COMMUNICATIONS ALLIANCE LTD

NATIONAL BROADBAND NETWORK

FIBRE TO THE PREMISES PLANNING – EXPRESS CONDUIT

MAY 2010

National Broadband Network - Fibre To The Premises Conduit Planning – Express Conduit Industry Guideline

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1 INTRODUCTION AND SCOPE

1.1 Introduction

1.1.1 This document has been developed by the Early Stage Deployments working group of the Communications Alliance National Broadband Network (NBN) Project. It provides a guide for planning the installation of new Main Conduits feeding one or multiple development(s) and/or the interconnection of their conduits with those of another carrier.

1.1.2 In the future, the planning of telecommunications infrastructure in Greenfields areas is likely to be increasingly spread among a number of carriers. It is important that an environment is fostered in which the conduit planning is managed in a way that facilitates future development in an orderly and economic fashion to the benefit of all carriers and the community. This includes:

(a) Express Conduits passing through new estates to future developments;

(b) Headworks conduits to extend network access to new estates; and

(c) Conduit planning for redevelopment.

1.1.3 This guideline is to be read in conjunction with other relevant codes and guidelines including, but not limited to:

(a) C524 External Telecommunications Networks; and

(b) G591 Telecommunications in Road Reserves – Operational Guidelines for Installations.

1.2 Relationship with other Communications Alliance NBN Working Groups

1.2.1 The work of the NBN Early Stage Deployments working group is related to activities within other NBN Project working groups in Communications Alliance. The general relationships can be seen in Figure 1.

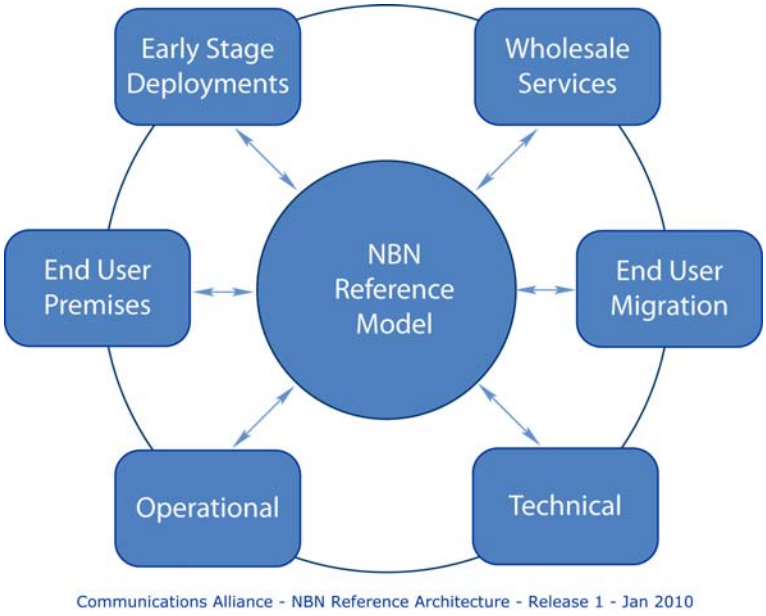

FIGURE 1

Communications Alliance NBN Project Working Group Structure

1.2.2 The NBN Early Stage Deployments working group is one of seven working groups established by Communications Alliance to address industry requirements for the NBN. The other six working groups address the following:

(c) **NBN Reference Model** - The NBN Reference Model Group is developing a reference model that seeks to identify within the NBN framework:

(i) the roles and responsibilities of Service Providers;

(ii) key principles related to End Users;

(iii) key principles related to Services; and

(iv) key principles related to Interconnection of Networks.

(d) **Wholesale Services** - The Wholesale Services working group is developing high level service definitions relevant to the NBN that will be required in an NBN framework and supplied by NBN Co, FTTP Greenfields carriers and other broadband access providers.

(e) **End User Premises** - The End User Premises working group is developing a set of high level NBN End-User Premises (EUP) installation practices and guidelines.

(f) **Technical** - The Technical working group is identifying appropriate international standards (or domestic standards and codes if available) and their features which meet the

characteristics required by the wholesale services, to demonstrate that the wholesale services can be implemented, and to facilitate the sourcing and configuration of network elements.

(g) **End User Migration** - The End User Migration working group is defining a 'migration' with respect to the NBN for the definition of processes for customer movement to, within and from the NBN.

