TRANSPORT FOR NSW (TfNSW)

TfNSW SPECIFICATION D&C R155

DESIGN AND CONSTRUCTION OF UNDERGROUND CABLEWAYS

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REVISION REGISTER

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FOREWORD

TfNSW COPYRIGHT AND USE OF THIS DOCUMENT

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When this document forms part of a deed

This document should be read with all the documents forming the Project Deed.

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BASE SPECIFICATION

This document is based on Specification TfNSW R155 Edition 1 Revision 8.
TfNSW QA SPECIFICATION D&C R155

DESIGN AND CONSTRUCTION OF UNDERGROUND CABLEWAYS

1 GENERAL

1.1 SCOPE

This specification sets out the requirements for the design and construction of cableways, which are mostly installed underground, for carrying communications and electrical cables, as part of Transport for NSW’s (TfNSW) Intelligent Transport System (ITS).

The scope of work covered by this specification includes:

(a) Survey of the cableway route;
(b) Design of the cableway, to be used for carrying ITS communications and electrical cables;
(c) Construction of the cableway, including cleaning up and restoration of the work sites;
(d) Testing of installed conduits;
(e) Preparation of work-as-executed drawings.

This specification does not cover the installation of conduits or pits for traffic signals, which are dealt with under other specifications.

1.2 STRUCTURE OF THE SPECIFICATION

This Specification includes a series of annexures that detail additional requirements.

1.2.1 (Not Used)

1.2.2 (Not Used)

1.2.3 Schedules of HOLD POINTS, WITNESS POINTS and Identified Records

The schedules in Annexure R155/C list the HOLD POINTS and WITNESS POINTS that must be observed. Refer to Specification TfNSW D&C Q6 for the definitions of HOLD POINTS and WITNESS POINTS.

The records listed in Annexure R155/C are Identified Records for the purposes of TfNSW D&C Q6 Annexure Q/E.

1.2.4 Planning Documents

The PROJECT QUALITY PLAN must include each of the documents and requirements listed in Annexure R155/D and must be implemented.

In all cases where this Specification refers to the manufacturer’s recommendations, these must be included in the PROJECT QUALITY PLAN.
1.2.5 Frequency of Testing

The Inspection and Test Plan must nominate the proposed frequency of testing to verify conformity of the item, which must not be less than the frequency specified in Annexure R155/L. Where a minimum frequency is not specified, nominate an appropriate frequency. Frequency of testing must conform to the requirements of TfNSW D&C Q6.

You may propose to the Principal a reduced minimum frequency of testing. The proposal must be supported by a statistical analysis verifying consistent process capability and product characteristics. The Principal may vary or restore the specified minimum frequency of testing, either provisionally or permanently, at any time.

1.2.6 Referenced Documents

Standards, specifications and test methods are referred to in abbreviated form (e.g. AS 1234). For convenience, the full titles are given in Annexure R155/M.

1.3 DEFINITIONS AND ACRONYMS

1.3.1 Definitions

The terms “you” and “your” mean “the Contractor” and “the Contractor’s” respectively.

The following definitions apply to this Specification:

- **Cableway**: System of conduits, including conduit fittings, pits and equipment housing, but excluding the communication and electrical cables and equipment.

- **Engineer**: Engineer(s) eligible for Corporate Membership of Engineers Australia and practising in the relevant type of engineering work.

- **Inadequate foundation material**: Material beneath or adjacent to the proposed cableway route which the Principal deems to be of insufficient strength to support the cableway loads, or material whose characteristics the Principal deems would adversely affect the performance or construction of the cableway.

- **Main backbone**: The part of cableway in the longitudinal direction of its route, but excluding any transverse or longitudinal branching parts.

- **TfNSW ITS CAD Standard**: CAD drawings submitted as a set of two (2) files as below:
  (a) one editable CAD file in “.dgn,” “.dwg” or “.dxf” format of each design plan drawing, and
  (b) one portable file in “.pdf” format of the same design plan drawing in A3 size, drawn in accordance with AS 1100.401, AS 1102, AS 3000, AS 3008 and AS 4383.

- **Offset branches**: The parts of the cableway branching out from the main backbone in any direction.

- **Ploughing**: The process of laying conduits and cables while also installing sand bedding, padding and marker tape simultaneously using a particular type of a tractor.
Regional Roads
A category of roads agreed with Councils for administrative purposes. They comprise the lesser trafficked classified roads which are not State Roads and some of the more important unclassified roads. They are managed by Councils with TfNSW providing significant funding assistance.

State Roads
A category of roads agreed with Councils for administrative purposes. They form the primary arterial network of classified roads in the State and some special purpose classified roads. TfNSW manages State Roads and accepts responsibility for funding, priorities and outcomes.

1.3.2 Acronyms

The following acronyms apply to this Specification:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AISI</td>
<td>American Iron and Steel Institute</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer Aided Design</td>
</tr>
<tr>
<td>DN</td>
<td>Nominal size, referring to internal diameter of a pipe or fitting</td>
</tr>
<tr>
<td>HD</td>
<td>Heavy duty</td>
</tr>
<tr>
<td>ITS</td>
<td>Intelligent Transport Systems</td>
</tr>
<tr>
<td>WAE</td>
<td>Work-as-executed, referring to drawings of completed construction works</td>
</tr>
</tbody>
</table>

2 DESIGN REQUIREMENTS

2.1 GENERAL

2.1.1 Design

Taking into account the requirements stated in this specification, carry out design of the cableways.

