running rail which comes into contact with the back of the wheel flange and is used in points and crossing work to provide steering of the wheelset such that the crossing nose is not contacted by the opposite wheel

light rail survey control network the control network of permanent survey marks installed at regular intervals along the light rail corridor, to manage all engineering and associated activities across the life cycle of the project

MCD maintenance concept definition

rate of change of deficiency the rate at which superelevation deficiency is increased or decreased, relative to the speed of a vehicle passing over the transition curve or super ramp expressed as the change of deficiency in mm per second of travel

reverse curve a curve formed by two circular curves of opposite hand, which may be connected by transition curves

rolling stock any light rail vehicle, track machine, piece of equipment, or loading, which is expected to be on a track, guided by the rails, outside of a worksite

superelevation the vertical distance that the outer rail is raised above the inner rail or grade rail on curved track; also known as 'cant'

superelevation deficiency the difference between the equilibrium superelevation on the track and the applied superelevation for the vehicle at the particular stated speed

TfNSW Transport for NSW

TfNSW Transport Network the transport system owned and operated by TfNSW or its operating agencies upon which TfNSW has power to exercise its functions as conferred by the Transport Administration Act or any other Act

track geometry horizontal alignment (that is, radius, superelevation, location of frame points), track centres, vertical alignment, relative track levels

track structure the combination of rail, rail support, rail fastening, ballast or concrete slab

transition curve a curve of constantly varying radius, usually positioned between straight track and curved track

turnouts special trackwork that allows trains to pass from one track on a diverging path. It consists of switch and stockrail assemblies, a 'V' crossing and checkrails, linked together by straight and curved infill rails (closure rails)

unsprung mass the mass of all of the components that are below the primary and/or secondary bogie suspension and hence apply a direct loading to the rails and track

vertical curve radius the equivalent circular curve radius of a vertical curve at its midpoint. A vertical curve is parabolic in form, however that section of the parabola that is the vertical curve very closely resembles a circular curve

wheel-rail interface study a process that examines the wheel-rail interface in order to determine the optimal wheel-rail combination, including materials and construction and maintenance tolerances, that can be used for the rail network to minimise the whole-of-life costs

5. Gauge

Where the standard interoperable vehicle is required to be operated, the track gauge shall be nominally 1435 mm, as measured at a height 14 mm below the head of the rail.

6. Track structure

For all light rail networks, the track structure shall be designed to meet the operational and whole-of-life needs of the particular network.

In addition, where the standard interoperable vehicle is required to be operated, the track structure is to be developed with consideration of the following rolling stock parameters:

- loading conditions – the track components and structure shall be capable of carrying the standard interoperable vehicle with a maximum axle load of 12.5 t
- impact forces - all track components and structure shall be capable of carrying the standard interoperable vehicle with a maximum unsprung mass of 0.71 t/wheel
- contact stresses - all rail and turnout components shall be capable of carrying the standard interoperable vehicle with a minimum wheel diameter of 510 mm. The wheel profiles are specified in T LR RS 00200 ST *LRU 200 series - Minimum Operating Standards for Light Rail Vehicles – Common Interface Requirements* (LRU 210) and rail profiles are specified in Section 9.1 of this standard
- load distribution - the track and other structures that will be required to support the standard interoperable vehicle shall be able to provide for load distributions of:
  - nearest axle 1.7 m
  - next nearest axle 7 m in opposite direction

7. Track alignment

For all light rail networks, the track alignment shall be designed to meet the operational and whole-of-life needs of the particular network.

In addition, where the standard interoperable vehicle is required to be operated and to provide for the consistent experience and safety of passengers, the track alignment shall be designed with consideration of the limits specified in Section 7.1 and Section 7.2.

7.1. Horizontal alignment

To provide for efficient ongoing management of TfNSW assets across all light rail networks and transport modes, horizontal alignment design and records for all light rail networks shall be a coordinated alignment defining the centreline of the 'four foot' of each track. Coordinates used shall be based on GDA 2020 (Geocentric Datum of Australia 2020), with the coordinates for geometric framepoints being calculated to six decimal places of a metre. Section 7.1.1 to Section 7.1.7 provides the specifications.

7.1.1. Horizontal alignment components

Horizontal alignment shall be defined by a combination of any of the following individual segment types:

- straights
- circular curves
- transitions
- compound transitions, which are permitted but not preferred

Bends between straights are permissible but not preferred. The interfaces for all other components shall provide tangency and continuity.