(h) **Operational** – The Operational working group is proposing approaches to enable the best possible customer experience in provisioning, assurance and billing of NBN services.

1.3 Scope

This guideline applies when carriers are planning the installation of new Main Conduits feeding one or multiple development(s) and/or the interconnection of their conduits with those of another carrier.

NOTES:

1. This document presents a range of scenarios and options that Communications Alliance working groups have identified with the purpose of facilitating broader NBN discussion and decision making for NBNs. It does not represent the preferred position of Communications Alliance, its individual members, or the communications industry.

2. While the scenarios presented in this paper are technically feasible, any agreed final set of scenarios will require tradeoffs between technical and operational complexity versus requirements for maximum flexibility in support of functional and service requirements. These issues will need further analyses as part of more detailed Communications Alliance work stream activities.

2 ABBREVIATIONS AND DEFINITIONS

2.1 List of terms

A current list of terms and their definitions is available at:
https://commswiki.dgit.biz/index.php/Agreed_Term_Definitions

2.2 Abbreviations

Abbreviations used in the Guideline and their meaning are:

FTTP	Fibre To The Premises
HV	High Voltage
mm	millimetres
PE	Polyethylene
PON	Passive Optical Network
PVC	Polyvinyl Chloride
uPVC	unplasticised Polyvinyl Chloride

2.3 Definitions

For the purposes of the document:

Breakout

means a place in an underground chamber of an infrastructure owner where another carrier's conduit accesses that chamber.

Distribution Conduit

means conduit connecting major network elements to access points such as pits or manholes located near end customer premises.

Express Conduit

means conduit feeding one or multiple development(s).

NOTES:

1. Express Conduits are often located along arterial roads.

2. All Express Conduits are also Main Conduits.

Greenfield

means broadacre development resulting in the establishment of new road and lot infrastructure.

Lessee

means the carrier requesting access to an underground conduit network of another entity.

Main Conduit

means conduit linking major network elements including network buildings, fibre distribution hubs, cross connect facilities and access multiplexers.

Owner

means the owner of a network and from whom access is being requested by a lessee.

Points of Confluence

mean points where two express routes intersect or where it can be envisaged that a carrier could require access.

> *NOTE: Examples of Points of Confluence include arterial road intersections or commercial areas.*

Rural

means those areas where the average lot frontage exceeds 60 metres.

> *NOTE: Rural areas are also typified by a lack of kerbing and street lighting but exceptions will occur.*

Service Address

means any address that could be expected to require one or more telecommunication services, including apartments and units that occupy the one cadastral location.

Urban

means areas that are not rural i.e. where the average lot frontage does not exceed 60 metres.

3 GENERAL REQUIREMENTS

3.1 Introduction

3.1.1 Refer to Figure 2 for an illustration of demarcation points between the network constructs.

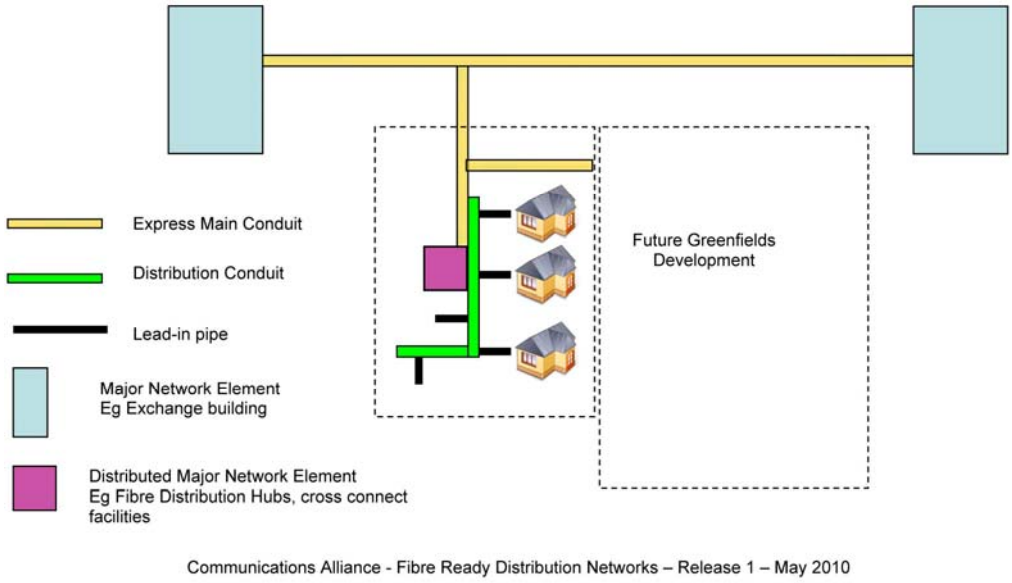

FIGURE 2
Illustration of Network elements

3.2 Conduit Size

3.2.1 It is recommended that all Main Conduits and bends installed in open trenches be 100 mm nominal diameter, especially if the Main Conduits form part of the Express Conduit network.

