

Section 2

Underground Services

Service and Installation Rules of New South Wales
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2 Underground Services

2.1 INTRODUCTION

This Section outlines the requirements for the installation of an underground service.

2.1.1 Underground Service

The underground service extends between the electricity distributor's connection point and the point of supply on the customer's premises.

The point of supply is established at either a pillar/pit on the customer's premises, or at the customer's main switchboard. Refer to Figure 1.2.

2.1.2 Underground Service from an Overhead Distribution System

The provision of an underground service from the electricity distributor's overhead supply is

permitted by the conditions detailed in this Section and will be referred to as an underground supply from an overhead distribution system (UGOH).

2.1.3 Specific Railway Requirements

Application in writing must be made to RailCorp for the route and installation method for an underground service on railway land.

Special conditions apply, and will be advised on application.

Written approval from RailCorp is required for any proposed route.

2.2 SERVICE ROUTE

2.2.1 Special Considerations

The following factors should be taken into account:

- (a) Length and route of the service, including the part in the street. Obstacles such as trees, major shrubs and other public services should be taken into account.
- (b) Access to the service and metering equipment.
- (c) The location of proposed and existing underground service mains, road crossings, and the presence of other utilities (ie gas, water, and communications), service fuses and metering.

(d) The location of any additional customer termination enclosure that may be required.

(e) The location of electricity distributor poles in the street if connecting to an overhead distribution system.

(f) A transformer or switchgear on the selected pole if connecting to an overhead distribution system.

2.2.2 Crossing of Adjoining Property

The route should not cross an adjoining property. If there is no alternative, a suitable easement must be obtained.

2.2.3 Access

The underground service termination points must have readily available access.

2.3 CONSUMERS MAINS

2.3.1 Electrically Un-Protected Underground Consumers Mains

To provide similar performance characteristics to the underground service cable, electrically unprotected underground consumers mains must be installed using the same cable type and minimum size as specified for the underground service cable. Refer to clause 2.6.1.

2.3.2 Alterations and Additions

Alterations or additions to existing consumers mains must be treated as a new installation.

Refer to clause 1.5.11. This need not apply where additional phase conductors are added to existing electrically unprotected single-phase consumers mains, provided that the cross-sectional area of the additional conductors is not smaller than the existing conductors.

2.3.3 Electrically Protected Underground Consumers Mains

Electrically protected underground consumers mains must comply with the requirements of AS/NZS 3000.

2.4 INSTALLATION OF UNDERGROUND SERVICE

Caution!
The installation of an underground service must only be carried out by an accredited service provider.

2.4.1 Installation Requirements

The customer is responsible for all costs and for providing all works and material in relation to installing an underground service cable.

All new service cables within the customer's property must be installed in conduit suitable for the drawing in and drawing out of the cable.

2.4.1.1 Underground Service Cables installed in conduit

Underground service cables of less than 240mm² must be installed in conduit throughout their entire length.

Furthermore, underground services installed in conduits must meet the following requirements:

- (a) Cables must be installed in UPVC conduits as specified in the AS/NZS 3000 Wiring Rules for a Category A system enclosure, or as determined by the electricity distributor.
- (b) The underground conduit must be maintained a minimum 500mm depth throughout the entire length.

Note: Where the ground or obstructions prevent maintaining the 500mm depth, the underground wiring requirements of AS/NZS 3000 will prevail. The electricity distributor must be notified by the Notification of Service Work (NOSW) form of the alternative method used.

- (c) Orange marker tape must be installed 300mm above the underground conduit for its entire length. Marker tape is not required when under boring techniques are used to install an underground service. The marker tape must meet the requirements of AS/NZS 2648

'Underground marking tape - Part 1 Non-detectable tape'.

- (d) The cables of each underground service must be identified with a permanently installed water-resistant tag. The tag is to be indelibly marked to nominate the street number and street name of the premises it supplies.
- (e) The cable ends must extend to a minimum of 1 metre above ground level.

2.4.1.2 Underground Service Cables – direct buried

Underground service cables comprising circular multi core conductors 240mm² or larger may be direct buried.

The underground service cable must maintain 500mm depth throughout its entire length.

Note: Where ground material/obstructions prevent maintaining the 500mm depth, the underground wiring requirements of the AS/NZS 3000 will prevail. The electricity distributor must be notified by way of the Notification of Service Work (NOSW) form of the alternative method used.

Where the direct buried technique is used, the service cable/s must be mechanically protected by means of a light orange coloured polymeric cable cover strip of a material equivalent to UPVC conduit complying with AS4702 having a thickness not less than 3mm.

This cover strip will fulfil the requirements of a marker tape and must be positioned 300mm above the cable.

2.4.1.3 Underground Service Cables – in a public reserve/easement (off the customer's property)

Where the underground service is installed **within the boundaries of a public road, public reserve or easement** (off the customer's property), the underground service

must be installed in accordance with the following:

- (a) 150mm lateral separation must be maintained between the underground service cable and the electricity distributor's cables and services belonging to other utilities.
- (b) Installed parallel to the property line and within the electricity distributor's easement or allocation or at 90° to the property line.
- (c) Specific requirements of the electricity distributor, (where applicable).
- (d) All relevant Acts, regulations and other statutory requirements, including notification requirements of local councils and restoration obligations in the public allocation.

2.4.2 Searches for Underground Utility Services

The accredited service provider must carry out a search for underground utility services, prior to excavating. Adequate clearances must be obtained between the proposed underground service and underground utility services. Check with the appropriate utility to determine required clearances.

Utilities may include:

- water
- sewer
- drainage
- gas
- communication cables
- other power cables
- railway power, signalling and communication cables (which may also be located in public streets, parks etc).



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Phone 1100 - free call (except from mobiles)
Website www.1100.com.au

Australia's major service providers have a single web-enabled information service for information on the location of underground communications, gas, water and electricity infrastructure. Use the website to ensure that you 'Dial Before You Dig' before any excavation work. If calling, be ready to provide the operator with:

- your name and address
- name of company
- contact telephone number
- fax number for return information
- contact name on site

- site address and both nearest cross streets
- start date of proposed work
- type of work being carried out

Caution
All buried cables must be considered as energised

2.4.3 Provision for other Utility Services on Customers Premises

Other utility services may be located in the same trench as the underground service provided they comply with the requirements of the AS/NZS 3000. Other utilities may have additional requirements.

2.4.4 Position of Underground Service/Consumers Mains

2.4.4.1 On the Premises

A sketch of the underground service/consumers mains route must be clearly marked on the inside of the meter enclosure or on the meter panel. Alternatively, a suitable sketch placed in a clear plastic envelope must be permanently attached either within the main switchboard enclosure or on the meter panel. Figure 2.5 shows a typical sketch.

2.4.4.2 Off the Premises

When notifying the electricity distributor of completed works, the accredited service provider must supply a sketch detailing the route of the underground service off the customer's property. The Notification of Service Work (NOSW) is to be used.

