

**AUSTRALASIAN SOCIETY
FOR
TRENCHLESS TECHNOLOGY**



**STATE OF THE INDUSTRY REPORT ON
TRENCHLESS TECHNOLOGIES IN
AUSTRALIA**

NO-DIG 2000

PERTH WESTERN AUSTRALIA

prepared by

**AWT ENGINEERING
PIPELINES**

SEPTEMBER 2000



SYNOPSIS

The basis of the preparation of this report was from a need by the Australasian Society for Trenchless Technology (ASTT) to gain an appreciation of the current state of the industry in trenchless technologies being utilised in Australia.

The report was to build on a paper produced by Shooter (1993) for the NO-DIG '93 Conference that reported on developments in the trenchless technology industry and the state of the market in Australia at that time. Similarly, the information contained in this report is proposed to be used by the ASTT at the NO-DIG 2000 Conference in Perth, Australia.

Australian Water Technologies (AWT), a business arm of Sydney Water Corporation (SWC) involved with the design, construction and rehabilitation of major water and wastewater pipeline infrastructure, was engaged by the ASTT to prepare this report.

The author, predominantly involved in the design of major water and wastewater infrastructure constructed by trenchless techniques, has used industry contacts in the form of contractors, suppliers, authorities and service providers to obtain input data for this report. The author's own involvement in several trenchless technology projects and the monitoring of several projects being carried out during the course of the preparation of this report, has provided some additional current industry information. Similarly, the author's preparation of a final year university thesis in 1999, based on horizontal directional drilling, also contributed to the information sources.

Despite the vast number of contacts made, the overall response was not as extensive as anticipated. Although the content of the majority of responses received was comprehensive, a full coverage of the wider industry was not able to be obtained during the report preparation stage.

This report is therefore by no means a definitive total sum of all trenchless technology projects carried out to date. It is however more a summary of the types of projects being undertaken and at least for some of the industries reported on, an indication of the current and future trends in the market.

It should be appreciated that the majority of the data contained in this report has been obtained from a variety of contractors' records and design and work-as-executed data from authorities and organisations and as such, the accuracy of the source information cannot be absolutely assured. The data has been analysed and summarised to give an indicative representation only.

ACKNOWLEDGMENTS

The author wishes to thank the following organisations for their valuable contributions in directly providing input data to this report;

AGL
AJ Lucas Group Pty Ltd
Australian Water Technologies
Bayside Boring
Brisbane Water
BTB Australia
Cherrington Australia
City of Launceston Council
Coe Drilling Australia Ltd
Energy Australia
Freemantle Drainage & Microtunnelling
Hunter Water Corporation
Kembla Constructions
Maroochy Shire Council
Melbourne Water
Minson Nacap Drilling
Pezzimenti Laserbore
South Australia Water
Sydney Water Corporation
Telstra Australia
The Trenchless Group - Trenchless Installations
WaterCorporation

EXECUTIVE SUMMARY

Trenchless Technologies are those methods or systems that allow the renewal, replacement or new installation of infrastructure that alleviates the need for open-trench construction. In utilising these technologies, the inherent social, environmental and economic issues associated with traditional construction techniques are often eliminated or at least reduced.

In Australia, a history of methods utilising trenchless techniques has developed over the last thirty years. Conventional pipe-cracking or pipe-bursting and horizontal boring techniques for new infrastructure installations has had a considerable history and success.

The 1990's has seen significant growth and development of existing and new technologies all aimed at creating and upgrading infrastructure whilst minimising disruption, disturbance and environmental damage and at the same time reducing costs.

The data obtained and presented in this report is not a true sum total of trenchless technology works carried out to date and hence the "raw numbers" do not accurately reflect the amount of work being undertaken when compared to data presented by Shooter (1993).

The report is more a summary of the types of projects being undertaken and, at least for some of the industries reported on, an indication of the current and future trends in the market.

From the amount and types of trenchless technology projects researched, confidence in the continuation of an increasing trend in the market and in the industries within the market can be assured.