3.2.2 Conduits will generally be of white uPVC construction, usually with a 4 mm wall thickness, but galvanized iron may be appropriate in circumstances where extra mechanical protection is required.

3.2.3 Conduit materials should conform to appropriate Australian Standard (AS) requirements. The colour of plastic pipes will be in conformance with AS requirements, including AS1345.

3.3 Dimensioning

3.3.1 In Urban areas, all fibre cables installed underground will be provisioned in conduits.

3.3.2 In Urban Greenfields areas, there will be a minimum of two Express Conduits provided along roads which are planned to extend beyond the development or where larger commercial or industrial areas are envisaged. These conduits will be made available to other carriers under the prevailing access regime at the time.

3.3.3 Additional conduits will be required when there is a reasonable expectation that the route will service a larger number of service addresses e.g. in excess of 10,000 service addresses within a 20 year timeframe. A minimum of one additional conduit should be provided for each additional 5,000 service addresses beyond 10,000.

3.3.4 Cable maintenance should also be considered when dimensioning conduit routes. As a guide, the largest size cable planned for the route must be able to be replaced by hauling into suitable vacant duct space. The maintenance space is to be retained by recovering the abandoned cable.

3.3.5 In situations where it would be difficult or impossible to further provision conduits, it is recommended that consideration be given to installing additional conduits so that it is unlikely that the route will ever require augmenting.

3.3.6 In rural areas the provision of conduits is optional. Cables may be direct buried at the discretion of the network owner. However, it is recommended that conduits be provisioned in new estates where trenches are opened for other services.

3.4 Route Selection

3.4.1 There are many issues that could affect the selection of the proposed conduit route. They need to be thoroughly investigated and considered prior to any planning decision being finalized. The key issues to consider are:

(a) Route length i.e. the shortest route is usually the most economical.

(b) Road type i.e. arterial or local. It is usually most efficient to locate Express Conduits in arterial road reserves because these usually offer the shortest and least obstructed access to subsequent developments.

(c) Location of freeways and other road reserves carrying considerable traffic. In accordance with the recommendations of *G591 Telecommunications in Road Reserves - Operational Guidelines for Installations*, do not install conduits longitudinally in freeways and avoid where possible the installation of conduits longitudinally in major roads carrying considerable traffic.

(d) The number of bends. Subsequent hauling is more efficient if bends are kept to a minimum.

(e) The ground condition for the proposed route e.g. rocky, shale, soil.

(f) Sharing of trenching offers from other entities if any.

(g) Any known or planned obstruction e.g. large trees, freeway, large water mains or transmission gas line, river or creek, etc.

(h) Areas with high volume of future potential developments.

(i) The locations of the existing conduit runs.

(j) The location of other underground services e.g. water, electricity etc.

(k) Route diversity from existing conduit feeds in order to provide additional security.

(l) Disruption to businesses in the area.

(m) Impact on pedestrian traffic.

(n) The safe location and accessibility of jointing chambers.

(o) Trench alignments – considering factors such as, footpaths, trees, other utilities assets, etc.

3.4.2 The main objective is to select a conduit route that most efficiently accesses the defined feed area and to provide route diversity to any secondary feed areas.

3.5 Shared Trenches

3.5.1 When installing conduits in trenches shared with other authorities, maintain the required separations and depths of cover.

3.5.2 The following documents provide information on shared trenches:

(a) *C524 External Telecommunication Networks.*

(b) *G591 Telecommunications in Road Reserves - Operational Guidelines for Installations.*

(c) *NSW Streets Opening Conference - Guide to Codes and Practices for Streets Opening.*

(d) *Energex Underground Distribution Construction Manual Section 2: Conduits and Trenching.*

(e) *'Services in Street Code of Practice" of the Land Management Commission (LMC) of South Australia.*

(f) *Utility Providers Code of Practice for Western Australia.*

3.5.3 A maximum of two pipes laid one upon the other is allowed in a shared trench. The uppermost conduit will generally be designated for distribution cable and should enter distribution pits. It is recommended that the lower Main Conduit, which is accessible by other carriers, bypass distribution pits to both minimize the size of those pits and to facilitate future uninterrupted hauling of optic fibre main cables.