Refer to Figure 2.6 for a typical sketch of the underground service route off the premises.

The sketch must clearly show:

- (a) Street alignments.
- (b) Lot boundaries.
- (c) Lot/house No's.
- (d) Name of street and suburb in which the work is being done.
- (e) North point.
- (f) Route of underground service.
- (g) Start and finish points of any conduits.
- (h) Reference the position of the service in the ground at all deviation points.
- (i) Depth of cover over the service.
- (j) Position of cable joints.
- (k) Type of cable used.
- (l) Type of joint made (if any).
- (m) The accredited service provider's full name and phone number.
- (n) Reference points from which all other measurements must be taken.

2.5 CONDUIT REQUIREMENTS

2.5.1 Sizes

The minimum conduit size used to enclose an underground service cable is 40mm diameter.

2.5.2 Installing Service Conduits

Underground service conduits must be laid in a straight line and any conduit bend must be a sweep bend. Only one sweep bend with a minimum internal angle of 90° is permitted on the customer's premises, unless a termination enclosure is installed.

A minor deviation in the straight-line run of conduits is permissible, i.e. within the flexibility of the conduit. Do not use heat on the conduit to aid bending. Heat causes shrinkage.

Where the underground service cable terminates, in the meter enclosure, the conduit must enter the enclosure.

Where permitted by the electricity distributor, a draw-in box located on the external wall may be installed. The draw-in box is to be located above finished ground level.

The draw-in box must have an IP rating suitable for the area in which it is located.

A length of heavy duty corrugated conduit (up to 1.2 metre) may be used to allow the service cable to enter the cavity and meter box. Where exposed, this conduit must be covered by a steel guard.

The underground service may then pass through the wall into the cavity in such a way that will permit the cables to be drawn in or out without damage.

2.5.3 Joints

Join the conduit using sockets or fittings. Install the sockets or fittings so that the bore of the system is continuous and smooth and presents no obstruction to pulling in the cable. Make joints watertight. Bond them using an appropriate jointing method.

2.5.4 Draining

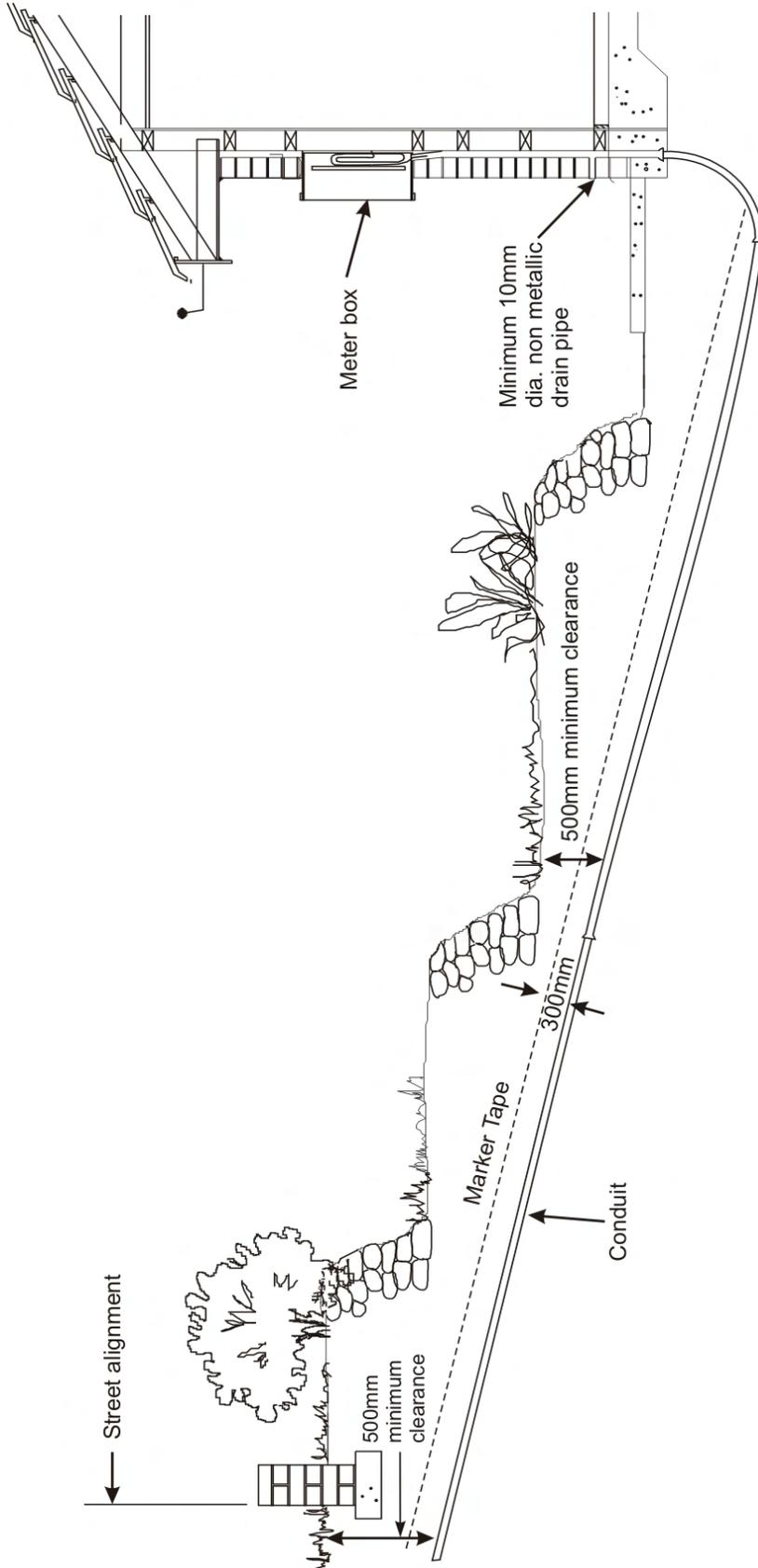
Install a drain in a conduit when the ground level at the street end of the conduit is above the floor level of a building in which the conduit terminates. Refer to Figure 2.1 for installation details.

Position the drain approximately 300mm above ground level. It should include:

- (a) A 10mm diameter hole facing the wall if the conduit rises on the outside of a building, or
- (b) A minimum 10mm diameter non-metallic pipe fitted into the conduit. The pipe must not protrude into the bore. Arrange the pipe so that it drains to the exterior of the building above ground level when the conduit is on the inside of a building.

Refer to Figure 2.1, 2.2, 2.3 and 2.4 for typical conduit installations details.