TABLE OF CONTENTS

1. BACKGROUND.....	1
2. TRENCHLESS TECHNOLOGIES	2
3. THE CURRENT MARKET AND MAJOR PLAYERS.....	2
3.1 Horizontal Directional Drilling (HDD).....	2
3.2 Microtunnelling	5
3.3 Pipe Bursting.....	7
3.4 Guided Boring.....	8
3.5 Conduit Rehabilitation.....	8
4. THE INDUSTRY DRIVERS AND FUTURE MARKET.....	9
4.1 The Industries	9
4.2 The Telecommunications Industry	9
4.3 The Gas Industry	10
4.4 The Water Industry.....	10
4.5 The Electricity Industry.....	12
4.6 Other Industries	13
5. CONCLUSION.....	14

1. BACKGROUND

There are approximately 130,000 km of watermains and 80,000 km of sewer mains in Australia. A large proportion of this infrastructure has exceeded or is rapidly approaching its design life, with estimates indicating a replacement value above two hundred million dollars (\$200 M) (Australasian Society for Trenchless Technology 1998, p. 1). In addition, there are also many thousands of kilometres of fuel, chemical, electrical and telecommunications conduits that, although not necessarily at critical stages of their design lives, still require installation, replacement and expansion and will continue to do so into the future.

Infrastructure owners and operators have become increasingly aware of the favourable economics of renovation and rehabilitation techniques for pipeline infrastructure and in Australia, a history of methods utilising trenchless technologies has developed over the last thirty years. Likewise conventional pipe-cracking, pipe-bursting and horizontal boring techniques for new infrastructure installations has a considerable history and success here in Australia.

Pipeline infrastructure owners and operators have an immense economic investment in underground pipelines, with each having a vested responsibility and interest in constructing and installing new infrastructure at minimum cost.

Society places a constant demand on improved infrastructure systems whilst at the same time, an ever-increasing value is placed on the existing environment, both natural and developed and the systems that exist within them. As the infrastructure networks are expanded to meet the demand, there develops a competition for space and working which results in increasing difficulty, complexity and cost for infrastructure installation projects.

Concurrent with society's increasing demand for new and improved infrastructure, there exists a greater emphasis on environmental protection in the form of minimising the impacts and damage due to development and due to the operation of the infrastructure systems in place. With both the community and regulators exerting influence to improve and rationalise infrastructure systems to meet environmental and regulatory requirements, authorities, developers and constructors are faced with seemingly conflicting tasks.

Industry providers are required to provide technically appropriate solutions to meet a demand whilst minimising environmental impacts, social disruption and disturbance all within an economically feasible framework appropriate to the current economic climate.

In more general terms, effective solutions to difficult problems must be provided, with minimal disturbance, impact and cost and with maximum public and political acceptance and "value for money".

2. TRENCHLESS TECHNOLOGIES

The traditional definition of “Trenchless Technologies” are those methods or systems that allow the renewal, replacement or new installation of pipeline infrastructure that alleviates the need for open-trench construction or any large scale excavation. In utilising these technologies, the inherent social, environmental and economic issues associated with the aforementioned construction techniques are often eliminated or at least reduced.

As shown by the types of projects currently being undertaken in Australia detailed within this report, the benefits of trenchless technologies are not only limited to the traditional applications of renewal, replacement and installation. The technologies being utilised in the industry are now providing innovative design and construction solutions and in some respects, changing the design methodology in terms of some infrastructure systems planning and operations.

3. THE CURRENT MARKET AND MAJOR PLAYERS

3.1 Horizontal Directional Drilling (HDD)

This technology was reported as being first utilised in Australia in 1970 by contractors from the United States of America (USA) to carry out a project for Esso Australia (APIA 1999, p. 40). However, it was not until 1988, that the technology was fully introduced for use in the mining industry (Donnelly 1993, p. 1).

Since this time, HDD has been extensively used for the installation of new pipeline infrastructure for the oil, gas, telecommunications and water industries.