For details of definitions and formulae, refer to ESC 210 *Track Geometry and Stability*.

For the purposes of efficient asset management, the form of the transition shall be either a clothoid or a cubic parabola, as defined in ESC 210. Any network shall have a means of identifying and recording the form of the transition curve in order to ensure future modifications to any transition adopts the same form. This can be achieved, for example, by imposing a common form on all designs within a network or by maintaining data records for each transition within an asset database. The adopted alternative shall be recorded in the project specification.

7.1.2. Minimum length of horizontal components

To allow for the operation of the standard interoperable vehicle, the following minimum horizontal alignment component lengths shall apply:

- for transitions, 12 m (length reduced proportionally for compound transitions)
- for straights between reversing curves, 12 m
- for combinations of horizontal and vertical curves, the horizontal and/or vertical curve radii shall be limited as follows:
  $H \times V \geq 25000$
  Where H = instantaneous horizontal radius (in m)
  and V = vertical radius (in m)

7.1.3. Minimum horizontal radius

To allow for the operation of the standard interoperable vehicle, the minimum horizontal radius in track carrying passengers shall be 25 m, and in other track shall be 20 m.

To provide for the consistent experience and safety of passengers, track adjacent to or close enough to platforms to have an impact on platform gaps shall be straight.

7.1.4. Maximum superelevation

To provide for the consistent experience and safety of passengers, the maximum applied superelevation is as follows:

- in separated track environments where it is not expected that light rail vehicles will stop, the maximum applied superelevation shall be 120 mm
- in segregated track environments where it is possible, but not likely that light rail vehicles will stop, the maximum applied superelevation shall be 75 mm
- in mixed track environments, where typically a light rail vehicle would be expected to stop, the maximum applied superelevation shall be 50 mm

In yard environments, speed will be low, and superelevation should not be applied.

In track affecting platforms, superelevation should not be applied.

7.1.5. Maximum superelevation ramp

To allow for the operation of the standard interoperable vehicle, the maximum (steepest) applied superelevation ramp shall be 1 in 300. The superelevation ramp should be applied over the length of a transition.

7.1.6. Maximum superelevation deficiency

Plain line

To allow for the operation of the standard interoperable vehicle, the speed of all vehicles on plain track shall be controlled (through the setting of speed limits) such that the absolute maximum deficiency of superelevation shall be 100 mm.

To provide for the consistent experience and safety of passengers, the maximum superelevation deficiency is as follows:

- for separated track areas, the maximum deficiency of superelevation shall be 75 mm
- for segregated track areas, the maximum deficiency of superelevation should be 50 mm
- for mixed track areas, the maximum superelevation deficiency should be 25 mm

Turnouts

To allow for the operation of the standard interoperable vehicle, the speed of all vehicles through turnouts shall be controlled such that the maximum deficiency of superelevation shall be 100 mm.

To provide for the consistent experience and safety of passengers, for tracks carrying passengers, the speed through turnouts shall be controlled such that the maximum deficiency of superelevation shall be 75 mm.

7.1.7. Maximum rate of change of deficiency

Plain line

To allow for the operation of the standard interoperable vehicle, the speed of all vehicles on plain track shall be controlled such that the maximum rate of change of deficiency of superelevation shall be 55 mm/s.

To provide for the consistent experience and safety of passengers, on tracks carrying passengers, the maximum rate of change of deficiency shall be 37 mm/s.

Turnouts

To allow for the operation of the standard interoperable vehicle, the speed of all vehicles on turnouts shall be controlled such that the maximum rate of change of deficiency of superelevation shall be 75 mm/s.

To provide for the consistent experience and safety of passengers, on tracks carrying passengers, the maximum rate of change of deficiency in a turnout shall be 55 mm/s.

7.2. Track vertical alignment

To provide for efficient ongoing management of TfNSW assets across all light rail networks and transport modes, vertical alignment design and records for all light tail networks shall define the Down Rail for straight track and the Low (inside) rail for curved track. Section 7.2.1 to Section 7.2.4 provides the specifications for vertical alignments.

7.2.1. Vertical alignment components

Vertical alignment shall be defined as a series of straight grades connected by vertical curves (VC). The interfaces for all components shall provide tangency and continuity.

For details of definitions and formulae, refer to ESC 210.