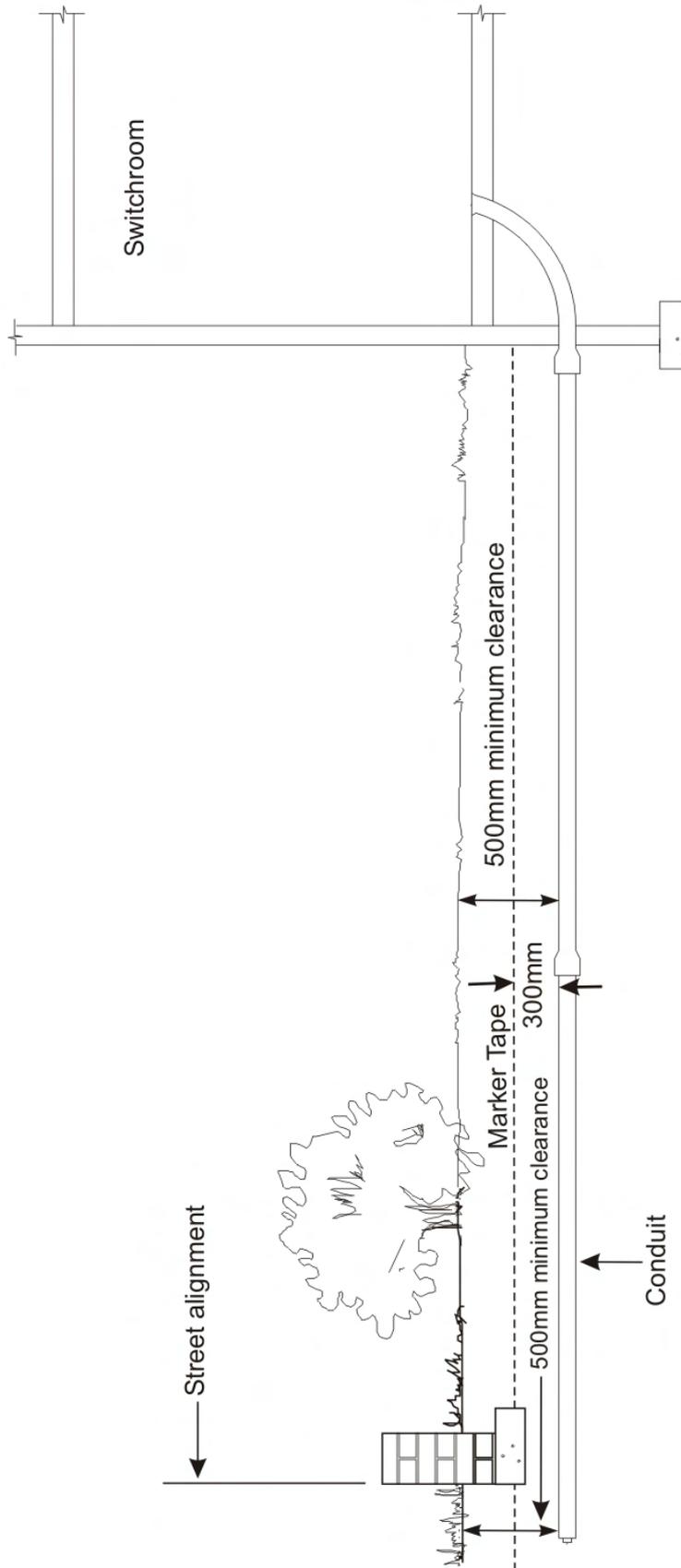
Figure 2.1: Typical Service Conduit in Domestic Premises



Install a conduit with a minimum diameter of 40mm.

The conduit is limited to 63mm when associated with a standard meter box panel due to the restricted space behind the panel.

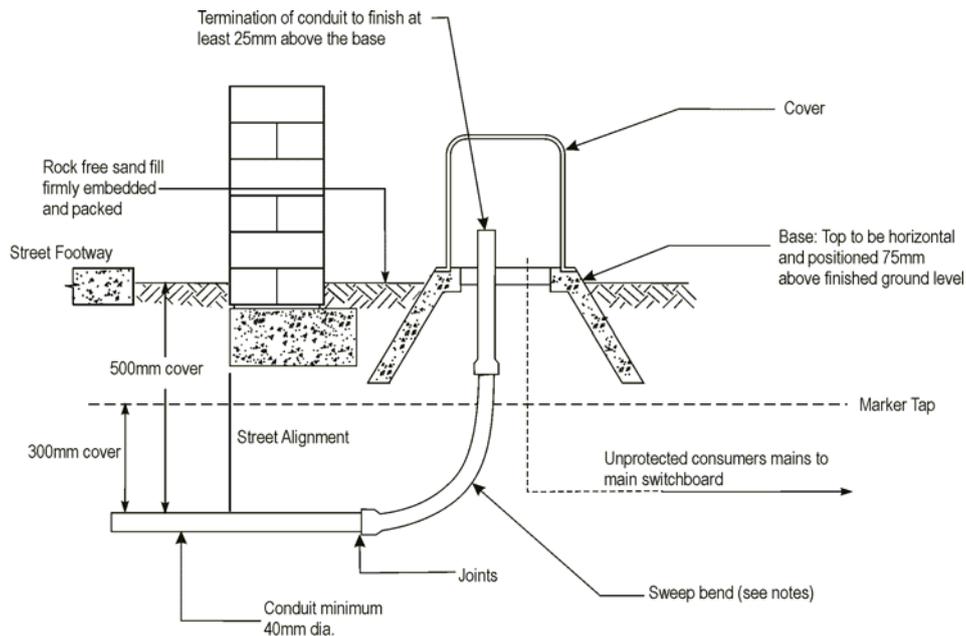
Figure 2.2: Typical Service Conduit - Non Domestic



Install a conduit with a minimum diameter of 40mm.

The conduit is limited to 63mm when associated with a standard meter box panel due to the restricted space behind the panel.