Your design must provide for appropriate methods of conduit installation.

2.1.2 Cableway Route Location

Locate the cableway within the road reserve and outside the area occupied by the road pavement. The route alignment must not result in any additional land acquisition.

Where the cableway passes through reinforced soil walls, the locations of the conduits must avoid the soil reinforcement components.

2.1.3 (Not Used)

2.2 DETAILED SITE SURVEY

Prior to commencing the detailed design, carry out a detailed site survey in accordance with Specification TfNSW G73 of the indicative cableway route, to be used in designing the actual cableway route.
The survey must identify the locations of all significant features such as rock outcrops, rocky surfaces, existing cableway routes and pits, other existing utilities/services, access roads and easements or rights of way to be provided, and locations of any under road, under waterway or bridge crossings required.

Submit the detailed site survey to the Principal prior to the commencement of your detailed design.

2.3 CONDUITS

2.3.1 Number of Conduits in Main Backbone

Where the main backbone of the cableway runs along a State Road or Regional Road, provide 4 x 100 mm conduits for communications cables and 4 x 100 mm conduits for electrical cables, unless shown otherwise on the Design Documentation drawings.

For all other roads, provide 2 x 100 mm electrical conduits and 2 x 100 mm communications conduits, unless shown otherwise on the Design Documentation drawings.

This requirement takes precedence over any conflicting requirements stated in Specification TfNSW D&C TS101.

2.3.2 Offset Branch at Intersections

(a) Signalised Intersections

Where a new signalised intersection is being constructed, or an existing signalised intersection is being reconstructed as part of the Works, provide an offset branch comprising 2 x 100 mm communications conduits and 2 x 100 mm electrical conduits in accordance with Drawing No. DS2012/000830.

(b) Unsignalised Intersections

Where a new unsignalised intersection is being constructed, or an existing unsignalised intersection is being reconstructed as part of the Works, provide an offset branch comprising 1 x 100 mm communications conduit and 1 x 100 mm electrical conduit in accordance with Drawing No. DS2012/000834.

2.3.3 Offset Branches Between Intersections

On roads that have intersections separated from each other by a distance of less than 2 km, provide an offset branch midway between the two intersections, where required.

On roads that have intersections separated from each other by a distance of more than or equal to 2 km, provide offset branches at 1 km intervals, where required.

For each offset branch installation, provide 1 x 100 mm communications conduit and 1 x 100 mm electrical conduit.

2.3.4 Separation Between Conduits

Provide a separation gap of at least 100 mm between the communications and electrical conduits in the cableway, as shown on Drawing No DS2012/000836.

2.3.5 Depth of Conduits

(a) Under Pavements Subjected to Traffic Loads
For cableways located under pavements which are subjected to traffic loads, provide a minimum cover of 1.2 m over the cableway conduits. This minimum cover may be reduced to 1.0 m where the cableway is encased within a concrete surround.

(b) Under Footpaths or Grasped Areas

For cableways located outside trafficked pavements, e.g. under footpaths or within grassed areas, provide a minimum cover of 0.6 m over the cableway conduits.

2.3.6 Obstructions In Cableway Route

When an obstruction such as existing utilities or a rock outcrop lies in the path of the cableway, divert the cableway with bends to avoid the obstruction as shown on Drawing No. DS2012/000832.

Align the communications and electrical conduits in parallel and at the minimum clearance from the obstruction as shown on Drawing No. DS2012/000832. Maintain the minimum separation gap between the communications and electrical conduits specified in Clause 2.3.4.

Bends in conduits must not have angles greater than 30°, and must be smooth and free of irregularities.

2.3.7 Bridge Crossing

Where conduits are provided within the bridge walkway or parapets, use these conduits as part of the cableway.

Where the conduits provided are insufficient or absent, run the conduits beneath the bridge deck, supported with galvanized steel brackets anchored into the bridge structure. Alternatively, install the conduits on a cable ladder anchored on to the bridge structure.

For box girder bridges, install conduits on cable ladders within the box girder in accordance with Drawing No. DS2012/000831.

2.3.8 Tunnels or Underpasses

In tunnels and underpasses, install conduits in cable ladders fixed to the walls of the tunnel or underpass in accordance with Clause 3.1.5.

2.4 PITS

2.4.1 Pit Dimensions

Pit dimensions must comply with Clause 3.2.

2.4.2 Pit Locations

Between intersections, provide pit locations at regular evenly spaced intervals where practical, with the distance between pit locations not greater than 250 m, along the main backbone of the cableway route, to enable pulling of the cable and allow connections with terminal equipment.

Where the road is on a curve, reduce the minimum distance between pits if necessary to avoid excessive curvature.

For each pit location, provide a pair of pits comprising one communications pit and one electrical pit, in accordance with the configuration shown on Drawing No. DS2012/000838.
Provide a pair of cableway pits (1 communications and 1 electrical) in the following situations:

(i) at both ends of each under-road, under-waterway and bridge crossing;
(ii) at an interface between different types of conduits; and
(iii) where there is a 90° change in direction.