7.2.2. Maximum grade

To allow for the operation of the standard interoperable vehicle, the maximum grade of track shall be 7%, apart from where vehicles are to be stabled empty, in which case the maximum grade of track shall be 4%.

For the consistent experience and safety of passengers, through platforms the grade shall be minimised as far as practicable, with an absolute maximum grade of 2.5%.

7.2.3. Minimum vertical radius

To allow for the operation of the standard interoperable vehicle, the minimum vertical curve radius shall be as follows:

- 500 m for a sag
- 500 m for a crest

To provide for the consistent experience and safety of passengers, the minimum vertical curve radius through a platform shall be 1500 m for both sag and crest curves.

7.2.4. Maximum vertical acceleration

To provide for the consistent experience and safety of passengers, the speed of vehicles on vertical curves shall be controlled such that the maximum vertical acceleration does not exceed 0.2 m/s^2.

7.3. Construction and maintenance tolerances

To allow for the operation of the standard interoperable vehicle, the following track geometry tolerances shall apply:

- for short twist (in all operational conditions) the absolute limit shall be 1 in 150 over 1.8 m
- for long twist (in all operational conditions) the absolute limit shall be 1 in 250 over 7.6 m

Each network shall determine a suitable set of track geometry construction and maintenance tolerances based on the anticipated deterioration rates, inspection intervals, vehicle capabilities and the required vehicle performance. These tolerances shall optimise system whole-of-life costs while taking into consideration the vehicle performance requirements.

These tolerances shall be developed and recorded according to T MU AM 01002 MA *Maintenance Requirements Analysis Manual* and T MU AM 01003 ST *Development of Technical Maintenance Plans*.

8. Transit space

Each network shall develop limits to allow the safe operation of vehicles past trackside structures and equipment. These limits shall be developed on the principle of providing clearance to the largest kinematic outline of the largest vehicle operating on the network. This shall include all reasonable construction and maintenance tolerances in both the vehicle and the infrastructure, plus any additional safety clearances which may be required in a mixed environment.

8.1. General clearances

To allow for the operation of the standard interoperable vehicle, clearance shall be provided for the standard interoperable vehicle outline, including the following factors:

- standard rolling stock outline, see T LR RS 00100 ST (LRU 110)
- standard rolling stock tolerances, see T LR RS 00100 ST (LRU 110)
- centre and end throw, see T LR RS 00100 ST (LRU 110)
- wheel flange lateral wear, see T LR RS 00200 ST (LRU 210)
- body yaw (rotation of the body about a vertical axis), calculated to include the additional yaw end throw arising from wheel wear, rail wear and wheel-rail free play acting in opposite directions at each end of the light rail vehicle module
- sufficient track tolerances (including rail gauge face lateral wear) shall be included to accommodate the expected range of construction and maintenance tolerances for the local track structure (tolerances adopted shall be dependent on the local designated track

inspection and maintenance standards adopted, and shall be documented according to the requirements of T MU AM 01002 MA and T MU AM 01003 ST)

These factors are to be accommodated following the methods as directed in ESC 215 *Transit Space*.

8.2. Platforms

For all light rail networks, the platform interface shall be designed to meet the operational and whole-of-life needs of the particular network.

In addition, where the standard interoperable vehicle is to operate, and to allow for the standard interoperable vehicle to pass passenger platforms and to facilitate consistent passenger access to and egress from the standard interoperable vehicle across all light rail networks, the platform considerations in Section 8.2.1 to Section 8.2.4 shall apply.

8.2.1. Height

The height of the platform coping edge relative to track centreline height shall be 300 mm ±20 mm. This means that at no time shall the platform be any higher than 320 mm or any lower than 280 mm (relative to the actual track height) during the operation of the network, including any variations in the track and platform position, and all reasonably practicable efforts will be made to minimise the variation about 300 mm height.

8.2.2. Offset

The offset of the platform coping edge relative to the track centreline shall be 1395 mm minus 0 mm, plus the minimum that can be achieved, given the track and platform structural type. This means that at no time during the operation of the network, including any variations in the track and platform position, shall the platform be any closer than this (relative to the actual track position), and all reasonably practicable efforts will be made to minimise the variation from this.

8.2.3. Platform coping tapered lead-in

To mitigate the consequences of any contact between the body of an approaching vehicle and the platform coping, all platforms shall have a horizontally-tapered lead-in to the approach corner of the platform face with a minimum ramp angle of 1 in 5, for a minimum longitudinal length of 100 mm.