3.6 Bends

3.6.1 To facilitate future cable hauling, the number of bends in new Main Conduit routes is to be minimised and the minimum radius bend should be five metres.

3.6.2 Bends down to 10 metres radius are possible by cold bending straight lengths.

3.6.3 Where pre-formed bends are used, it is recommended that the part of the conduit nest accommodating the bends be surrounded by a minimum of 50 mm of concrete.

3.7 Depth of Cover

3.7.1 Refer to C524 for recommended minimum depths of cover.

3.7.2 The depth at which conduits are installed should be sufficient to ensure that they cannot be broken, displaced or deformed by any loading due to traffic which may be imposed upon them.

3.7.3 So that conduits can enter pits and manholes at the correct height, it is recommended that the maximum depth of cover be limited to 600 mm where allowable, particularly at the location of proposed pits or manholes.

Conduits Installed under Rivers

3.7.4 The minimum depth of cover is difficult to specify in such cases. Each situation is almost unique and should be addressed through risk assessment based on specific aspects of the site. Factors to consider could include:

(a) Geological nature of the river.

(b) Likely material movements as a consequence of tidal, flood or current influences.

(c) Likelihood of anchors, dredges or other riverbed penetrating devices being used in the vicinity.

Conduits Installed in Rock

3.7.5 Rock is defined as any continuous strata lain down on a large scale that can only be removed by blasting, rock breaker or rock saw.

3.7.6 When rock is encountered, the depths of cover may be reduced after consultation with the relevant road authority.

Conduits Installed by Thrust Boring

3.7.7 When thrust boring, it is recommended that the depth of cover be at least eight times the diameter of the boring head to ensure that any ground swell does not cause damage to paved or concreted areas. Pit and manhole locations will need to be

known prior to boring so that the bore can be raised to the required depth at these locations.

3.8 Bedding

3.8.1 Conduit nests installed in trenches are to be surrounded by 50 mm of fine granular material.

3.8.2 It is recommended that conduits be separated vertically by 40 mm and horizontally by 25 mm.

3.9 Conduit Location

3.9.1 Refer to section 9.3 of C524 for recommendations on the locating of conduits after installation, including the use of an appropriate marker tape to warn others subsequently excavating a trench.

3.10 Backfill

3.10.1 After bedding in granular material, the trench may be backfilled with material from the excavation. The backfill material is to be compacted such that the surface does not settle. This can usually be accomplished by compacting in layers of 150 mm maximum.

3.11 Joining

3.11.1 All conduit joints are to be water tight. A standard PVC solvent adhesive is to be used at all joints to weld the two components together.

3.11.2 Refer to AS/NZS2033 for information on the joining of polyethylene pipe systems.

3.12 Testing of Installed Conduits

All conduits installed should be tested after installation.

NOTE: An example of a test method is hauling an appropriately sized duct proving mandrel throughout the entire length of a conduit.

3.13 Records

3.13.1 Each carrier is required to maintain a geospatial database of all their underground plant.

3.13.2 It is recommended that carriers with underground facilities become members of Dial Before You Dig (www.1100.com.au) and they should register an interest in all areas in which they have underground facilities.

3.13.3 Lessees must inform lessors of the location of their infrastructure, including the type of equipment installed and the appropriate documentation provided to the lessor.

3.14 Sealing of Conduits

3.14.1 It is a mandatory requirement that conduit breakouts be sealed at the entrance to the owner's pit or manhole.

3.14.2 It is recommended that all new unoccupied conduits are to be sealed in manholes and pits to prevent the ingress of silt, water, gas or vermin.

3.15 Conduit Configuration

3.15.1 So far as is practicable, conduit configurations are to be maintained between pits and manholes. Individual conduits are not to change position relative to other conduits in the nest. Where configurations cannot be maintained (e.g. where conduit routes diverge after exiting a manhole), the details are to be recorded in the owner's geospatial database such that a conduit exiting one manhole or pit may be identified at the next manhole or pit.