### 2.4.3 Clear Distance of Pit From Kerb Line

Provide a clear distance for the pits from the kerb line of a carriageway or edge of a road in accordance with Table R155.1, unless otherwise specified or shown on the Design Documentation drawings.

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<th>Speed Zone</th>
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<tr>
<td>&lt; 80 km/hr</td>
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</tr>
<tr>
<td>≥ 80 km/hr to ≤ 110 km/hr</td>
<td>3.0 m</td>
</tr>
<tr>
<td>&gt; 110 km/hr</td>
<td>5.0 m</td>
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### 2.4.4 Safe Access for Inspections and Maintenance

Your detailed design must provide for safe access to, and sufficient space around all pits and equipment housings, for future inspection and maintenance activities.

### 2.5 EQUIPMENT HOUSINGS

#### 2.5.1 General

Where shown in the Design Documentation, provide equipment housings complying with Drawing No. DS2012/000835.

Provide clearance for the equipment housings from the kerb line equivalent to that specified for pits in Clause 2.4.3.

Where the minimum clearance cannot be achieved, notify the Principal and provide details of the site constraints. The Principal may require a safety barrier between the roadway and the equipment housing be installed, with a clearance of at least 1.5 m. Installation of this safety barrier will be in accordance with Specification TfNSW D&C R132.

In areas where an alternative route is proposed, due to the presence of rock etc, equipment housing may be required.

#### 2.5.2 Adjacent to Rock Faces

Equipment housings adjacent to rock faces must be linked to the pits using galvanized steel conduits as shown on Drawing No. DS2012/000833.
2.6 DESIGN DOCUMENTATION DRAWINGS

2.6.1 Digital Format

Design Documentation drawings must be done in a digital format, complying with TfNSW ITS CAD Standard, incorporating the TfNSW standard title block.

2.6.2 Details Required

The Design Documentation drawings must be based on the concept design drawings and must show details of the following:

(a) cableway route alignment and chainages along the route, with the areas where the cableway route crosses other utilities or obstructions highlighted;

(b) locations of any under road, under waterway and/or bridge crossings;

(c) number of each type of conduits, their configuration and their depth below the finished surface level, along the length of the cableway;

(d) locations of cableway pits and any equipment housings;

(e) details of the cableway pits and their lids, including dimensions, wall thicknesses, reinforcement details, and loading classes;

(f) which of the pits require risers and pit access ladders;

(g) details of any bends required;

(h) details of any conduit transitions required at crossings of bridges or culverts;

(i) proposed methods of support and attachment of the cableway to the bridge structure, retaining wall or rock face;

(j) finished ground surface levels along the cableway route.

2.7 DESIGN REPORT

Together with the Design Documentation drawings, provide a design report that includes the following information where relevant:

(i) choice of cableway route, including reasons for any deviation from the indicative route shown in the concept design;

(ii) reasons for choice of pit locations, orientation and configurations;

(iii) locations where galvanized steel tubes for the conduits are used, and the reasons for their use;

(iv) any site specific environmental requirements addressed in the design;

(v) any obstruction along the cable route, and methods adopted to avoid the obstruction;

(vi) proposed method(s) of construction, including those for under road, under waterway and bridge crossing;

(vii) any differences between your design and the TfNSW model drawings or other requirements in this Specification and the reasons for this;

(viii) materials to be used.
3 MATERIALS

3.1 CONDUITS AND ASSOCIATED ITEMS

3.1.1 Type and Class

All conduits must have smooth internal surfaces.

(a) Underground Conduits

Conduits installed underground for carrying communications and electrical cables must be heavy duty rigid PVC (i.e. UPVC), conforming to AS/NZS 2053.2.

UPVC conduits for carrying communications and electrical cables must be in white and orange colour respectively.

(b) Exposed Conduits

All exposed conduits must be hot-dip galvanized steel tubes.

All steel tubes must be Medium pipe to AS 1074. Hot-dip galvanizing must be in accordance with AS 4792, with a minimum average coating mass of 300 g/m².

Clearly mark, using stencils, the words “Roads & Maritime Services Electrical” in orange colour, or “Roads & Maritime Services Communications” in white colour, on the external surface of the respective galvanized steel tubes, at 20 m intervals, as shown on Drawing No. DS2012/000833.

3.1.2 Conduit Joints

Join conduits strictly in accordance with the manufacturer’s instructions.

Conduit surfaces to be joined must be clean and free from any foreign matter.

Glued joints must be watertight.

3.1.3 Draw Rope

Install a draw rope made of synthetic cord in each conduit for the purpose of cable pulling. The draw rope must be able to withstand a load of 90 kg. Anchor the draw rope securely at each end, leaving approximately 1 m of slack in each pit.

3.1.4 Marker Tape

Marker tape must conform to AS 2648.1, be suitably identified with written warnings and contain a 0.7 mm stainless steel (AISI grade 316) conductor wire, laminated between the two layers of plastic comprising the marker tape, suitable for locating the marker tape with cable location equipment.

The marker tapes for electrical and communications conduits must be in orange and white colour respectively.

3.1.5 Cable Ladders

Cable ladders and their support brackets must be of hot-dip galvanized steel.
Cable ladders and support brackets (including fixing devices) must be of adequate strength to support a loading of at least 150 kg/m, without permanent deflection.