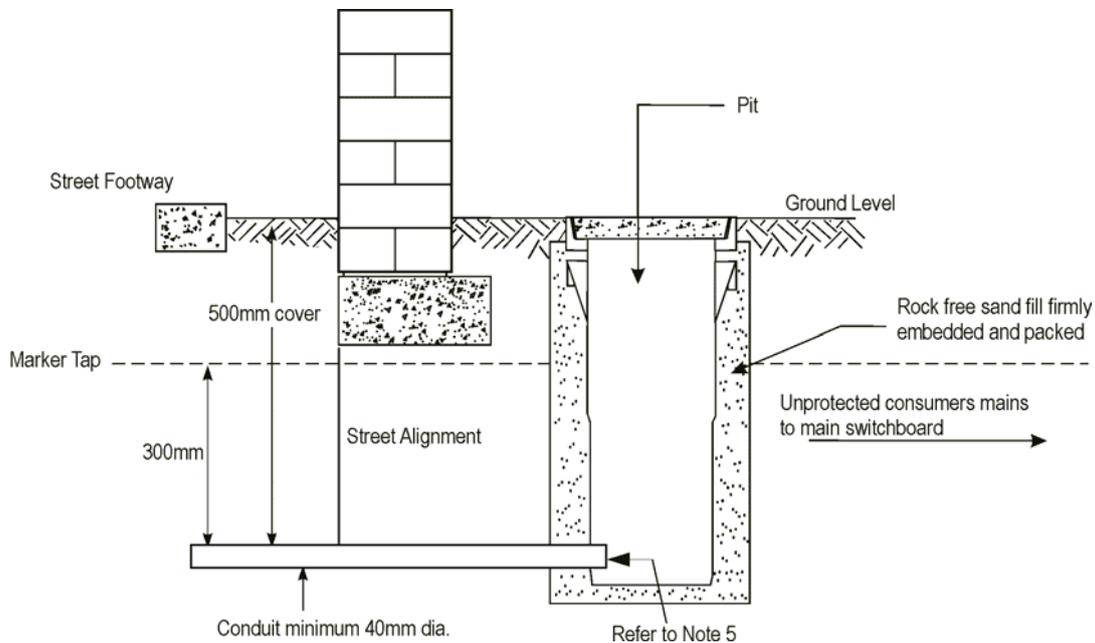
Figure 2.3: Typical underground service installation to a consumers termination enclosure - (pillar)



Notes:

1. For services rated above 100 amperes, the accredited service provider must on each occasion consult the electricity distributor.
2. Locate enclosure within 1 metre of the property alignment under which the underground service passes.
3. Marker tape 300mm above conduit (clause 2.4.1.1 (c)).
4. Only one sweep bend with a minimum internal angle of 90° is permitted on the customer's property.

Figure 2.4: Typical underground service installation to a consumers termination enclosure - (pit)



Notes:

1. For services rated above 100 amperes, the accredited service provider must on each occasion consult the electricity distributor.
2. Locate enclosure within 1 metre of the property alignment under which the underground service passes.
3. Top of pit to be level with final ground or footpath level.
4. Coil a minimum of 1500mm of service cable and consumers mains in the pit.
5. Service conduits are to extend at least 40mm into the pit.
6. Marker tape 300mm above conduit (clause 2.4.1.1 (c)).

2.6 CABLE REQUIREMENTS

2.6.1 Cable Specifications

The following information provides the minimum specifications for single and multiphase underground service cables:

All underground services must be four-wire three phase, except for single domestic premises, duplexes and builder's services. In these cases a two-wire single-phase service is permissible provided the service cable does not require a direct buried joint.

The cable size and service ratings are set out in Table 2.1.

Service cables must be XLPE insulated PVC sheathed, comply with Table 2.1 and be comprised of either:

- (a) Single core cables; or
- (b) One 4-core circular cable; and
- (c) Must comply with AS/NZS 4026:2001.

Service cables with a CSA of 240mm² must be of four-core aluminium, XLPE insulated, PVC-sheathed construction. Single core cables shall only be connected at pillars or to service tails. Check what method of connection is required prior to purchasing cable.

Table 2.1: Service cable size and ratings

Cable CSA (mm ²)	Conductor Material	Cable Rating Amps	No. of Cable Cores
16	Cu	100	1 or 4
25	Cu	100	1 or 4
50	Cu	200	1 or 4
70	Cu	200	1 or 4
240	Al	400	4

Note: 4x185mm² CU1XQZ single core cables are acceptable alternatives for 400 Amp services in city locations, where it is physically impractical to install and terminate the 240mm² Al 4-core cable. Other locations may also be accepted, where the electricity distributor has granted prior approval.

Table 2.1 and the above note specify the **only** service cables that may be used for various service ratings. Any intermediate service ratings (based on the assessed demand of the installation) must use the next largest service rating/cable available. The 50mm² cable may also be used for a 100 Amp service to satisfy the voltage drop requirement.

In addition, underground service cables must be brand new and joints are not permitted

unless otherwise approved by the electricity distributor.

If these requirements are incompatible with the electricity distributor's design standards, the electricity distributor will specify the number and size of conductors and stipulate a method of termination. For example: where the connection point is buried directly in the ground, the underground service cable must comprise single core insulated and sheathed conductors.

Consult with the electricity distributor for services greater than 400 Amps.

2.6.2 Maximum Length

The maximum total length of an underground service is 50 metres providing the point of supply is established at the main switchboard. Refer to Figure 1.2(a).

2.6.3 Non Urban Installations

Where the connection point is located on the customers' property, and the underground service exceeds the maximum permissible length (50 metres), the electricity distributor will nominate the location of the point of supply. Refer to Figure 2.8.

2.6.4 Spare Conductors

The authorised accredited service provider must energise any spare underground service conductors installed to provide for future phase connections.

Spare conductors are to be terminated in a sealable fuse or in a sealable link.

2.6.5 Alterations and Additions

Alterations or additions to an existing underground service or unprotected consumers mains must be treated as a new installation. Refer to clause 1.5.11. This need not be applied where:

- (a) Additional phase conductors are added to an existing single phase service cable or unprotected single phase consumers mains - provided that the cross-sectional area of the additional conductors is not smaller than the existing conductors; or
- (b) The existing conduit is smaller than 40mm but is able to accommodate the additional or replacement conductors.

2.7 POINT OF SUPPLY ENCLOSURE - OTHER THAN THE MAIN SWITCHBOARD

2.7.1 Enclosure

An appropriately manufactured (with appropriate waterproofing and method of connections) electrical termination enclosure (pit or pillar) is required where the point of supply is not established at the main switchboard.

2.7.2 Access

The customer must supply and install the enclosure in a way that allows the underground service conduit to meet the requirements of these Rules, and provide unrestricted access from two sides and above.

The cover of the pillar/pit must, with the use of a tool, be totally removable from the base, allowing full access to the contents. Where the pit or pillar is prone to mechanical damage at or

above ground level, suitable mechanical protection must be installed.

2.7.3 The Termination Enclosure

Where the point of supply is not established at the main switchboard, the termination facility must be located within 1 metre of the property alignment under which the underground service passes.

The Termination Enclosure must be labelled either 'private pit' or 'private pillar'.

2.7.4 Labelling

The top of the cover for the termination enclosure must be clearly labelled to indicate it contains electrical apparatus, eg, CAUTION ELECTRICITY and that the facility is a PRIVATE PIT or PRIVATE PILLAR. The height of the lettering must be at least 20mm.

2.8 SERVICE CABLE CONNECTION REQUIREMENTS

Authorised service providers should consult with the electricity distributor before carrying out service connection or disconnection work at pillars and pillar standards with exposed live parts, as restrictions on live work at these may apply.

Electricity distributors will supply details of their standard connection arrangements to accredited service providers working in their distribution area.

2.8.1 Colour Coding

The phase/neutral colour coding must meet the specifications of the AS/NZS 3000 requirements for consumers' mains.

