TS 01055:1.0

CRN CS 540

Civil

Service Installations in the Rail Corridor

Issue date: 30 January 2022

Effective date: 30 January 2022

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Document information

Owner:	Director Corridor Infrastructure & Engineering, AMB, SER
Mode	Heavy rail
Discipline	Signalling

Document history

Revision	Effective date	Summary of changes
Version 1.1	January 2022	TfNSW template applied.
Version 2.0	30 January 2022	First full UGLRL release.

Table of contents

1. Purpose, scope and application

This Standard specifies the technical requirements for the design, installation and maintenance of electrical, signalling, communications and utility services, cables and pipelines on the Country Regional Network (CRN) rail corridor.

The requirements are applicable to both UGLRL CRN services and services owned by non-rail parties.

The requirements are applicable to both above ground and below ground services.

Services covered in this document include:

- Electrical
- Signalling
- Telecommunications
- Water and sewerage
- Stormwater drainage - Combustible liquids - Flammable fluids.

The requirements for track drainage are specified in CRN Engineering Standard CRN CS 420 “Track Drainage”.

The requirements apply to all CRN corridors and property.

2. References

2.1. Australian and International Standards

AS 1100.401	Technical drawing - Part 401: Engineering survey and engineering survey design drawing
AS 1289	Methods of testing soils for engineering purposes
AS 3000	Electrical installations (known as the Australian / New Zealand Wiring Rules)
AS 4799	Installation of underground utility services and pipelines within railway boundaries
AS 5100	Bridge design
AS/ACIF S009	Installation requirements for customer cabling (Wiring Rules)

Unless otherwise specified, all references relate to the latest standard versions, including amendments and relevant superseding standards.

2.2. CRN documents

CRN CS 215	Transit Space
CRN CS 310	Underbridges
CRN CS 320	Overbridges and Footbridges
CRN CS 330	Miscellaneous Structures
CRN CS 420	Track Drainage
CRN CM 541	Service Crossings
CRN SP 050	Use of Cable Locators
CRN SC 021	Construction of Cable Route and Signalling Civil Works

2.3. Other references

SafeWork NSW “Code of Practice Excavation”

SafeWork NSW Guide “Work Near Underground Assets”

2.4. Definitions

Terms used in this standard are defined as follows:

Non-Rail Party: Organisation external to UGLRL CRN, e.g. Telstra, Optus, Local Government Authorities, electrical, water, sewerage and gas utilities

Applicant: Individual, company or organisation that wishes to install a service within the rail corridor

ULX: A service crossing beneath a rail line

URX A service crossing beneath a roadway (e.g. access road)

Definitions of other standard terms used in this standard are provided in AS 4799 “Installation of underground utility services and pipelines within railway boundaries”

3. Engineering authority

Design and selection of infrastructure detailed in this standard for use on the CRN may only be undertaken by persons who have been granted appropriate Engineering Authority by the Principal Track and Civil Engineer.

4. General requirements

4.1. Applications by non-rail parties

Applications by non-rail parties for the installation of services on the rail corridor shall be made in accordance with the process detailed in CRN Engineering Manual CRN CM 541 “Service Crossings”.

Management of the application and approval process by UGLRL CRN shall follow the procedure detailed in CRN CM 541.

Major service crossings, e.g. pipelines carrying flammable liquids, toxic or corrosive substances are not permitted without the approval of the Principal Track and Civil Engineer.

4.2. Services search

A Services Search shall be undertaken by the Applicant to identify any existing services that may be affected by the proposed new installation.

Service searches for non-rail (external) services shall be undertaken with the relevant authorities in accordance with industry-standard procedures including Dial-Before You-Dig.

Service searches for UGLRL CRN services shall be undertaken in accordance with the requirements of UGLRL CRN’s Services Search procedures

4.2.1. Methods for locating existing services

There are various non-destructive methods available for validating the location of existing underground services on site. These include:

- Use of electronic cable locating equipment;
- Use of ground penetrating radar (GPR) equipment;
- Potholing by hand digging (refer to Safe Work NSW Guide “Work Near Underground Assets”);
- Potholing by vacuum excavation, using compressed air or water to break up the ground and vacuum to remove the loosened material.

Potholing to expose a service provides a greater guarantee of the precise location of a service than the electronic or GPR methods.