### 3.1.6 Support Brackets for Conduits

Support brackets, and associated anchor bolts and nuts, for exposed conduits such as those in bridge crossings or rock faces must be of galvanized steel.

### 3.1.7 Certificate of Conformity

Prior to incorporating into the Works any supplied conduits and associated items including marker tape, provide a signed certificate stating that the materials used and the finished product conform to the requirements of this Specification.

The certificate described above must describe the item and identify the inspection and test records that verify conformity of the item, and must be available for inspection as part of the Quality Records.

**HOLD POINT**

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<td>Certificate of conformity, at least 7 days prior to incorporation into the Works.</td>
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<td>Release of Hold Point:</td>
<td>The Nominated Authority may inspect the Quality Records prior to authorising the release of the Hold Point.</td>
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### 3.2 PITS

#### 3.2.1 General

All pits, including lids, must be of precast reinforced concrete complying with Specification TfNSW D&C R11.

All precast base units must be manufactured specifically to suit the design configuration of the particular pit. Standard precast pit base units with thinned wall sections on all four sides are not acceptable.

Provide a certificate of conformity for the precast pits in accordance with TfNSW D&C R11.

#### 3.2.2 Pit Plan Dimensions

The internal dimensions of pits in the main backbone of the cableway must be not less than 900 mm x 900 mm for communications pits and 600 mm x 600 mm for electrical pits as shown on Drawing No. DS2012/000838.

Pits at the far end of offset branches, outside the main backbone, must have internal dimensions of not less than 450 mm x 450 mm.

Any pit with depth greater than 1200 mm must have internal dimensions of not less than 900 mm x 900 mm.
3.2.3 Pit Depth

Pits of internal dimensions 600 mm x 600 mm or larger must have an internal depth of not less than 950 mm as shown on Drawing No. DS2012/000838 unless located in rock areas, where the pit depth is reduced to suit the reduced conduit depth specified in Clause 2.3.5.

3.2.4 Pit Opening

The opening at the top of the pit which accommodates the lid must not be less than the internal dimensions of the pit.

The rim of the pit opening must be reinforced to prevent damage due to lateral forces on the lid, or chipping due to shock loads caused by passing vehicles or dropping of the lid.

3.2.5 Ladder

For all pits which are deeper than 600 mm, install an individual-rung ladder (step irons) in accordance with AS 1657 on one internal wall for the full depth of the structure.

The top of the uppermost rung must not be more than 600 mm below the top of the pit. The top of the bottom rung must not be more than 500 mm or less than 300 mm above the invert of the pit. Rung spacings must be 300 mm ± 50 mm.

3.2.6 Pit Lid Labels

Supply and install brass labels on the lid of both the communications and the electrical pits as shown on Drawing No. DS2012/000837.

Submit to the Principal for approval the layout of lettering on the labels, and submit to the Project Verifier for approval the method of fixing them to the lids.

3.3 EQUIPMENT HOUSINGS

Equipment housings and their foundations must comply with Drawing No. DS2012/000835.

Submit details of the equipment housing for approval by the Principal.

3.4 BEDDING AND BACKFILL MATERIAL

3.4.1 Bedding Material for Conduits and Pits – General

Bedding material for conduits and pits must be Type BH Select Fill (refer TfNSW D&C R11). Type BH Select Fill must have the following properties:

(a) a particle size distribution, determined by Test Method TfNSW T201, within the limits set out in Table 6 in AS 3725; and

(b) a Plasticity Index, determined by Test Method TfNSW T109, of not more than 6.

3.4.2 Backfill Material Other Than Bedding Material – General

Backfill material other than bedding material for conduits and pits must be Type SO Select Fill (refer TfNSW D&C R11). Type SO Select Fill must have the following properties:

(a) a maximum particle dimension of 53 mm; and
3.4.3 Backfill Material for Road Crossings

For trenches in road crossings, backfill material around and over the conduits up to the level of the underside of the road pavement must be controlled low strength flowable fill complying with AS/NZS 3725 Appendix A.

4 CONSTRUCTION

4.1 GENERAL

4.1.1 (Not Used)

4.1.2 (Not Used)

4.1.3 (Not Used)

4.2 ADDITIONAL SAFETY PRECAUTIONS

4.2.1 Protection of Completed Works and Existing Utilities

Take all necessary precautions to protect other completed works and avoid interference with other existing surface and underground utility services during construction of the cableway.

Before commencing any excavation work, determine and mark on the ground the locations of all existing utility services adjacent to or intersecting the cableway route.

Where cathodic protection has been provided to existing metal conduits (for carrying drinking water, gas, sewage, etc) and metal armour on high voltage cables or other structures, use suitable excavation and installation methods to prevent any damage or disturbance to these installations.

4.2.2 Installation of Conduits in High Voltage Areas

Where conduits are to be installed in proximity to high voltage earthed locations such as substations, obtain written authorisation from the Principal before commencing installation.

Do not disturb existing high voltage earthing arrangements under any circumstances.

4.3 ENVIRONMENTAL PROTECTION

Implement and monitor appropriate environmental control measures during construction in accordance with Specification TfNSW D&C G36, and Specification TfNSW D&C G38.

Do not remove any trees or shrubs without the written approval of the Principal and/or the relevant Statutory Authority.