HDD involves the drilling of a pilot hole (by a guided and steered drilling head) and then enlargement (reaming) to accommodate a liner pipe. The borehole drilled is supported or stabilised by a drilling fluid or ‘mud’ during the drilling and reaming process, which also acts as a lubricant and a method of returning cuttings to the surface.

Guidance is achieved through instruments located behind the drilling head assembly relayed to the surface via a wireline or surface tracking system. Steering is undertaken by controlling the direction of the bias in the drilling head assembly.

Alignments involving horizontal and vertical curves can be drilled at grades from a steepness limited only by the drilling rig orientation down to approximately 2.5-3.0%.

The technology has been used to install pipelines in the range of 100mm diameter to 1100mm diameter for lengths of just over the 1000m distance in Australia. Projects carried out overseas have exceeded these diameters and lengths and several projects are currently proposed here in Australia incorporating the drilling of lengths in excess of 1000m.

Projects carried out to date have been successfully undertaken in a variety of stratas: hard rock (basalts, granites and ironstones), medium rock (sandstones), soft rock (shales and mudstones) to clays, sands and marine/alluvial sands and silts.

The HDD market in Australia currently has five (5) major players undertaking significant-sized pipeline installation projects:

AJ Lucas Group Ltd

AJ Lucas have been carrying out HDD projects within Australia since 1990. To date the company has undertaken in excess of seventy (70) drilling projects for pipeline installations.

The group has three drilling rigs for use in Australia with push/pull (installation) capacities ranging from 65 tonnes up to 250 tonnes (APIA 1999, p. 42). The 250 tonne Hercules rig has been modified to increase the pulling capacity to 300 tonne for a large crossing project currently being undertaken in Hong Kong.

AJ Lucas recently acquired significant interests in Drilltec GUT, a European-based drilling company with international experience which may ultimately increase their equipment availability and capacity to undertake even more large drilling projects.

Projects of note, undertaken by the group in Australia, are: fifteen (15) drills for the Moomba-Sydney Ethane Pipeline in New South Wales (NSW) completed in 1996; twin telecommunications ocean cable landfalls at Floreat Beach, NSW in 1997; six (6) inclined boreholes for sewerage transfer in the Blue Mountains, NSW since 1997; six river crossings for the Century Mine Slurry Pipeline in Queensland (Qld) completed in 1999; two (2) optical fibre installations at Mt Sugarloaf, NSW completed in 1998; primary gas main and telecommunications conduit crossings of Middle Harbour, NSW in 1999. Four river crossings for wastewater pipelines are currently in progress or due to commence in both NSW and Qld (Lucas 2000).

The project at Mt Sugarloaf was reported to be the world record height gain during drilling for optical fibre installation at that time (APIA 1999). Details of projects successfully carried out are detailed in the Appendices in Table 1.0.

Coe Drilling Australia Pty Ltd

Coe Drilling have been carrying out significant-sized drilling projects since 1996. A total of twenty-two (22) projects for pipeline installations have been carried out to date.

The company has two drilling rigs available for the larger scale work in Australia; a 40 tonne push/pull capacity rig and the larger CoeDrill 550 with a 250 tonne/55 tonne push/pull capacity. The CoeDrill 550 was reported to be the largest drill rig available for use in Australia in 1999 (APIA 1999, p. 47). A third and smaller rig is generally used for smaller scale telecommunications projects (APIA 1999, p. 42).

Projects of note completed by the company are: six (6) gas pipeline installations in NSW, Qld and the Australian Capital Territory (ACT) since 1996 including three (3) river crossings; two (2) crossings of the Yarra River, Victoria (VIC) in 1999; three (3) drills for wastewater pipelines in NSW and Qld completed since 1998. Coe Drilling currently undertakes a large number of small-scale conduit installations for the telecommunications industry. Details of projects successfully carried out are detailed in the Appendices in Table 1.0.

Cherrington Australia

Cherrington Australia is a subsidiary of the company that originally developed HDD in the USA.

The company has a variety of drilling rigs that are used in the South-East Asia/Australia region that are available for use in Australia. Typically the R-550 with 173 tonne/55 tonne push/pull capacity has been used for projects in Australia (APIA 1999, p. 42).