Use of electronic cable locating equipment shall be in accordance with CRN Engineering Procedure CRN SP 050 “Use of Cable Locators”

4.2.2. Marking of services

Once identified, the ground marking of underground services shall be done using the following colour scheme:

Type of Service	Colour
Signalling / Communication	Pink
LV &HV Power Internal & External	Orange
External Telecommunications	White
Gas	Yellow
Water / Sewerage / Drainage	Green
Compressed Air	Light Blue
Fuel, Combustible and Flammable Liquids	Red

4.3. Installation planning

The planning of excavation work shall incorporate the following requirements:

- Assessment of effect when installing undertrack crossings (ULX) on track settlement and the safe passage of trains, and determination of safe working methods (e.g. rail baulking if required);
- The need to monitor any movement of the track or other adjacent infrastructure by survey, during and after installation, and preparation of a track and structures monitoring plan.

Excavation work shall comply with the requirements of Safe Work NSW “Code of Practice Excavation” (Cat. No. 312) and Safe Work NSW Guide “Work Near Underground Assets” (2007).

5. Above ground (aerial) services

5.1. Types of services

Above ground services include aerial lines such as electrical and communication services, freestanding structures carrying pipelines and services attached to bridges.

The services may run along or across the rail corridor.

5.2. Permitted installations – non-rail parties

Permitted installations of above ground services by non-rail parties include high and low voltage power, telecommunications, water, sewerage and gas.

Pipeline crossings on dedicated free-standing aerial structures are not permitted without approval of the Principal Track and Civil Engineer.

5.3. Design requirements

5.3.1. General

Aerial crossings for electrical, telecommunications and other utilities shall be designed and installed in accordance with relevant industry and Australian Standards.

Free-standing structures carrying pipelines shall be designed in accordance with CRN Engineering Standard CRN CS 330 “Miscellaneous Structures”.

5.3.2. Services attached to bridges

Design loadings for services attached to bridges shall be in accordance with relevant Australian Standards. The bridge shall be assessed for the structural capacity to withstand the service pipeline design loadings.

Fixing details shall be in accordance with design codes and practices. They shall not impact on the structural integrity of the bridge. They shall not create an obstruction that causes water to pond or debris to accumulate on the bridge structure. They shall only be made into existing structural members with the approval of the Principal Track and Civil Engineer.

The service and fixings shall not impinge on the clear walking space of walkways and the clear space of refuges.

Services and fixings shall not prevent access for inspection and maintenance of the bridge, including the structure immediately behind the service.

5.3.3. Location

Designs shall comply with the minimum clearances specified in CRN Engineering Standard CRN CS 215 “Transit Space”.

Other criteria for locating above ground services shall be applied as follows:

- access to CRN infrastructure shall be maintained as specified for the particular site;
- provision shall be made for any future infrastructure requirements advised by UGLRL CRN;
- design of any structure supporting an aerial service shall be such that the number of elements that are likely to be struck by a derailed train is minimised. Any columns at track level supporting the structure shall comply with the standards for pier and column protection (refer to Section 5.4 below).

No services shall be attached to bridges and structures without the approval of the Principal Track and Civil Engineer. Proposals shall ensure that there is no adverse impact on the structure (e.g. walking areas for authorised personnel and access for inspection and maintenance of the structure).

5.4. Collision Protection

The design of piers or columns supporting service structures within the rail corridor shall comply with the provisions of collision protection and loading in AS 5100 “Bridge Design”.

The prime requirement is to protect the piers and columns against damage from a derailed train, which in turn could result in collapse of the structure onto the train.

The minimum clearance to track centre line from any pier or column shall be as specified in CRN CS 215.

A pier or column shall not be located between tracks. Variation to this may only be approved by the Principal Track and Civil Engineer.

Design and configuration of collision protection shall meet the requirements of CRN CS 320.

6. Below ground (underground) services

6.1. Types of services

Below ground (underground) services may include low or high voltage electrical, signalling and telecommunication cables and pipelines conveying, water, sewerage, combustible liquids (e.g. petroleum) and flammable fluids (e.g. gas).

The services may run along or across the rail corridor and pass beneath a rail line (ULX) or roadway (URX).

6.2. Permitted installations – non-rail parties

Installation of new service crossings directly across the rail corridor will be considered and may be approved by UGLRL CRN, subject to all engineering requirements being met and a satisfactory agreement being reached between UGLRL CRN and the Applicant.

Although there are many existing non-rail services that have been installed longitudinally along the rail corridor, further installations shall not be permitted unless approved by the Principal Track and Civil Engineer.

Valves, compressor stations and flare points for combustible liquids or flammable fluids are not permitted on the rail corridor.