3.15.2 Conduit configurations should allow smooth cable flow at jointing chambers avoiding future cable tangles and blocking of adjacent conduits by poorly installed cables.

3.16 Subduct

3.16.1 Either the conduit owner or the lessee may require the provision of a physical barrier to minimise the risk of damage to their own or other carrier's plant during hauling. This may be achieved by the provision of Polyethylene (PE) subduct.

3.16.2 Where PE subduct is required, the subduct used shall have:

(a) a 32 mm external diameter;

(b) a 28 mm internal diameter; and

(c) a tensile strength and crush resistance complying with AS/NZS 4130 type 50, class 6 PE pipe.

NOTE: Mention of AS-1159 might appear in relation to pipe/conduit specifications. AS/NZS 4130 has replaced AS-1159.

3.16.3 If the owner of the conduit requires the installation of subduct, then the lessee is to provide it. If the owner does not require the provision of subduct, then the lessee may still choose to provision subduct.

3.16.4 An empty P100 conduit can accommodate up to three PE subducts if all three subducts are hauled into an empty conduit simultaneously. Only two subducts can be accommodated in a single conduit if they are provisioned separately. Because it is not reasonable to require a lessee to provision more than one subduct at a time, it is unlikely that three subducts can be provisioned in a conduit. However, to maintain a physical barrier

between three cables, it is only necessary that two of the cables be subducted.

3.16.5 The subduct shall be installed by a suitable contractor acceptable to both the owner and the lessee of the conduit.

3.16.6 Lengths of subduct may be joined by mechanical compression couplers to provide a continuous length limited only by the capacity to haul and handle the subduct and the maximum hauling length of the cable to be installed within it.

3.16.7 Couplers should only be located in accessible locations.

3.16.8 Subduct can overhaul existing fibre cable providing there is adequate space in the conduit. The conduit space is to be proven by passing a mandrel through the conduit equivalent to at least 1.5 times the diameter of the subduct.

3.16.9 All subducts are to be suitably labelled to identify the lessee/user. Identification tapes, markers and tags are to be provided by the lessee at each accessible location.

3.17 Conduit Usage

3.17.1 When accessing another carrier's conduits, the conduit owner may select partly occupied conduit in preference to an unoccupied conduit. The conduit must be able to house the required cable or subduct without causing damage to the existing cables in that conduit. Allocation of an empty duct will usually be the last preference.

3.17.2 It is recommended that the conduit selected be an occupied conduit that is lowest in the manhole and closest to the side wall of the manhole except where such selection would block off other ducts or interlace, obstruct or interfere with other cables or plant in the manhole. Where the subduct is traversing the manhole, minimise any deviations of the subduct within the manhole.

3.17.3 The conduit owner should ensure:

(a) there is space at each of the proposed joint closure locations; and

(b) the excess looped cable causes no blockages for future installations.

3.18 Provision of Draw Rope

3.18.1 A draw rope is to be provided in all conduits for their continuous length and is to be of sufficient strength to draw in a hauling rope.

NOTE: If a gas tight seal of a conduit is required then a draw rope may not be feasible.

3.18.2 The draw rope is to be secured at each pit or manhole with sufficient slack to enable the attachment of hauling ropes at a later date.

3.18.3 Draw ropes are not to be attached to cables, manhole cross bars or ladders.

3.19 Manholes and Pits

3.19.1 Manholes and pits are underground chambers installed along conduit routes to enable cables and subducts to be installed in and withdrawn from conduits and to give access to the cables for jointing and maintenance.

3.19.2 Each carrier shall house their closures in their own pits or manholes where possible. Where it is not feasible to install a new pit or manhole, a carrier may negotiate with the network owner for access to an existing pit or manhole.

3.19.3 Pits can be installed as underground chambers for 1 or 2 way conduit runs. Manholes are to be used for more than 2 way conduit runs to provide adequate space for cable hauling and jointing.

> *NOTE: More than 2 conduits may enter a pit (e.g. spur access to the main route) but the primary route should not comprise more than two conduits.*

3.19.4 Pits and manholes should be able to withstand the loads that may be expected in all installations. Typically this would require compliance with AS 3996 Class B for footway installations and Class D where it is necessary to install them in or near driveways.

3.19.5 Pits/manholes on Main Conduit routes will have relatively long side walls. It is recommended that pits/manholes be of concrete construction to eliminate the risk of side walls collapsing.