Projects of significance, undertaken by the company in Australia are: seven (7) drilling projects for the Eastern Gas Pipeline project in NSW including four (4) river crossings completed up to 2000; two (2) ocean cable landfalls for telecommunications conduits at Narrabeen Beach and Clovelly Beach, NSW completed in 1999; a seawater intake at Brooms Head, NSW completed in 1999; two (2) river crossings for the Lara to Iona Gas Pipeline in VIC in 1999.

The latter project was reported to be the largest diameter (508mm pipeline) HDD crossings carried out to that date in Australia (APIA 1999, p. 44). Details of these projects are included in the Appendices in Table 1.0.

BTB Australia

BTB has been undertaking HDD work in Australia since 1994 with the majority of the work being cable installations for the telecommunications industry. A variety of drilling machines are used by BTB to carry out this type of work, typically being Ditch-Witch 8/20 and 8/60 machines.

The company utilises a Vermeer 23 tonne push/pull capacity drill rig for larger installation projects.

Larger scale projects undertaken by BTB are: a crossing of the Murray River, VIC completed in 1998; several freeway/highway crossings; twin electrical cable conduits installed beneath a railway line in Boronia, VIC in 1999.

Minson Nacap Pty Ltd

Minson Nacap first commenced HDD operations in Australia in 1997 and have since completed nine (9) drilling projects for pipeline installations.

The company has a 30 tonne/12 tonne push/pull capacity drilling rig for work within Australia and also has 100 tonne and 250 tonne capacity rigs in South-East Asia available for work here if required (APIA 1999, p. 42)

Projects of note completed by Minson Nacap to date are: two (2) gas pipeline crossings of the Murray River and the Black Swan Lagoon in VIC; two (2) gas pipeline crossings of the Yarrowonga canal and Ovens River; three (3) conduit crossings beneath Sydney Airport runways/taxiways. Details of these projects are included in the Appendices in Table 1.0.

Figure 1.0 in the Appendices details the extent of HDD construction and installation in Australia. Confidence in the accuracy of the totals of the work carried out to date is reasonable based on the work being carried out by the major industry participants. However, the estimate of future work shown is significantly less than what is forecast. For commercial reasons, full data on proposed work is not available from the participants supplying the information.

Pontil, another major player in the HDD industry, originally involved in pipeline/conduit installation for the telecommunications and water industries in the late 1980's and early 1990's is now heavily focussed on directional drilling work for mining and mineral exploration, but may have the capacity to undertake pipeline installation works if desired.

It should also be noted that directional drilling technology is available for the installation of small diameter conduits over short lengths. These projects are typically carried out for the telecommunications, electrical and gas industries.

Described as mini-HDD, in 1999 there were reported to be approximately 100 mini-rigs used in the telecommunications industry (APIA 1999, p. 40).

As an indication, Ancon, a company involved in carrying out mini-HDD work, installed 75km of conduit/cable using HDD technology for Telstra Australia in 1999.

Figure 2.0 in the Appendices details the extent of mini-HDD construction and installation carried out for Telstra Australia. The total for the year 2000 is for lengths installed up to 30 June, 2000 only.

3.2 Microtunnelling

Microtunnelling, developed and used extensively in Germany and Japan, was first introduced into Australia in the mid-late 1980's. Much of the initial development of the industry in Australia can be attributed to Pezzimenti Laserbore and their use of the technique in Melbourne, VIC before expanding to Sydney, NSW.

Since this time, microtunnelling has been extensively used for the installation of new pipeline infrastructure particularly for the water industry.

Microtunnelling involves the construction of a bored hole with the boring machine thrusting or bearing from a launch shaft along a predetermined alignment to a receiving shaft. Liner pipes are either jacked in directly behind the boring machine

(generally in collapsible strata) or jacked or pulled in after the machine has completed the hole (generally in self-supporting strata).

Spoil or cuttings are removed via vacuum extraction or a re-circulating slurry disposal system. In collapsible strata, earth pressure balance machines are used where the slurry system also provides a balancing outward pressure against the earth pressure force and any hydrostatic force due to the water table.