Do not stockpile excavated material in locations where it could obstruct stormwater or road drainage, or be washed onto roadways or into watercourses by rain.
4.4 SETTING OUT

Set out the cableway as shown on the approved Design Documentation drawings in sufficient detail to identify:

(a) the locations, lengths and levels of the conduits;
(b) the locations and levels of cableway pits;
(c) the locations, lengths and levels of all under road, under waterway and bridge crossings.

HOLD POINT

<table>
<thead>
<tr>
<th>Process Held:</th>
<th>Commencement of excavation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details:</td>
<td>Notification:</td>
</tr>
<tr>
<td></td>
<td>- that the cableway route, including locations of pits, has been set out; and</td>
</tr>
<tr>
<td></td>
<td>- of any changes to the design proposed by you.</td>
</tr>
<tr>
<td>Release of Hold Point:</td>
<td>The Nominated Authority will inspect the set out, including any changes proposed and, if necessary, amend the design to suit actual site conditions prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

The final location of each under road crossing must be approved by the Principal.

4.5 EXCAVATION AND TRENCHING

4.5.1 General

Carry out trenching, pipe laying and backfilling progressively so that trenches are open for the minimum practicable time. Do not leave trenches open overnight.

Shore trenches securely to prevent collapse, particularly where excavation is in proximity to buildings or other structures.

Erect suitable barricades around the excavation and cover the excavation where access is required across them.

4.5.2 Road Crossings By Trenching

If trenching is used to install conduits for road crossings where daytime traffic flow must be maintained, carry out any excavation and backfilling as night work.

Lay steel plates over open excavation when needed for opening the road to traffic the following morning.

4.5.3 Base of Trenches or Excavations

The bottom of trenches or excavations must be level or of even gradient, and free from stones, sharp objects and other foreign material.

4.5.4 Inadequate Foundation Material

Notify the Principal of any area within the cableway route which contains material that is inadequate to support the cableway conduits or pits. If the Principal considers that the material is inadequate
foundation material, or any areas of the foundations are so deemed by the Principal, the Principal may require the removal and replacement of this material. Dispose of such material in accordance with Specification TfNSW D&C R44.

### HOLD POINT

<table>
<thead>
<tr>
<th>Process Held</th>
<th>Replacement of inadequate foundation material.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details</td>
<td>Notification that inadequate foundation material has been excavated to the extent directed.</td>
</tr>
<tr>
<td>Release of Hold Point</td>
<td>The Nominated Authority will inspect the excavation and may require further excavation prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

Replace inadequate foundation material with materials from cuttings, or with other material acceptable to the Principal, and compacted in accordance with Clause 4.7.5.

#### 4.5.5 Ploughing

Where appropriate, you may use ploughing as a method of cableway installation.

#### 4.6 CROSSINGS USING TRENCHLESS TECHNIQUES

##### 4.6.1 General

Where trenching is not appropriate for use in road or waterway crossings, you may use trenchless techniques involving boring or drilling for the cableway construction.

##### 4.6.2 Work Method Statement

Prior to the commencement of any such work, provide a Work Method Statement to the Principal giving full details of how you intend to carry out the boring or drilling without damaging or otherwise disturbing the road pavement or any adjacent installations, and including details of any traffic control or environmental protection measures required.

### HOLD POINT

<table>
<thead>
<tr>
<th>Process Held</th>
<th>Commencement of under road or under waterway boring using trenchless techniques.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details</td>
<td>Work Method Statement, at least 5 working days prior to the commencement of the work.</td>
</tr>
<tr>
<td>Release of Hold Point</td>
<td>The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

Perform all work required, including excavation and shoring of the entry and exit pits, in accordance with the approved Work Method Statement.
4.6.3 Outer Casing

The outer casing for carrying the individual communications and electrical conduits, installed by trenchless techniques, must be of sufficient strength to carry the traffic and overburden loads without collapse.

4.7 CONDUIT INSTALLATION IN TRENCHES

4.7.1 Conduit Surround in Trenches

Place bedding material around the conduits with minimum thickness of 100 mm above and below the conduits, for the full width of the trench, as shown on Drawing No. DS2012/000836.

4.7.2 Laying of Conduits

Lay conduits in the trenches in accordance with your detailed design. Underground conduits must be continuous between pits.

4.7.3 Marker Tapes Over Conduits

Lay white and orange marker tapes over communications and electrical conduits respectively (matching the respective colour of the conduits) as shown on Drawing No. DS2012/000836.

For trenches in earth, lay marker tapes on conduits within the backfill approximately 300 mm below the finished surface level. For road crossing trenches, lay the tapes above the conduits at the top surface of the bedding material surrounding the conduits.

For trenches in rock, lay marker tapes for the conduits approximately 150 mm below the finished surface level.

Marker tapes are not necessary over conduits inside casings installed by trenchless techniques (refer Clause 4.6)

4.7.4 Backfilling

Material for bedding and backfilling must be in accordance with Clause 3.4.

Notify the Project Verifier of your intention to backfill over, and cover up, the conduits or marker tapes in any trench or excavation.