2.8.2 New Termination Enclosure required in Public Area with existing Distribution System

Where a new connection point is established in a public area, the work must be carried out by an appropriately authorised, Level 1 accredited service provider. The electricity distributor will determine the need for the location of the enclosure.

2.8.3 Pit and Duct Systems

Where the electricity distributor's low voltage distribution system is installed as part of a pit and duct system, the connection will be made at a pit. Existing pits and ducts from the customers' premises must not be used without the agreement of the electricity distributor.

The electricity distributor will nominate the connection point and whether a new pit needs to be constructed. Where no suitable pit exists for connection, a Level 1 accredited service provider or the electricity distributor will supply and install one.

Only an accredited service provider authorised by the electricity distributor may work on or near an electricity distributor's pit or pillar.

Where a suitable cable entry is not provided in the pit, it must be installed by an appropriately authorised accredited service provider.

2.8.4 Phase selection for the Connection of Services

Single-phase customers should be connected to the following phase arrangement:

- reconnect existing service cable to the same phase as previously connected, or
- connect the new underground service cable as listed in Table 2.2.

Table 2.2: Phase Selection

For lot or street number ending in:	Connect to:
1	A phase
2	B phase
3	C phase
4	A phase
5	B phase
6	C phase
7	A phase
8	B phase
9	C phase
10	A phase
20	B phase
30	C phase

2.8.5 Earthing of Equipment

Where the sheathing is removed from an underground service cable installed within a metallic service or metering enclosure, the enclosure must be earthed in accordance with the equipotential bonding arrangements of the AS/NZS 3000.

2.8.6 Phase Selection for Single Phase Controlled Loads, supplied from a 3 Phase Service

Where a single-phase controlled load (eg off peak hot water system) is installed on a premises supplied from a three-phase service, apply Table 2.2 for the connection of the single-phase controlled load.

Figure 2.5: Typical sketch of the underground service route on the premises - to be placed in the main switchboard enclosure.

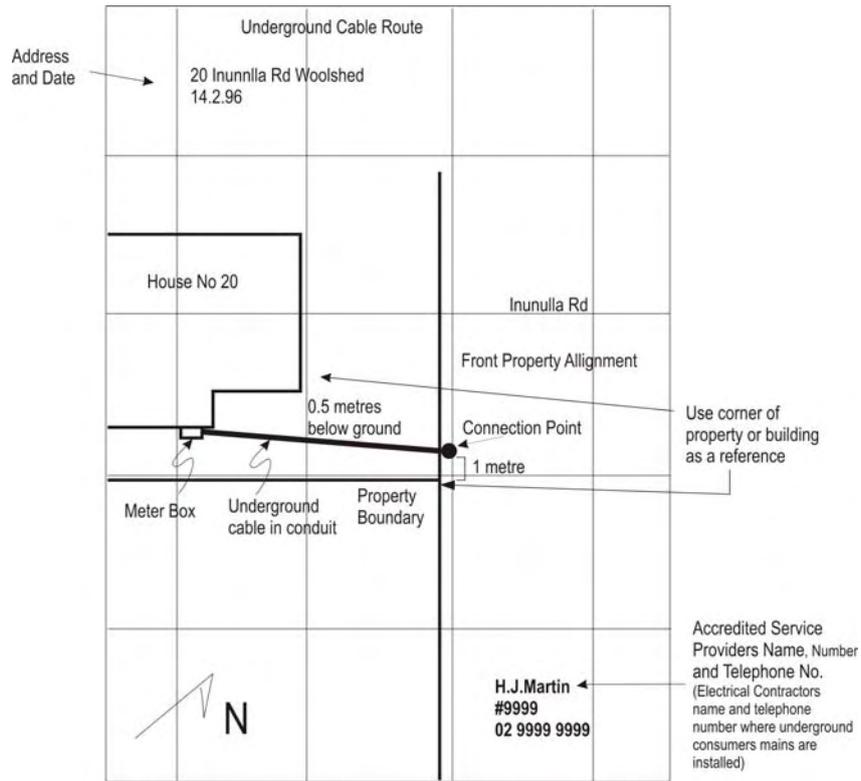
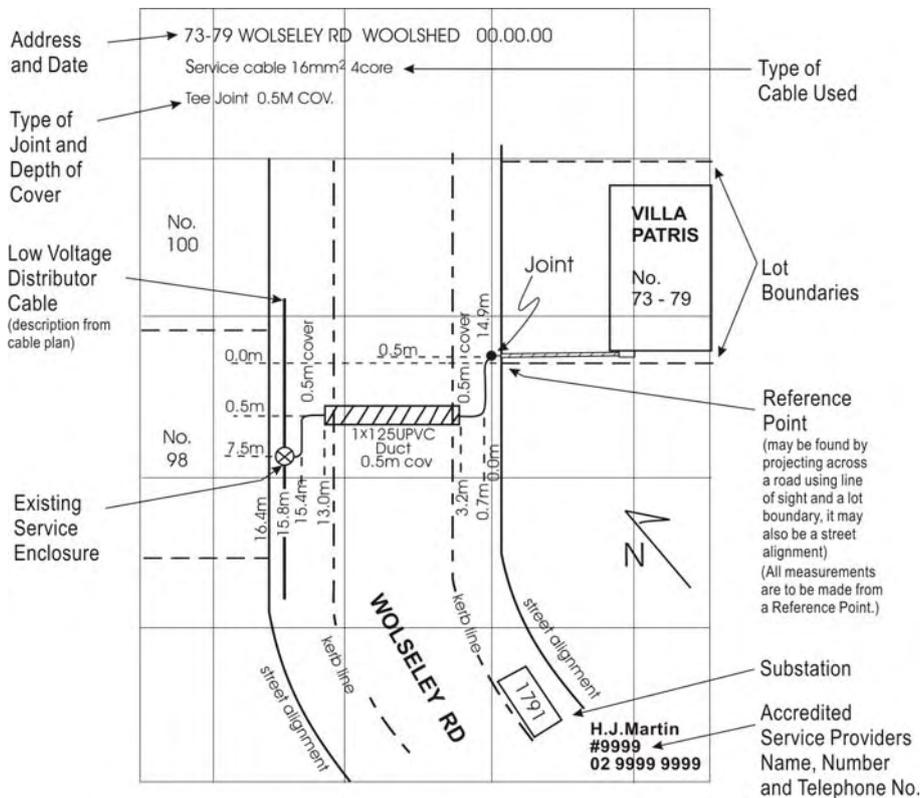


Figure 2.6: Typical sketch of the underground service route off the premises - to be submitted to the electricity distributor by way of a Notification of Service Work form. This figure does not necessarily show the specific design requirements for a service installation.