Guidance and control of the boring machines is achieved by laser guidance methods and adjustment of the thrust direction.

Total lengths that can be bored are generally limited to drives up to 200m, however with improved lasers and increasing size of machines, these distances are expected to be exceeded as the demand warrants.

Grades ranging from 70% down to less than 0.5% have been bored. The capability to be able to bore at the flatter grades has rendered this technology extremely suitable for the installation of sewerage and stormwater conduits.

The technology has been used to bore holes in the range of 300mm up to 1350mm in Australia.

Projects carried out to date have been successfully undertaken in a variety of stratas: ironstone and sandstone, shales and stiff clays, wet and dry clays and sands.

The current market in Australia has seen several contractors undertaking microtunnelling work. The two main players, Pezzimenti Laserbore and Freemantle Drainage and Microtunnelling would appear to be undertaking a large percentage of this type of work.

Pezzimenti Laserbore

Pezzimenti, based in both Melbourne and Sydney, design and manufacture their own laser-guided, vacuum extraction boring machines capable of boring holes from 300mm up to 1350mm in rock, stiff clays and other self-supporting materials.

The majority of the work undertaken by this company is for sewerage and drainage projects. Details of projects completed to date are included in Table 2.0 in the Appendices.

Freemantle Drainage and Microtunnelling

Freemantle Drainage and Microtunnelling, based in both Western Australia (WA) and VIC were heavily involved in undertaking microtunnelling works in the soft sands of WA and have now established themselves to undertake work on Australia's East Coast.

The company uses machines manufactured by Soltau of Germany, and are experienced in using earth pressure balance machines to microtunnel in wet, soft sands and clays.

Recent projects have involved boring of holes to accommodate liner pipes from 150mm up to 600mm for drainage projects. Details of these recent projects are included in Table 2.0 in the Appendices.

Other contractors involved in the industry are: Civil and Construction Engineering Services based in Fremantle, WA, who have three (3) microtunnelling rigs available for use; the Georgiou Group based in WA who utilise an Iseki Unclemole machine to construct 300mm to 600mm diameter holes; Mary Donald Nominees Pty Ltd who have equipment capable of installing pipes from 150mm to 1500mm diameter.

Figure 3.0 in the Appendices details the extent of microtunnel construction in Australia. The totals of the work carried out to date is indicative only as data was not obtained from all the major industry participants.

The forecast decreasing trend in the number of metres bored in Australia in the early (to mid) 1990's (Shooter 1993, p. 2) is shown true, however an upsurge to the current date and the increase in industry players since the early 1990's indicates that this technology is continually developing.

3.3 Pipe Bursting

Pipe bursting has been used in Australia since the mid 1980's. The technology involves the insertion of a pneumatic hammer or ram into an existing pipe which splits, cracks and expands the pipe wall along the length of the existing pipe to allow a new pipe (generally polyethylene (PE)) to be winched through the inside.

Projects carried out to date in Australia demonstrate that pipes of 150mm to 600mm diameter can be renewed for lengths up to 1500mm in conditions varying from hard strata and cobbles to clays and water-charged sands.

There are numerous contractors undertaking pipe bursting works throughout Australia. As a typical example, Sydney, NSW-based NO-DIG Pipe Laying has recently carried out pipe bursting projects for water authorities in NSW, ACT and VIC.

The company operates such equipment as Grundocrack hammers and rammers, Tracto Technik bursting tools and Gigant hammers and expanders.

Projects of note recently carried out by NO-DIG are: replacement of 1000m of 250mm diameter watermain in Sydney, NSW; reinstatement and amplification of 1500m of 400mm diameter sewer in Melbourne, VIC; amplification of 500m of 600mm diameter sewer in Sydney, NSW. Details of projects completed to date are included in Table 3.0 in the Appendices.

The majority of pipe busting carried out in the industry in Australia appears to be to renew pipes for water, sewerage and drainage projects.