**HOLD POINT**

<table>
<thead>
<tr>
<th>Process Held:</th>
<th>Backfilling over conduits or marker tapes in trenches.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submission Details:</td>
<td>Notification that the conduits or marker tapes have been installed, at least four hours before backfilling is scheduled to commence.</td>
</tr>
<tr>
<td>Release of Hold Point:</td>
<td>The Nominated Authority will inspect the conduit or marker tape installation prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

This Hold Point applies to either of the two stages; viz backfilling over the conduits, and backfilling over the marker tapes.
4.7.5 Placing and Compaction

For trenches in road crossings, place and compact the controlled low strength flowable fill complying with Clause 3.4.3 and AS/NZS 3725 Appendix A.

For trenches in other than road crossings, place and compact the bedding and other backfill material in layers not exceeding 150 mm thick after compaction.

Compact carefully the first 150 mm of backfill over the conduits to ensure that no conduits are displaced or damaged. Submit a Work Method Statement to the Principal detailing how you would place and compact the backfill without damaging or disturbing the conduits.

4.8 CONDUIT INSTALLATION ON CONCRETE OR ROCK FACES

4.8.1 General

Where you propose to install support brackets for carrying the steel conduits along concrete or rock faces, carry out a structural design and provide certification by an Engineer for the supports, including anchorage requirements into the concrete or rock face. The spacing of brackets must be such that there is no sagging of the conduits.

Use only chemical anchors for anchoring into the concrete or rock face. Do not use expanding masonry anchors.

Provide a minimum distance of 25 mm between the conduits and the mounting surface (concrete or rock).

The Principal will review the design prior to construction.

Provide earthing to all exposed steel conduits.

<table>
<thead>
<tr>
<th>HOLD POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Held: Installation of supports for steel conduits or any other fixing proposal on concrete or rock faces.</td>
</tr>
<tr>
<td>Submission Details: Design details and certification by Engineer of conduit support brackets, at least three working days before installation.</td>
</tr>
<tr>
<td>Release of Hold Point: The Nominated Authority will consider the submitted documents prior to authorising the release of the Hold Point.</td>
</tr>
</tbody>
</table>

Fit the bolts holding the steel brackets with an approved locking device.

Do not core or drill into existing concrete structures without written approval from the Principal. Prior to any such coring or drilling, determine the presence and locations of any steel reinforcement bars or other cast-in items to avoid damaging them.

4.8.2 Bridge Crossings

For conduits in bridge crossings, provide suitable jointing of the conduits and conduit support system to accommodate expansion/contraction of the bridge without causing unacceptable stresses in the conduits. Submit details of the jointing to the Principal for approval.
Where necessary, you may use cable ladders for carrying the conduits.

4.8.3 Rock Faces or Retaining Walls

For conduits running along rock faces or retaining walls, the bottom of the lowest conduit must be at least 500 mm above ground surface level.

4.9 PITS

4.9.1 Pit Foundation

Provide a bedding layer below the pit comprising Type BH Select Fill of not less than 100 mm thick as shown on Drawing No. DS2012/000838.

The top of the bedding layer must be level.

4.9.2 Installation of Pits

Install cableway pits in accordance with this Specification, Drawing No. DS2012/000838 and the manufacturer’s recommended practice.

Submit for approval the lifting methods including the lifting points, lifting devices and certification of their suitability by an Engineer. Use only approved methods for lifting and lowering precast pits in place to prevent damage during installation.

Coat the rim of the pit with an approved sealing compound so that, when the lid is placed over the pit, an airtight seal is achieved and ingress of water and dust into the pit is prevented.

The exposed face of each pit lid must be flush with the surrounding ground surface, and must not be a trip hazard to any pedestrians.

4.9.3 Conduit Connections With Pits

Provide bell-mouth fittings at conduit entries into pits. Remove sharp, rough or jagged edges from conduit internal surfaces. Seal any annular gaps between the conduit and the pit wall with mortar or cementitious grout to prevent ingress of water.

The height at which the conduits enter the pits must not be less than 150 mm from the pit floor.

4.10 TOLERANCES

Tolerances on the plan positions, levels of conduits and pits and thicknesses, must be in accordance with Table R155.2, unless shown otherwise on the Design Documentation drawings.
Table R155.2 - Dimensional Tolerances for Cableway Components

<table>
<thead>
<tr>
<th>Item</th>
<th>Tolerance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduits:</td>
<td></td>
</tr>
<tr>
<td>Departure from plan position in any direction</td>
<td>±50</td>
</tr>
<tr>
<td>Level of top of conduit at any location between pits</td>
<td>±50</td>
</tr>
<tr>
<td>Pits:</td>
<td></td>
</tr>
<tr>
<td>Thickness of DGB20 bedding layer</td>
<td>±10</td>
</tr>
<tr>
<td>Departure from plan position in any direction</td>
<td>±100</td>
</tr>
</tbody>
</table>

Note: The above tolerances are with reference to the plan positions and levels shown in the Contractor’s approved design.

4.11 CLEAN UP AND RESTORATION

4.11.1 Cleaning Up

Clean up and clear all pits of debris at Construction Completion of the Works.

4.11.2 Disposal of Surplus Material

Dispose of as spoil any surplus excavated material in accordance with TfNSW D&C R44.

4.11.3 Restoration of Work Areas

On completion of backfilling and cleaning up, restore the work area to the same condition prior to commencement of the Works.

Where trenches have been dug across sealed roads or concrete footpath, restore the pavement layer similar to that of the existing pavement.