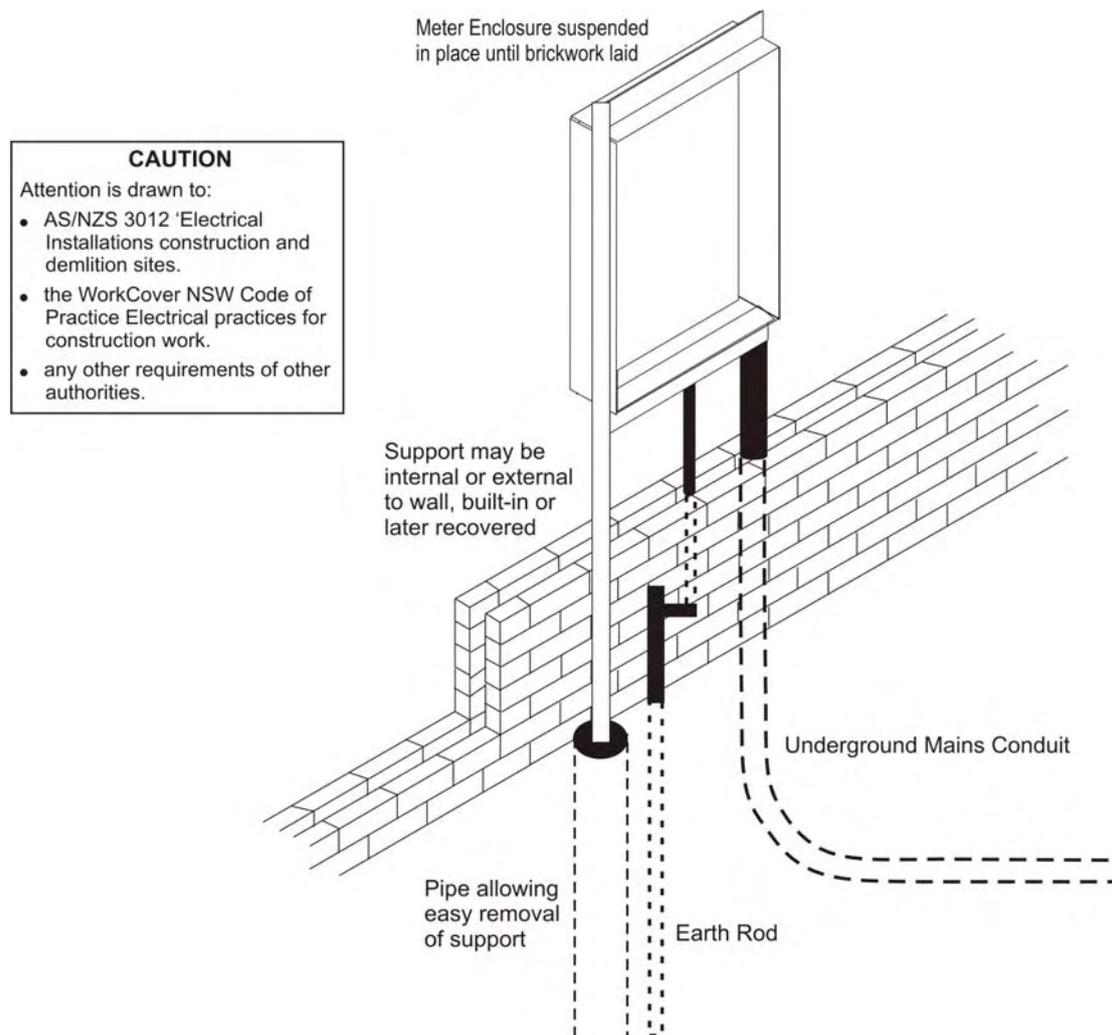


2.9 TEMPORARY SUPPORT IN A PERMANENT POSITION FOR BUILDING PURPOSES

Supply may be taken via a metering enclosure/main switchboard, supported in a way that allows building construction to proceed. It must encompass the switchboard enclosure and secure it in its permanent building position.

Figure 2.7 shows a main switchboard temporarily supported to provide supply for building purposes. Other configurations of this support, provided they meet safety requirements, are acceptable.

Figure 2.7: Typical main switchboard temporarily supported in permanent position to provide supply for building purposes.



Notes:

1. Install a permanent main earth conductor and electrode.
2. Install the electrical installation for construction purposes to comply with the applicable codes and legislation.
3. Provide adequate protection against mechanical damage during the construction phase, in particular for the underground service/consumers' mains, main earthing conductor and earthing electrode.
4. Provide adequate protection for flexible cords entering the meter enclosure. Flexible cords must be protected from mechanical damage caused by the meter enclosure door.

2.10 UNDERGROUND SUPPLY FROM AN OVERHEAD DISTRIBUTION SYSTEM (UGOH)

2.10.1 UGOH

A customer may request supply by way of an underground service from the overhead distribution system. This will be provided by an underground to overhead connection (UGOH) at the nearest electricity distributor pole. The following conditions apply:

- (a) The arrangement must not require any additional street pole.
- (b) The electricity distributor may inspect the site before agreeing to the proposal.
- (c) In footpaths, the conduit must be parallel to the property line and within the electricity distributor's easement or allocation, or at right angles to the property boundary.

2.10.2 Installation on the Electricity Distributor's Pole for an Underground Service with conductors up to a maximum 70mm²

The method of installation on the electricity distributor's pole for an underground service with conductors up to a maximum of 70mm², must meet the following requirements (refer to Figure 2.9 for details).

- (a) The underground service cable must be installed in flexible plain conduit to AS 2053 'Conduits and fitting for electrical installations - Part 4 Flexible plain conduits and fittings of insulating material'.
- (b) Where the accredited service provider is not authorised as Category 3, the conduit and cable on the pole must be left coiled 3000mm above ground level.
- (c) The flexible conduit must extend a minimum of 1000mm underground from the base of the pole, and be protected against mechanical damage.
- (d) The conduit on the pole must be protected against mechanical damage up to a distance of 2500mm above and 300mm below finished ground level. The protection must be a close fit, tubular or "U" section construction with no side flanges (side-securing tabs are permitted). This is to minimise the surface area of the pole that is covered and help prevent climbing. Timber is unacceptable. Refer to figure 2.9.
- (e) Where fabricated metal enclosures are used to provide mechanical protection, they must be hot dipped galvanised to meet the specifications in AS 4534, 4680 and 4792.

- (f) Where the electricity distributor's pole on which the underground service is attached supports a high voltage earthing conductor or high voltage equipment that is earthed, all mechanical protection for the service cable is to be of non-metallic material. Specific (non-conductive) material is available.
- (g) The underground service must be installed to comply with the requirements of this document.
- (h) The amount of flexible plain conduit left coiled on the pole must be sufficient to reach the crossarm and enable a bellmouth to be formed adjacent to the connection point. Allow for 1500mm of cable to be free of the conduit at the connection point to enable connection to the distribution system. Refer to Figure 2.9.