Shooter (1993, p. 2) reported an increasing trend in pipe bursting since the mid-1980s, but a hampering of real growth due to lack of acceptance of polyethylene (PE) pipe as suitable for water reticulation systems amongst water authorities.

The data presented in Figure 4.0 in the Appendices does not accurately indicate the lengths of pipe bursting carried out to date as data was not able to be obtained from the numerous contractors undertaking this work. From the information sourced, pipe bursting is still used considerably more for sewerage and drainage projects rather than watermain works.

3.4 Guided Boring

Guided boring was first introduced into the industry in 1991. Guided boring machines or directional rod pushers were used mainly for under- road crossings for the telecommunications, gas and water industry for conduit installation typically in the range of 20mm diameter to 150mm diameter.

The lack of data able to be obtained on this technology makes it difficult to quantify the current extent and trends in the industry.

The technology is known to still be used by contractors carrying out minor crossings work for gas and water utilities.

The driving force of the telecommunications industry initially inspired and developed growth in this technology. With the development of the more sophisticated mini-HDD machines and their significant usage in the telecommunications industry, then further use of guided boring may not be as marked as anticipated in the past.

3.5 Conduit Rehabilitation

Conduit rehabilitation has developed since the mid 1980's throughout Australia as conduit owners and operators, particularly in the water industry, have progressively adopted an asset management approach to maintaining existing water, sewerage and drainage systems.

There has been, and currently still is, a wide range of rehabilitation technologies or methods available, ranging from relining (formed in-situ or prefabricated and inserted) and grouts and mortars (cement, epoxy or chemical-based) to patch lining and robotic repairs.

The majority of conduit rehabilitation works carried out to date has been to sewerage and drainage systems although some relining of watermains has been completed. This may be due to the concerns of limited materials being acceptable for contact with potable water supplies. The industry does not appear to have failed in developing materials and techniques for this application, it appears more to have been due to some water authorities' reluctance to accept and implement these systems.

Sizes of conduits being rehabilitated range from sewerage house service lines (<150mm diameter) and reticulation system sizes (150mm –300mm diameter) up to

large trunk conduits of at least 1300-1500mm diameter. In these sized systems, although the conduits are traversable, the technologies available still allow renewal without having to open-trench.

Some of the main players in the rehabilitation market and the systems that are being used are detailed below:

Nissho Iwai Australia – EPTEC fibreglass lining

Pacific Pipeliners- sliplining techniques

Interflow – PVC Ribloc systems

Tyco (formerly Tubemakers) – Danby sliplining system

Metropolitan Restorations – live sewer epoxy mortar systems (Sika, MBT & Fosroc)

Chemtek- live sewer epoxy mortar systems (Parbury Technologies)

Insituform- Insituform lining

Protec Pacific-Stueller PE lining

Enertech- live sewer epoxy systems

NO-DIG pipelaying- PE lining systems

Kembla Constructions – EX Method and Tiger Patch

Details of rehabilitation projects completed to date are included in Table 4.0 in the Appendices.

Figure 5.0 in the Appendices details the extent of conduit rehabilitation in Australia. The totals of the work carried out to date is indicative only as data was not obtained from all the major industry participants. The chart does show an increasing trend and is predicted to do so into the future as assets reach the end of their design lives. Infrastructure owners and operators will continue to focus on rehabilitating existing systems rather than face the often higher capital cost of constructing new systems.

4. THE INDUSTRY DRIVERS AND FUTURE MARKET

4.1 The Industries

The industries currently involved in trench technology and their contribution to the market are detailed in Figure 6.0 in the Appendices. The involvement and contribution is based on each individual industry's use of trenchless technologies, be it worked carried by or for them, creating a demand for particular technologies and driving the further development of existing or new technologies.

4.2 The Telecommunications Industry

The Telecommunications industry has invested large sums of money in long-distance communications networks involving optical fibre and cable installations. Telstra Australia, Optus and other industry providers have seen, tested and proven mini-HDD and HDD as technologies with immense time and cost savings benefits as well as substantial social and environmental benefits.