6.3. Design requirements

6.3.1. General

Underground cables and pipelines shall be designed and installed in accordance with Australian Standard AS 4799 and the requirements of this Standard.

Signalling and communication service installations shall comply with CRN Engineering Specification CRN SC 021 “Construction of Cable Route and Signalling Civil Works”.

Power cable installations shall also comply with the requirements of CRN SC 021.

6.3.2. Location

For non-rail party installations, underground services shall be located in natural ground.

For UGLRL CRN services, they shall generally be located in natural ground but in restricted locations they may be located in the formation, including the shoulder areas.

Where the installation method includes excavation of the capping and formation, restoration of the formation and capping shall be carried out on completion of the cable laying works as specified in Section 7.

Minimum clearances to adjacent structures and vulnerable areas such as drains, toes of embankments, shoulders of embankments and tops of cuttings shall be in accordance with AS 4799.

No services shall be attached to bridges and structures without the approval of the Principal Track and Civil Engineer. Proposals shall ensure that there is no adverse impact on the structure (e.g. walking areas for railway employees and access for inspection and maintenance of the structure).

Where crossings are being installed under a bridge, the trench shall be excavated no closer than 3 metres to the footings of any abutment or pier. The excavation shall not undermine the bridge footing or lead to instability or sliding of the abutment or pier. The stability of the abutment or pier shall be checked for the temporary open trench condition and it shall be demonstrated that the requirements of AS 5100 have been met.

Where crossings are being installed through a culvert, the following requirements apply:

- The maximum nominal diameter of pipe shall be 75mm unless approved by the Principal Track and Civil Engineer.
- The pipe shall be located close to the culvert wall and as close to the soffit as possible.
- The pipe shall be located by grouting under and over the pipe to present a smooth surface to the water passing through the culvert.
- The pipe shall return underground at each end of the culvert as quickly as practical.

No services shall be installed in an open channel drainage system.

No underboring can be carried out at any location under, or within 10 metres of turnouts or special trackwork (catch points, expansion switches, diamonds, slips etc.).

CRN signalling and communication cable routes shall to be located in accordance with CRN SC 021.

6.3.3. Geotechnical assessment

All proposed undertrack crossings shall be assessed by UGLRL CRN personnel in the planning stage in accordance with the process detailed in CRN CM 541. If as a result of the assessment it is considered that there is a significant risk to the stability of CRN infrastructure a Geotechnical assessment shall be required.

The geotechnical assessment shall consider

- the geotechnical conditions and the material through which the service is to be installed, and
- the effect of the proposed installation on the track, and other infrastructure, including any effects from changes in the water table.

The geotechnical investigation/ report shall be undertaken and prepared by a competent geotechnical engineer.

The geotechnical investigation for the proposed undertrack crossing shall include (but not be restricted to) the following:

- Boreholes or test pits at entry and exit points to a minimum depth of 1000mm below the base of the proposed excavation entry/ exit points;
- Boreholes or test pits at the toe of the ballast on either side of the line to a minimum depth of 1000mm below the base of the proposed ULX invert. For double track lines, an additional borehole or test pit shall be carried out in the six foot if feasible. For multiple track lines, additional boreholes or test pits shall be carried out as required by UGLRL CRN.

The geotechnical report for the proposed undertrack crossing shall include (but not be restricted to) the following:

- Site description and results of investigation;
- An accurately surveyed cross section along the ULX alignment showing current ground surface, rail levels/ positions, position of proposed ULX, existing underground services, borehole or test pit information and correlation lines of subsurface layers between boreholes or test pits, and any other relevant information;
- Prediction of possible ground subsidence during the ULX installation, especially if noncohesive soils are present;
- Recommendation for the most suitable installation method;
- An assessment as to whether a geotechnical engineer should be in attendance during construction to monitor any suspect ground conditions and ground movement.

If, as a result of a design and works planning review undertaken by CRN in accordance with the process detailed in CRN CM 541, and based on geotechnical report/s, UGLRL CRN determines

that ground movement is possible or expected as a result of the work, UGLRL CRN may determine that infrastructure monitoring is required.

Where track monitoring is required, it shall comply with the requirements of Engineering Manual CRN CM 541.

If underboring is planned and it meets the requirements of 'minor' underboring detailed in CRN CM 541, the simplified monitoring guidelines also detailed in CRN CM 541 may be applied.

6.3.4. Design traffic load

Pipelines carrying underground services within the rail corridor shall be designed for R20 vehicle loading. Refer to CRN CS 320 for details of the R loading configuration.