2.10.3 Installation on the Electricity Distributor's Pole for an Underground Service with conductors larger than 70mm²

Where an underground service cable comprises conductors larger than 70mm² the cables must be installed in accordance with the distributor's construction/approved materials inventory and installation method. Refer to Figure 2.10.

2.10.4 Maximum Number and Location of Underground Service Mains that can be installed on an Electricity Distributor's Pole

The number of underground to overhead services that may be attached to the electricity distributor's pole is limited to the numbers shown in Table 2.3.

Cable attached to the side of a pole for the purpose of connecting aerial construction to underground construction or earth, with the exception of cables used to earth the electricity distributor's equipment, is considered an underground to overhead service. This includes all telecommunication cabling.

Where there is a requirement to put more than the permitted number of underground services on one pole, the electricity distributor will provide an underground pillar/pit in the footway allotment for the connection of additional underground service cables.

This is carried out at a cost to the customer requiring the last connection, or the connection that exceeded the permitted number of underground services on the electricity distributor's pole.

This cost is equal to the additional cost that this customer would have had to pay to extend the underground service onto the pole.

Additional underground services, where required, will be connected to the pillar/pit.

2.10.5 Underground Supply from Overhead Reticulation

Street poles on which distribution transformers, air break switches or similar equipment are mounted, or poles belonging to other statutory authorities (eg Telstra), will not be used except as a last resort. The electricity distributor must agree to this. New street (lead-in) poles must not be erected for underground services. An existing lead-in pole may be used for an underground service if there is at least one other service or attachment (including streetlight or other utility service) currently attached to the lead-in pole.

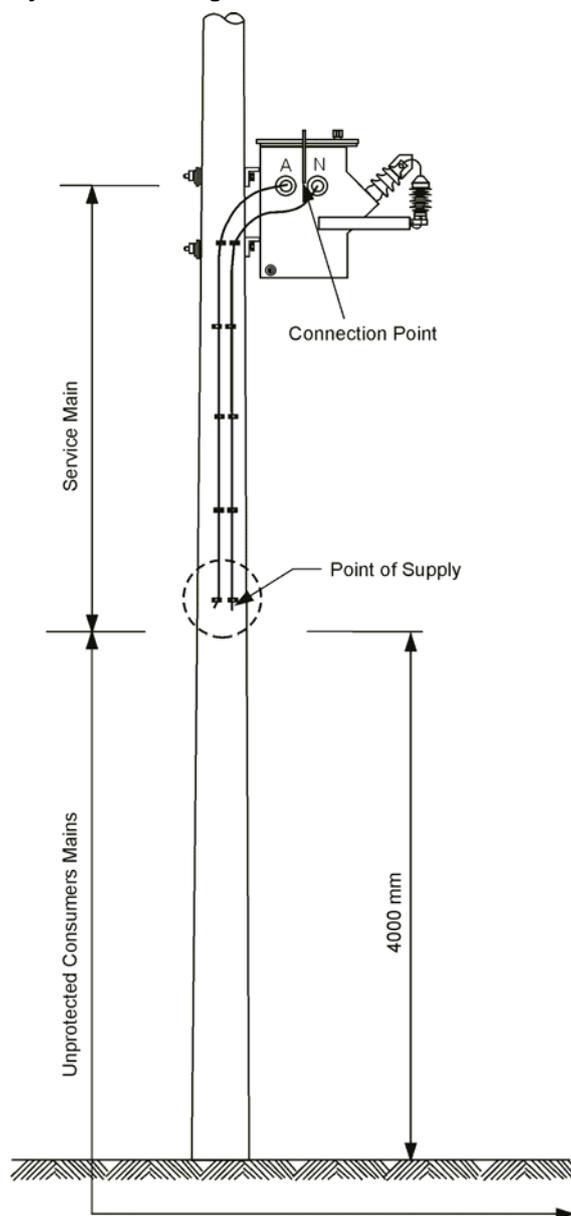
Table 2.3: Maximum Number of Underground to Overhead (UGOH) Service Cables allowed on an Electricity Distributor's Pole

Total Number of All Types of Existing UGOH's on the Distributor's Pole (Refer to Clause 2.10.4)	Additional Number of Customer UGOHs that can be placed on a Electricity Distributor's Pole			
	Conductors up to a maximum of 70mm ²			Conductors greater than 70mm ²
	Line pole	Transformer pole	Air Break switch pole	All situations
0	3	1	1	1
1	2	#	#	#
2	1	*	*	
3	*			

* The customer must apply to have a UGOH installed to a pillar in the footway.

One additional UGOH may be installed provided one is not connected to the LV mains, eg HV or telecommunications.

Figure 2.8: Example of locating the point of supply when the connection point is located on the customers' property and the underground service would exceed 50 metres in length.



Notes:

1. This application only applies when the connection point is located on the customers' property and where the underground service would exceed 50 metres in length.
2. Where the connection point is nominated on a transformer pole (as shown) the distribution system (deemed a service main for indicative purposes) forms part of the electricity distributor's standard construction and must be completed by an authorised Level 1 accredited service provider.
3. Where the connection point is established on a pole other than a transformer pole, the underground service component will extend and terminate at the low voltage overhead distribution system. Category 3 (overhead) service providers must complete the work above 4 metres from ground level.
4. The installation method for the unprotected consumers mains on the electricity distributor's pole is to be in the same fashion as described in Figure 2.9 and 2.10 (an electrical contractor can carry out this work).
5. The installation and subsequent termination of the consumers mains on the electricity distributor's pole above 3 metres must only be completed by an authorised Level 2 (underground) accredited service provider.
6. In this example, the point of supply will be located on the pole, 4 metres above finished ground level.
7. To account for variations, connection method to be as nominated by the electricity distributor.

Figure 2.9: Typical Underground Service with conductors up to a maximum of 70 mm² installed on an Electricity Distributor's Pole. (Refer to Table 2.3)