8.2.4. Tolerances

All track and platform construction and maintenance tolerances shall be determined for the local conditions such that the height and offset limits documented in Section 8.2.1 and Section 8.2.2 are never exceeded. These tolerances shall be documented in construction and ongoing maintenance instructions such that at no time during the operation of the network will these tolerances be exceeded.

8.3. Contact wire height

For contact wire heights and clearances, refer to T LR EL 00007 ST *Traction Power Supply Infrastructure and Light Rail Vehicle Interface.*

9. Wheel-rail interface

To allow for the efficient long term maintenance of the network, the running and contact surfaces of the rail and turnout components shall meet the following requirements, outlined in Section 9.1 to Section 9.4.

9.1. Rail contact profile

To allow for the operation of the standard interoperable vehicle, the geometry of the surfaces of the rail that come into contact with the wheel shall match the geometry of type 51R1 grooved rail as detailed in EN 14811:2006 *Railway applications - Track - Special Purpose Rail - Grooved and associated construction* or equivalent, unless an alternative profile has been determined through a wheel-rail interface study which demonstrates that this alternative provides lower system whole-of-life costs.

On networks for which the standard interoperable vehicle is not appropriate, the geometry of the surfaces of the rail that come in contact with the wheel shall be determined through a wheel-rail interface study which shall demonstrate that the adopted wheel and rail profiles have optimised system whole-of-life costs, while taking into consideration the vehicle performance.

9.1.1. Gauge widening in curves

Each network shall demonstrate whether curves should be gauge widened to bring the wheel back into contact with the low rail keep (with the outcome of sharing the wear on critical system components, extending the maintenance intervals and reducing derailment risks). This shall be through a wheel-rail interface study which shall demonstrate that the adopted practice has optimised system whole-of-life costs, looking at the particular mix of curve radii and vehicle/axle types proposed for the network.

9.2. Turnouts

To allow for the operation of the standard interoperable vehicle, the geometry of the surfaces of turnout components that come into contact with the wheel shall match the geometry of type 51R1 grooved rail as detailed in EN 14811:2006 rail or equivalent, unless an alternative profile has been determined through a wheel-rail interface study which demonstrates that this alternative provides lower system whole-of-life costs.

To allow for the operation of the standard interoperable vehicle, raised checkrails should be avoided.

On networks for which the standard interoperable vehicle is not appropriate, the geometry of the surfaces of turnout components that come into contact with the wheel shall be determined through a wheel-rail interface study which shall demonstrate that the adopted wheel and rail profiles have optimised system whole-of-life costs while taking into consideration the vehicle performance.

9.2.1. Flangeway gap and effectiveness

To allow for the operation of the standard interoperable vehicle, the geometry of the flangeways in turnouts (including checkrail effectiveness and maintenance tolerances) shall be designed to accommodate the wheel profiles and wheelset back-to-back dimensions and tolerances specified in T LR RS 00200 (LRU 230).

On networks for which the standard interoperable vehicle is not appropriate, the geometry of the flangeways in turnouts (including checkrail effectiveness and maintenance tolerances) shall be determined through a wheel-rail interface study which shall demonstrate that the adopted wheel and rail profiles have optimised system whole-of-life costs, while taking into consideration the vehicle performance.

9.2.2. Flangeway depth and flange tip running

Each network shall demonstrate the geometric conditions for which flange tip running may be required (with the desired outcome of reducing wheel impacts at crossings) and shall determine the turnout and flangeway ramp geometry required. This shall be through a wheel-rail interface study which shall demonstrate that the adopted practice has optimised system whole-of-life costs, while at the same time taking into consideration the vehicle axle type, wheel dimensions and maintenance tolerances, vehicle speed and wheel impacts.

9.2.3. Minimum wheel diameter

To allow for the operation of the standard interoperable vehicle through turnouts, all turnout components shall be designed to accommodate a minimum wheel diameter as specified in Section 6.

On networks for which the standard interoperable vehicle is not appropriate, all turnout components shall be designed using the inputs from a wheel-rail interface study which shall determine the appropriate minimum wheel diameter to be used on the network based on optimising the system whole-of-life costs while at the same time taking into consideration the vehicle performance.

9.2.4. Axle type (independently rotating wheels and fixed axles)

To allow for the operation of the standard interoperable vehicle through turnouts, all turnout components shall be designed to accommodate a mix of fixed axles and independently rotating wheels.