Replacement landscaping must be in accordance with the Landscape Drawings, or match the surrounding landscaping where no Landscape Drawings are available.

4.12 (NOT USED)

5 TESTING AND ACCEPTANCE

5.1 TESTING OF CABLEWAY CONDUITS

Carry out testing of all installed conduits by drawing a test mandrel through each conduit after the trenches or excavation have been backfilled and pits installed.

Use a 240 mm long test mandrel with a diameter 90% of the nominal internal diameter of the conduit.

If installed conduits are found to have been damaged, report the damage to the Principal and replace the damaged section without delay.
5.2 **FINAL INSPECTION**

Provide inspection reports for all pits and conduits installed under the Contract.

After conduits have been tested in accordance with Clause 5.1 and prior to notifying the Project Verifier for final inspection, inspect all backfilled trenches and excavation, and refill any depressions caused by settlement or erosion of the backfilling. If erosion of the backfilled trenches or excavation occurs, undertake remedial work using methods approved by the Principal to repair erosion and to prevent future occurrence.

Ensure that the cableway as installed satisfies the acceptance criterion listed in the Final Inspection Acceptance Checklist in Annexure R155/E, prior to notifying the Project Verifier for the final inspection.

Arrange for all pits to be opened for the final inspection by the Project Verifier.

5.3 **CONSTRUCTION COMPLETION REPORT AND WORK-AS-EXECUTED DRAWINGS**

Provide the following to the Principal on Construction Completion of the cableway.

5.3.1 **Construction Completion Report**

The Construction Completion report must include a close-up colour photograph of the interior of each pit and/or equipment housing, and another photo of the pit or equipment housing set against the surrounding background to allow for easy identification of the location of the pit or equipment housing.

Show against the photos of each pit the date that the photo was taken, its pit identification number and its GPS coordinates.

5.3.2 **Work-As-Executed (WAE) Drawings**

In addition to the requirements of the Scope of Works and Technical Criteria, all WAE drawings prepared for the cableway must comply with the TfNSW ITS CAD Standard based on the approved detailed design drawings (refer to Clause 2.6). WAE plans must show GPS coordinates for each asset listed below, as applicable:

(a) Pits
(b) Equipment housing

**NOTES TO TENDER DOCUMENTER:** *(Delete this boxed text before issue of Tender Documents)*

*Insert any further requirements below, such as outlet for permanent VMS, VSLS or CCTV camera*
ANNEXURES R155/A TO R155/B – (NOT USED)

ANNEXURE R155/C – SCHEDULES OF HOLD POINTS, WITNESS POINTS AND IDENTIFIED RECORDS

Refer to Clause 1.2.3.

C1 SCHEDULE OF HOLD POINTS AND WITNESS POINTS

<table>
<thead>
<tr>
<th>Clause</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.7</td>
<td>Hold</td>
<td>Submission of certificate of conformity prior to incorporation into the Works of any supplied conduits and associated items</td>
</tr>
<tr>
<td>4.4</td>
<td>Hold</td>
<td>Detailed set out of cableway route</td>
</tr>
<tr>
<td>4.5.4</td>
<td>Hold</td>
<td>Inadequate foundation material</td>
</tr>
<tr>
<td>4.6.2</td>
<td>Hold</td>
<td>Submission of Work Method Statement for trenchless techniques</td>
</tr>
<tr>
<td>4.7.4</td>
<td>Hold</td>
<td>Backfilling over conduits or marker tapes in trenches</td>
</tr>
<tr>
<td>4.8</td>
<td>Hold</td>
<td>Design and certification of steel conduit supports on concrete or rock faces</td>
</tr>
<tr>
<td>5.1</td>
<td>Witness</td>
<td>Testing of installed conduits</td>
</tr>
</tbody>
</table>

C2 SCHEDULE OF IDENTIFIED RECORDS

The records listed below are Identified Records for the purposes of TfNSW D&C Q6 Annexure Q/E.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description of Identified Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2</td>
<td>Detailed site survey</td>
</tr>
<tr>
<td>2.6.2</td>
<td>Detailed design drawings</td>
</tr>
<tr>
<td>2.7</td>
<td>Design report</td>
</tr>
<tr>
<td>3.1</td>
<td>Details of conduits, draw rope, marker tape, cable ladders, and steel brackets</td>
</tr>
<tr>
<td>3.1.7</td>
<td>Certificate of conformity, stating that the supplied conduits and associated items conform to the requirements of this Specification</td>
</tr>
<tr>
<td>3.2</td>
<td>Details of pits, including risers, lids, and rung ladders</td>
</tr>
<tr>
<td>3.3</td>
<td>Details of equipment housing</td>
</tr>
<tr>
<td>3.4</td>
<td>Details of bedding and other backfill material</td>
</tr>
<tr>
<td>4.7.5</td>
<td>Compaction test results</td>
</tr>
<tr>
<td>4.8.1</td>
<td>Design and certification of steel support brackets for conduits on concrete or rock faces</td>
</tr>
<tr>
<td>4.8.2</td>
<td>Details of jointing to accommodate expansion/contraction for conduits in bridge crossings</td>
</tr>
<tr>
<td>5.1</td>
<td>Conduit test records</td>
</tr>
<tr>
<td>5.2</td>
<td>Completed final inspection acceptance checklist</td>
</tr>
<tr>
<td>Clause</td>
<td>Description of Identified Record</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>5.3</td>
<td>Construction Completion report</td>
</tr>
</tbody>
</table>
ANNEXURE R155/D – PLANNING DOCUMENTS

Refer to Clause 1.2.4.