Pipelines carrying underground services crossing under the tracks shall be designed for train loads as specified in CRN Engineering Standard CRN CS 310 “Underbridges”. The dynamic load allowance (DLA) shall vary linearly from 1.5 at 0.3 m depth to 1.0 at 3.5 m depth or greater, where the depth is measured from the top of rail. This load shall be applied to the length of pipe as specified in AS 4799.

6.3.5. Depth of cover

The minimum cover to underground services shall be as prescribed in AS 4799, except for crossings under the track

For undertrack crossings, the minimum depth below rail shall be the depth specified in AS 4799 or 1600mm, whichever is the greater.

The depth of cover for CRN signalling and communications cable routes shall meet the requirements of CRN SC 021 Section 6.

Where practicable, new undertrack crossings shall be installed at greater than the minimum depths specified above. This ensures that the service is well clear of other existing services and future maintenance activities on CRN infrastructure.

6.3.6. Direction of services

For non-rail party installations, undertrack service crossings shall cross at 90 ±5° to the tracks. Where this is not achievable, the crossing shall be as close as possible to 90°. Service crossings shall not have bends within the rail corridor.

6.3.7. Carrier and encasing pipes

In general, the need for an encasing pipe for undertrack crossings shall be assessed on a case by case basis.

Encasing pipes shall be provided for all undertrack crossings conveying high voltage cables, pressure pipelines and pipelines carrying combustible liquids and flammable fluids.

6.3.8. Separation of services

Trenches may be shared by high voltage cables, signalling and communications cables and other services.

Different services shall be separated as prescribed in Clause 3.2.6 of AS 4799, AS/ACIF S009 “Installation requirements for customer cabling (Wiring Rules)” and AS 3000 “Electrical installations (known as the Australian/New Zealand Wiring Rules)”.

CRN signalling, power and communications shared cable routes shall be constructed in accordance with CRN SC 021.

6.3.9. Service pits

Pits and access chambers for non-rail services shall be located outside the rail corridor.

Pits within the rail corridor shall be located and constructed in accordance with the requirements of CRN SC 021 and AS 4799.

Pits within the rail corridor shall be designed for road vehicle loads. The minimum load shall be the R20 vehicle loading.

6.4. Installation

6.4.1. General

For excavation work, the requirements of Safe Work NSW “Code of Practice Excavation” shall be observed in their entirety. This Code gives specific direction on legal requirements for shoring of excavations, periodic inspections, safety fencing, excavations adjacent to buildings and structures, flooding risks, stacking of materials, protection from falling objects, work adjacent to or under overhead power lines, manual handling, lighting, ladders and scaffolding, mechanised plant and heavy machinery, working in confined spaces, use of personal protective equipment and environmental protection.

6.4.2. Installation methods

Depending on the particular site conditions, alternative methods for installing underground services under tracks or access roads within the rail corridor include:

- Cased auger boring (refer to Clause 3.6 of AS 4799): this method is suitable where precise accuracy is not crucial;
- Laser-guided micro-tunnelling: this method uses a laser-guided vacuum borer head with articulated positive steering;

- Pipe jacking (refer to Clause 3.6 of AS 4799): pipe jacking methods are generally suitable for larger pipe diameters and can be employed up to a distance of 100 metres. Accuracy in alignment is achieved by using a laser beam. In addition to Clause 3.6.2.2 of AS 4799, for jacking through non-cohesive soil where the pipe can be advanced ahead of excavation, removal of soil in the pipe shall only proceed to within one pipe diameter behind the leading edge of the pipe. Generally, excavation shall proceed not more than 50mm ahead of the leading end of the pipe before the pipe is jacked forward;
- Directional drilling: this process is surface launched and can be tracked down to a depth of over 100 metres below the surface. Services can typically be laid up to a distance of 1000 metres in a single bore. Advantages include elimination of trenching and associated excavation and shoring costs, greater safety, no disruptions to rail traffic and less delays owing to unfavourable weather conditions.
- Tunnel boring: this method typically employs a steel cylinder equipped with a hydraulic excavator in the front. Extracted material is removed with an auger or conveyor and a liner plate is installed in the rear section as the borer progresses forward. Using this method, tunnels up to 2400mm in diameter can be installed in granular soil;
- Trenching: trenching with rail baulks or temporary tunnelling under tracks is permitted in exceptional circumstances only. This method may necessitate a complete closedown of the track. Technical aspects of trenching are addressed in Clause 3.7 of AS 4799 and Section 7 of this standard.