While cable ploughing over long “green fields” corridors is the most economic method of installation in most cases, the use of HDD for waterway crossings, ocean cable landfalls, roadway crossings and within highly-developed and infrastructure – congested areas has enormous advantages.

To date over 800km of directionally-drilled installations have been carried out for the telecommunications industry with large percentages of that total being completed for Telstra and Optus.

Suppliers of directional drilling equipment have reported a slowing down of work for the telecommunications industry at present. This has been attributed by them to Telstra's works programme reaching completion and budgets having been expended.

Data for future proposed works could not be obtained, however the suppliers have reported that the industry is currently awaiting new Telstra contracts to be established. With the commencement of this work, it is anticipated that the industry will return to the increasing trends previously experienced in the past

Table 5.0 in the Appendices details lengths installed by trenchless methods for this industry.

4.3 The Gas Industry

The gas industry throughout Australia has embraced HDD technology on several major gas pipeline projects for waterway crossings and crossings of difficult terrain. Data obtained shows in excess of 22km of major crossings have been carried out within Australia since 1995.

AGL conducts on average 8000 under-road crossings per year to connect retail customers to reticulation systems. These crossings are predominantly carried out by guided boring, installing conduits in the range of 18mm diameter up to 160mm diameter.

In addition, as part of AGL's 'Goldline' programme, 140 km of existing reticulation gas systems have been rehabilitated to date. The programme involves the insertion of nylon or PE sleeves into existing cast iron conduits in the range of 18mm up to 160mm diameter.

In line with the perceived trends in HDD it would be expected that work carried out within this industry would continue to increase. With an 8.0 million dollar budget for the 'Goldline' programme for 1999/2000, it was expected for this type of work to continue.

Table 6.0 in the Appendices details lengths installed/rehabilitated by trenchless methods for this industry.

4.4 The Water Industry

Although not indicated directly by the data in Figure 6.0 in the Appendices, the Water Industry is most definitely the driving force behind a wide range of trenchless technologies.

In 1990-93, Water Corporation (WA) used microtunnelling successfully in several major sewer installations as part of their Sewer Infill Programme totalling approximately 3.5km in length.

Sydney Water Corporation (NSW) has used microtunnelling extensively since 1990 for the construction of new sewers.

The Blue Mountains Effluent Transfer Scheme was the staged construction of carrier tunnels (constructed by tunnel boring machines) from the Upper to Lower Blue

Mountains, designed to eliminate small, inefficient Sewerage Treatment Plants (STP) and Sewerage Pumping Stations (SPS), provide sewerage facilities to outlying catchments and transfer flows to upgraded STPs. Microtunnelling has allowed the construction of near horizontal bores to allow provision of these sewerage facilities without the need for SPSs and to allow the elimination of existing SPSs.

Microtunnelling has also been used extensively in situations where open trench construction was not desirable, that is, in heavily developed and infrastructure congested—areas of Sydney. The total lengths of new sewer constructed by microtunnelling to date is approximately 3.7km.

HDD has also been extensively used by Sydney Water Corporation as part of the Blue Mountains Effluent Transfer Scheme. The construction of long inclined bores has allowed the transfer of flows from outlying catchments directly to the carrier tunnels and allowed elimination of existing SPSs.

In 1999, an STP at Mt Riverview in the Lower Blue Mountains area of Sydney was eliminated by a 600 m long and 500mm diameter directional bore to transfer flows by gravity to an alternate part of the existing system. The alignment involved both horizontal and vertical curves to traverse down through an escarpment through a height difference of 80m.

Watermain and sewermain crossings of the Georges River and Port Hacking are significant projects currently scheduled to commence using HDD technology.

To date, approximately 6.0 km of new sewers have been installed using this technology with an at least another 6.0 km proposed to be constructed within the next twelve months.

Since 1995, Sydney Water has carried out rehabilitation (grouting) of approximately 7.0 km of reticulation sewer and relining of approximately 47km of reticulation and trunk size sewer mains. The reticulation work has been carried out as part of the Infiltration/Exfiltration Programme, designed to rehabilitate aged sewers and reduce sewerage pollution through exfiltration and overflow.