On networks for which the standard interoperable vehicle is not appropriate, all turnout components shall be designed using the inputs from a wheel-rail interface study that shall determine the appropriate axle type to be used on the network based on optimising the system whole-of-life costs while at the same time taking into consideration the vehicle performance.

9.3. Tolerances

The maintenance tolerances to be adopted for rails and turnout components shall be determined through a wheel-rail interface study which shall consider system whole-of-life costs.

9.4. Lubrication and friction modification

To allow for the operation of the standard interoperable vehicle, all gauge face and checking surface lubrication requirements, and any top-of-rail friction modification product requirements shall be met through the use of wholly vehicle-mounted and vehicle-activated equipment and shall not rely on any track-side equipment for its function. Supplementary track-side lubrication or friction modification can be used for specific local issues.

On networks for which the standard interoperable vehicle is not appropriate, a lubrication and friction modification regime shall be determined which optimises system whole-of-life costs while at the same time taking into consideration potential risks to the public.

10. Buffer stops

Buffer stops used on light rail networks do not need to be energy-absorbing.

To allow for the operation of the standard interoperable vehicle, buffer stops shall be designed for a minimum impact of a 100 t gross mass vehicle, at a speed appropriate for the location.

To allow for the operation of the standard interoperable vehicle, the shape of the impacting surface shall interface with the anti-climber beam of the standard interoperable vehicle.

11. Data management

All TfNSW data management requirements are contained in the TfNSW asset management standards, state or federal legislation. Some of those requirements specific to track design are presented here to reinforce these requirements.

11.1. Kilometrage

To provide for efficient ongoing management of TfNSW assets across all light rail networks and transport modes, each network shall adopt a kilometrage origin and develop track kilometrages in accordance with common TfNSW practices as adopted in the heavy rail environment and documented in T MU AM 01006 ST *Asset Reference Codes*.

11.2. Track naming

To provide for efficient ongoing management of TfNSW assets across all light rail networks and transport modes, each network shall adopt a track and corridor naming convention in accordance with TfNSW practices as detailed in T MU AM 02001 *ST Asset Information and Register Requirements.* Thus, where the Down direction is the direction of increasing kilometrage, generally the Down track is the left of the two when facing the Down direction and the Down rail is the left rail when facing the Down direction.

11.3. Survey

To provide for efficient ongoing management of TfNSW assets across all light rail networks and transport modes, each network shall develop a light rail survey control network, realised on the ground by light rail survey control marks.

The coordinated alignment of the light rail network shall be based upon the light rail survey control network.

The light rail survey control network shall be based upon, and connected to the current National Geospatial Reference System (NGRS). In NSW, the current national horizontal and vertical reference systems are the Geocentric Datum of Australia (GDA2020), and the Australian Height Datum (AHD71). In the Greater Sydney area, this reference system is realised on the ground by a network of Class A State Survey Control Network marks, adopted and adjusted by Spatial Services NSW, and known as the Greater Sydney Subspine Network (GSSN). Spatial Services NSW is also in the process of developing Subspine Networks for other areas of the state.

The methods and observations required for connection of the light rail survey control network to the GSSN shall be developed in collaboration with Spatial Services NSW, as detailed in *Surveyor General's Directions No. 12 – Control Surveys and SCIMS* (SGD12). This is to ensure that any observations undertaken as part of the light rail control network shall be of a sufficient standard to be incorporated into the Survey Control Information Management System (SCIMS) database. This collaboration with Spatial Services NSW shall include all aspects of the survey, including selection and placement of marks, network design, station density, observation and processing techniques, levels of redundancy, equipment and presentation of results.

Any infill traversing undertaken to further densify the light rail survey control network using conventional survey techniques, shall adopt the procedures outlined in T HR TR 13000 ST *Railway Surveying*. This includes any observations of permanent track control marks (TCMs), including any differential levelling undertaken.

Requirements relating to TCM survey plaques, specifically relating to type, lettering, data and installation thereof, shall be based on the information provided in T HR TR 13000 ST.

All permanent survey marks and TCMs (including associated plaques), installed as part of the light rail survey control network, shall be recognised as assets and managed as such. This recognition shall extend to all the metadata associated with these marks, including observation and reduction files, and resulting coordinates (xyz).

Records management and reporting shall be organised such that all relevant information is easily accessible, is maintained in a recognised and compatible format with existing similar databases, and is available to all authorised personnel.