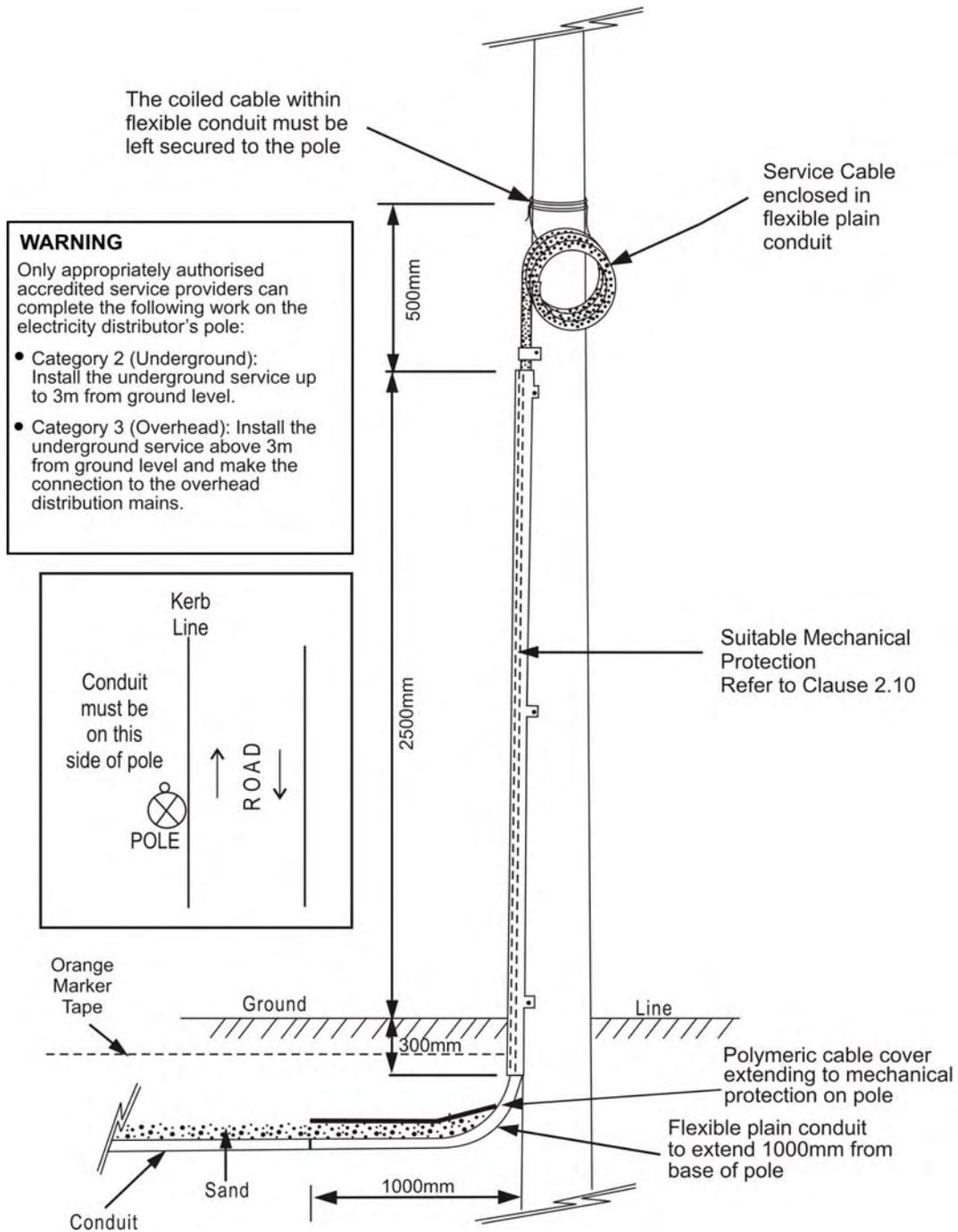
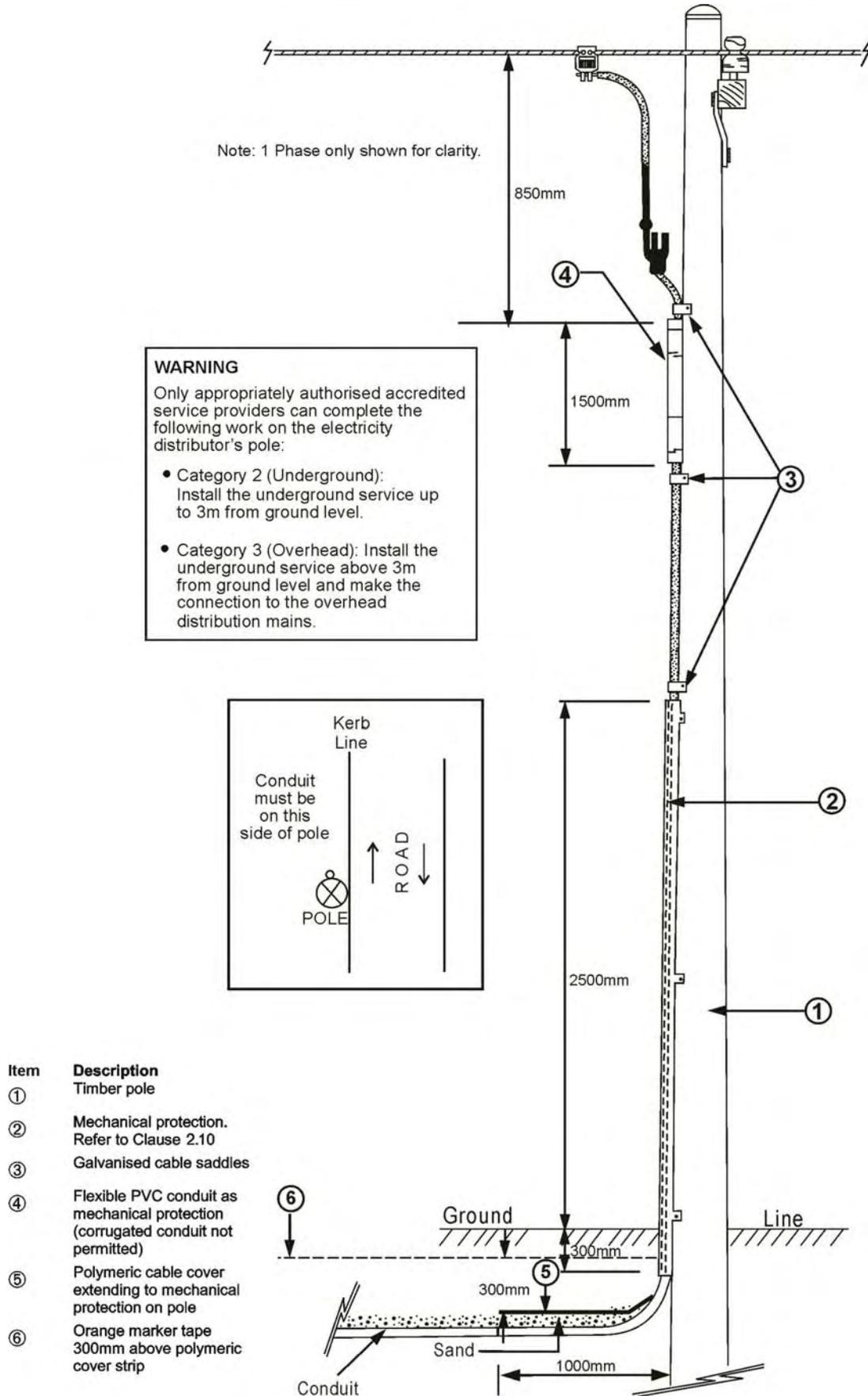


Figure 2.10: Typical Underground Service with conductors larger than 70 mm² installed on an Electricity Distributor's Pole. (Refer to Table 2.3)



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