The following documents are a summary of documents that must be included in the PROJECT QUALITY PLAN. Review the requirements of this Specification and other contract documents to determine any additional documentation requirements.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.6.2</td>
<td>Work Method Statement for trenchless techniques of road or waterway crossing</td>
</tr>
<tr>
<td>4.7.5</td>
<td>Work Method Statement for compacting first 150 mm of backfill over conduits</td>
</tr>
<tr>
<td>4.8.1</td>
<td>Method of fixing steel support brackets to concrete or rock faces</td>
</tr>
</tbody>
</table>
# ANNEXURE R155/E – FINAL INSPECTION ACCEPTANCE CHECKLIST

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
</tr>
</tbody>
</table>

**Notes for completion of checklist:**

- Column 5: Insert pit size shown in detailed design
  - A: 450×450,
  - B: 600×600,
  - C: 900×900

- Column 15: Insert number of conduits shown in detailed design

- Columns 6 to 14, 16 to 19: Insert either “Yes” or “No” (Y/N)

**Name and Signature:**

- TfNSW ITS Projects Representative
- Project Verifier
- Contractor Representative
**ANNEXURES R155/F TO R155/K – (NOT USED)**

**ANNEXURE R155/L – MINIMUM FREQUENCY OF TESTING**

Refer to Clause 1.2.5.

<table>
<thead>
<tr>
<th>Clause</th>
<th>Characteristic Analysed</th>
<th>Test Method</th>
<th>Minimum Frequency of Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.4.1</td>
<td>Type BH Select Fill:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>particle size distribution</td>
<td>TfNSW T201</td>
<td>- One per 50 m³ or part thereof prior to placement</td>
</tr>
<tr>
<td></td>
<td>plasticity</td>
<td>TfNSW T109</td>
<td>- One per 100 m³ or part thereof prior to placement</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Type SO Select Fill:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>particle size distribution</td>
<td>TfNSW T201</td>
<td>- One per 100 m³ or part thereof prior to placement</td>
</tr>
<tr>
<td></td>
<td>plasticity</td>
<td>TfNSW T109</td>
<td>- One per 200 m³ or part thereof prior to placement</td>
</tr>
</tbody>
</table>
ANNEXURE R155/M – REFERENCED DOCUMENTS

Refer to Clause 1.2.6.

**TfNSW Specifications**

TfNSW D&C G36  Environmental Protection
TfNSW D&C G38  Soil and Water Management (Soil and Water Management Plan)
TfNSW G73  Detail Survey
TfNSW D&C Q6  Quality Management System
TfNSW D&C R11  Stormwater Drainage
TfNSW D&C R44  Earthworks
TfNSW D&C R132  Safety Barrier Systems
TfNSW D&C TS101  Traffic Control Signals – New Installation and Reconstruction

**TfNSW Test Methods**

TfNSW T109  Plastic Limit and Plasticity Index of Road Construction Materials
TfNSW T201  Particle Distribution of Aggregates (by Washing)

**TfNSW Model Drawings**

DS2012/000830  ITS Cableway Layout at Traffic Signalled Intersections
DS2012/000831  ITS Cableway in Box Girder Bridges
DS2012/000832  ITS Cableway in Obstacle Field
DS2012/000833  ITS Cableway Along Rock Faces
DS2012/000834  ITS Cableway Configurations without Traffic Control Signal (TCS)
DS2012/000835  ITS Roadside Equipment Housing
DS2012/000836  Conduit Trenching
DS2012/000837  ITS Cableway Pit Lid Labels
DS2012/000838  General Arrangement of Communications and Electrical Pits for Offset Branches

Copies of the above drawings are available on the TfNSW Internet website

**Australian Standards**

AS 1074  Steel tubes and tubulars for ordinary service
AS 1100.401  Technical drawing – Engineering survey and engineering survey design drawing
AS 1102  Graphical symbols for electrotechnical documentation
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1657</td>
<td>Fixed platforms, walkways, stairways and ladders – Design, construction and</td>
</tr>
<tr>
<td></td>
<td>installation</td>
</tr>
<tr>
<td>AS/NZS 2053.2</td>
<td>Conduits and fittings for electrical installations – Rigid plain conduits</td>
</tr>
<tr>
<td></td>
<td>and fittings of insulating material</td>
</tr>
<tr>
<td>AS/NZS 2648.1</td>
<td>Underground marking tape – Non-detectable tape</td>
</tr>
<tr>
<td>AS 3000</td>
<td>Electrical installations (known as the Australian/New Zealand wiring rules)</td>
</tr>
<tr>
<td>AS 3008</td>
<td>Electrical installations – Selection of cables</td>
</tr>
<tr>
<td>AS 3725</td>
<td>Design for installation of buried concrete pipes</td>
</tr>
<tr>
<td>AS 4792</td>
<td>Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a</td>
</tr>
<tr>
<td></td>
<td>continuous or a specialized process</td>
</tr>
<tr>
<td>AS 4383</td>
<td>Preparation of documents used in electrotechnology</td>
</tr>
</tbody>
</table>