3.19.6 To minimise disruption to the carrier's network by other carriers, it is recommended that manholes be provisioned on Express Conduit routes at any Points of Confluence.

Breakouts

3.19.7 A carrier's pit or manhole is not to be installed over conduits that are not owned by that carrier. Where a carrier wishes to gain access to another entity's conduit network, a breakout from one of the owner's manholes or pits will be required.

> *NOTE: A breakout consists of a hole through the manhole or pit end wall through which another carrier's conduit enters the manhole or pit.*

3.19.8 As a general rule, the following are not suitable for breakouts:

(a) Cable tunnels.

(b) Purpose built auxiliary manholes forming part of the exchange cable chamber.

(c) Roadway manholes.

(d) Underground electronics housings.

(e) Small size pits.

3.19.9 However, if no alternative to a breakout exists, the carrier may negotiate with the owner on a site by site basis.

Separation Between Different Carrier Pits/Manholes

3.19.10 Where possible, a minimum separation of three metres is to be maintained between the openings (covers) of owner and occupier pits or manholes. A minimum of one metre is to be maintained between the adjacent walls of pits or manholes. (Refer to Figure 3.)

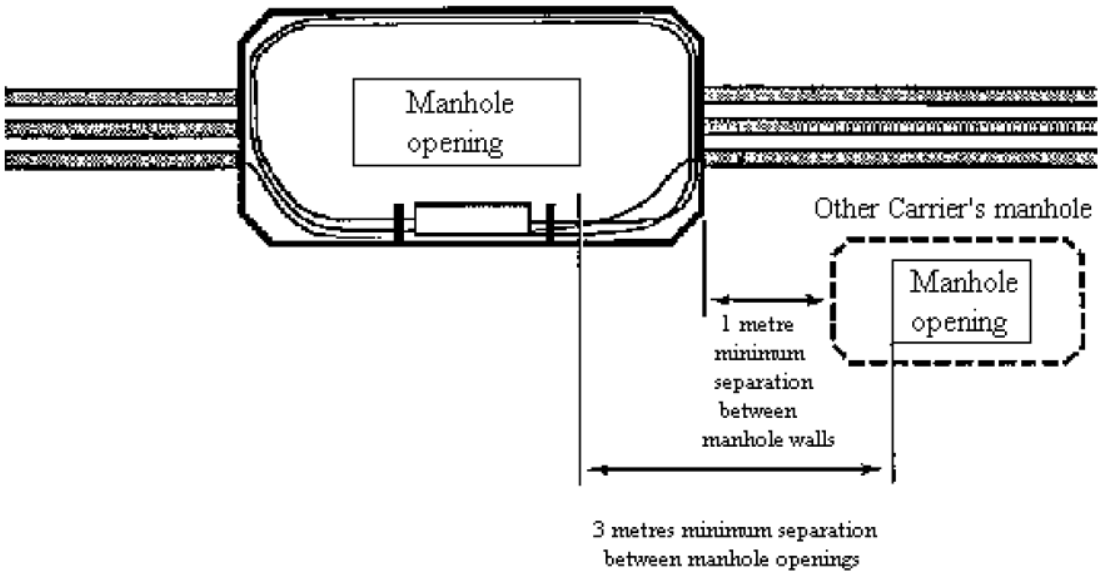

FIGURE 3

Separation Between Different Carrier Pits/Manholes

Placement of Manholes and Pits

3.19.11 So far as is practicable, manholes or pits are to be placed:

(a) Along the line of the street conduits (i.e. not offset with the chamber conduit entries). Note that minor offsets may be required for some pits in shared trench arrangements.

(b) At the start and end of conduit runs.

(c) At a junction of conduit runs.

(d) So as access by hauling trucks is not restricted.

(e) No closer than three metres from a road intersection as measured from the transverse property line (i.e. the property line of the cross street).

(f) No closer than one metre from a kerb.

(g) At property intersections (where required).

(h) Away from driveways, especially commercial driveways.

(i) Away from shop doorways or general access ways.

(j) Away from hazard zones that may exist in the event of an earth fault on nearby power lines should the manhole or pit house copper cables in the future. As a guide, pits or manholes should not be located within:

(i) 300 mm of a low voltage power structure including pedestals;

(ii) 15 metres from HV structures less than 66kV; and

(iii) 40 metres from HV structures 66kV and greater.