Trenching is also permitted for services running along the rail corridor and not crossing under a track or access road, subject to the technical requirements and procedures being followed as laid down in Section 7.

6.4.3. Protection of rail infrastructure

Care shall be exercised when excavating within 5 metres of rail infrastructure as there is a risk that the rail infrastructure may be disturbed or damaged.

This could include for example:

- Track subsidence;
- Excavation at the base of railway embankments, that might lead to destabilisation and failure of the embankment;
- Disturbance to drainage systems over railway cuttings that might lead to failure of the cutting slopes or fouling of the tracks below;
- Undercutting of the base of railway cuttings;
- Damage to railway cess drains and disturbance to the flow of stormwater runoff;

- Excavation adjacent to building, bridges or other structures that might undermine or destabilise the foundations;
- Damage to above ground railway equipment, e.g. signalling infrastructure;
- Damage to other existing underground services.

When excavating adjacent to structures, there is a risk that the footings may be undermined or the structure destabilized, resulting in structural failure and potential collapse.

No excavation is permitted :

- within 5m of structure footings
- below the base of the footings of any structure (for example bridges, retaining walls and station platform walls)
- without: prior analysis of structure stability with respect to the effects of the excavation, documented engineering advice and certification by an authorised geotechnical/structural engineer, based on the results of an appropriate geotechnical and/or structural investigation, and - approval by the Principal Track and Civil Engineer.

6.5. Markers

Marker signs shall generally be installed in accordance with the technical requirements and procedures laid down in Clause 3.10 and Sections 4 to 6 of AS 4799.

In addition to above ground markers, plastic warning tape shall be laid in every trench 100 mm above telecommunications cables, to act as a warning during subsequent excavation, fire break grading or access road maintenance.

For CRN signalling and communication cable routes, markers shall be installed in accordance with CRN SC 021.

7. Trenching

7.1. Placement of excavated material

Material from excavations shall be placed clear of track ballast so as to avoid fouling of ballast and blocking of track or other surface drainage.

Where it is necessary to place such material between the rails or upon the ballast shoulders, a suitable screen of plastic, timber or other suitable material shall be used to provide a barrier between the ballast and the spoil.

Spoil placed between the rails or within 1000mm from any rail shall not extend above the top of rail level.

Spoil shall not be placed in a position where it may damage or affect the operation of existing equipment (e.g. mechanical signalling control rodding or wires, cable routes, power operated points etc.).

7.2. Width of trenches

The width of trenches shall only be wide enough for installation and compaction. The minimum requirement is pipe diameter plus 150mm minimum each side.

7.3. Backfilling and compaction

Backfilling and compaction of excavations under tracks, and for a distance of at least 3m beyond the outer rails, shall be carried out in accordance with Clause 3.9 of AS 4799.

Other excavations more than 3 metres beyond the rails shall be backfilled with the same material unless otherwise approved and compacted to not less than 95% maximum dry density as determined by AS 1289 Test 5.1.1 and 5.3.1 (Standard Compaction).

The ground surface above and around backfilled excavations shall be graded so as not to restrict the flow of surface water and to prevent ponding.

Surface drainage shall be reinstated during the backfilling operations.

7.4. Disposal of excavated materials

The provisions of Clause 3.8 of AS 4799 shall be applied to the disposal of excavated material.

7.5. Ponding of water in open trenches

At no time shall water be allowed to pond in open trenches. If rain is occurring or forecast, or if active seepage into the open trench is encountered, the trench shall be filled on the same day as the excavation.

8. Documentation

8.1. Design stage

Documentation complying with AS 1100.401 ”Technical drawing - Part 401: Engineering survey and engineering survey design drawing” and AS 4799 shall be provided as part of the planning and design process.

General requirements include a site survey and scaled plans and cross-sections detailing:

- Proposed location in plan view and rail kilometrage of the crossing, relative to the railway boundary, tracks and other adjacent railway infrastructure;

- Proposed reduced levels of the crossing, relative to the ground, track and other infrastructure;
- Angle of the crossing;
- Details of the proposed type and construction of the crossing;
- Location of proposed valves, pits, masts/poles and other fixtures and fittings;
- Details of markers or other protection devices to be installed;
- Details of other adjacent services as determined from the Services Search.

8.2. Work-as-executed plans

Work-as-executed plans shall be prepared and submitted on the completion of all new service installations and changes to existing services. Any variations to the approved plans shall be clearly marked, particularly with respect to any change in location, changes in depth of services below ground or direction of services.

GPS coordinates shall be provided for start/end points and any changes of direction within the rail corridor.