Spacing of Manholes and Pits

3.19.12 Manholes and / or pits are to be spaced no more than 250 metres apart. Refer to AS/NZS 3084 Appendix ZB for more information.

Conduit Entry to Pits and Manholes

3.19.13 Conduits shall enter pits via the end of the pits and not via the sides.

3.19.14 It is preferable that conduits enter manholes so as to align with the side wall of the manhole. This will minimise the length of the manhole required to accommodate bends in cables.

Labelling of Pits and Manholes

3.19.15 Refer to C524 for labeling requirements of pits and manholes.

3.19.16 Under no circumstances is a carrier permitted to label its pits or manholes with the designation of another carrier.

Labelling of Plant in Pits and Manholes

3.19.17 All carriers plant should be suitably labelled to identify the carrier. Identification tapes, markers and tags are to be provided by the acquiring carrier.

Manhole Dimensions

3.19.18 The manholes selected for the new cable route have to be deep and large enough for cable hauling and jointing. The strategic manhole must allow enough room to house cable loops and the associated joint closures. The manhole dimensions must allow for

cable loops to be installed without impacting the minimum bend radius of the proposed cables.

NOTE: The number of fibre counts of the cable governs the minimum radius of the cable loop.

3.19.19 The recommended dimensions of manholes are specified in the table below.

TABLE 1

Recommended Dimensions of Manholes

Conduit Route (ways)	Manhole Dimensions (minimum)		
	Length (mm)	Width (mm)	Depth (mm)
1- 4	1600	900	1000
6 – 12	2400	1200	1200
14 – 20	3800	1400	1500

Pit Dimensions

3.19.20 The recommended minimum dimension for a pit installed on a Main Conduit route where joints are proposed or could reasonably be envisaged is 1800 mm (L) x 450 mm (W) x 750 mm (D). Such an enclosure will be able to accommodate one or two large fibre joints.

3.19.21 The current standard pit that meets the dimensioning requirements in section 3.19.20 is the 9 pit.

3.19.22 The smaller 8 pit may be used as a hauling pit where joints are not likely to be required by either the network owner or future lessees.

4 REFERENCES

Publication	Title
Australian Standards	
AS 1345-1995	Identification of the contents of pipes, conduits and ducts http://infostore.saiglobal.com/store/Details.aspx?ProductID=224345
AS/NZS 2033:2008	Installation of polyethylene pipe systems http://infostore.saiglobal.com/store/Details.aspx?ProductID=1009456
AS 3996-2006	Access covers and grates http://infostore.saiglobal.com/store/Details.aspx?ProductID=307453
AS/NZS 3084:2003	Telecommunications installations - Telecommunications pathways and spaces for commercial buildings http://infostore.saiglobal.com/store/Details.aspx?ProductID=367215
AS/NZS 4130:2009	Polyethylene (PE) pipes for pressure applications http://infostore.saiglobal.com/store/Details.aspx?ProductID=1123080
Industry Code	
C524:2004	External Communication Cable Networks http://commsalliance.com.au/Documents/Documents/codes/c524
Industry Guideline	
G591:2006	Telecommunications in Road Reserves - Operational Guidelines for Installations http://commsalliance.com.au/Documents/Documents/guidelines/g591
	NSW Streets Opening Conference Guide to Codes and Practices for Streets Opening http://www.ipwea.org.au/Content/NavigationMenu3/UPLOADS/SOC_Guide_2009.pdf

	Energex Underground Distribution Construction Manual Section 2: Conduits and Trenching http://www.energex.com.au/upload/technical_documents/20080704_134215_1327326.pdf
	'Services in Street Code of Practice" of the Land Management Commission (LMC) of South Australia
	Utility Providers Code of Practice for Western Australia http://www2.mainroads.wa.gov.au/Internet/Standards/RTems/roadside/services/utili_providers_code_of_practice_for_western_australia.asp

Communications Alliance was formed in 2006 to provide a unified voice for the Australian communications industry and to lead it into the next generation of converging networks, technologies and services.

In pursuing its goals, Communications Alliance offers a forum for the industry to make coherent and constructive contributions to policy development and debate.

Communications Alliance seeks to facilitate open, effective and ethical competition between service providers while ensuring efficient, safe operation of networks, the provision of innovative services and the enhancement of consumer outcomes.

It is committed to the achievement of the policy objective of the *Telecommunications Act 1997* - the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry.

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