In addition, although only estimates, Sydney Water Corporation proposes to rehabilitate and reline 118km of reticulation and trunk sized sewers over the next five to ten years as part of the Infiltration/Exfiltration and Capital Works Programmes.

Brisbane Water (QLD) has also extensively embraced trenchless technologies for wastewater infrastructure projects.

Since 1997, approximately 6.0 km of new wastewater pipelines have been constructed using HDD technology for elimination of SPSs, SPS rising mains and

several crossings of the Brisbane River. Similarly, approximately 2.4km of sewer constructed by microtunnelling will have been completed by the end of 2000.

A project of note carried out in 1997 was the upgrade of a deteriorating sewer by pipebursting in Brisbane. The existing 225/300mm sewer laid in river mud at 7.0m

depth, was successfully amplified to 440mm diameter for a length of 820m along the centre of a major road.

Typical of a regional water authority in a rapidly developing area, Hunter Water Corporation serving the Greater Newcastle and Central Coast areas of NSW, have recently used trenchless technologies to upgrade existing reticulation and trunk sewers.

Since 1998, approximately 850m of pipebursting and 1.1km of relining have been undertaken.

Typical of the trenchless work being carried out for local authorities, by the end of 2000, Launceston City Council will have undertaken in excess of 400m of pipebursting of reticulation and trunk sewers and constructed approximately 700m of microtunnelled sewer.

Table 7.0 details trenchless projects carried out for the Water Industry.

As more stringent regulatory and environmental requirements are imposed on water authorities and as they implement a greater asset management approach for economic and efficient system operation, it is anticipated that the demand for trenchless technologies in this industry will most definitely increase.

In doing so, traditional system planning and design methodologies are likely to change (if not already) to incorporate the use of the trenchless technologies available. Conversely, planners and designers are already pushing many technologies to the limits of performance, which will only encourage further development of the technologies.

4.5 The Electricity Industry

The industry throughout Australia has used HDD technology, generally for the construction of significant length river crossings for conduit installations. Since 1995, approximately 7.0km of major conduit installations have been carried out.

A Sydney electrical authority, Energy Australia reported that traditionally they have undertaken large numbers of under-road conduit crossings for small diameter conduits by guided boring techniques each year. Energy Australia also reported that at the current time, they were encouraging contractors engaged in conduit installations to utilise other trenchless techniques such as mini-HDD.

If these actions are representative of the industry in general, then an increase in the use of trenchless technologies in this industry could be expected.

Table 8.0 details trenchless projects carried out for the Electricity Industry.

4.6 Other Industries

Other industries such as the mining and oil industries have carried out new pipeline installation by HDD for mine slurry pipelines and fuel lines beneath major taxiways

at airports in NSW and QLD. HDD work carried out for the mining industry totals 3.5km undertaken during 1999 and 2.3km for the oil industry since 1990.

Compared to other industries, the totals are low and are restricted to only a few projects for each industry. This may be due to the industries being specialised and generally concentrated in locality, hence the scope for construction of new infrastructure is limited.

Likewise, unless any significant expansion of these industry sites is planned, it would be expected that future trends in these industries would at best remain constant.

Table 9.0 details trenchless projects carried out for these industries.

5. CONCLUSION

The paper presented by Shooter (1993) to NO-DIG '93 detailed a variety of trenchless technologies that had (at that time) appeared on the market relatively recently and were undergoing an initial surge in interest and usage.

Building on that initial base, the growth of the existing technologies and development of new ones has steadily increased in most industries from 1993 through to 2000.

Where technologies have not experienced this growth during the mid-1990's, this has been attributed to reluctance by some areas of the industry to accept some of the techniques or materials involved, due to changes in direction of some of the industry providers and due to fluctuating demands following economic trends.

For the most part, areas of the industry responsible for providing essential infrastructure, such as for public health and energy, have embraced the social, environmental and cost benefits that trenchless technologies provide. High technology industries providing communications and entertainment infrastructure have identified the use of some trenchless technologies as methods of rapid and wide expansion with substantial cost savings.

In the early to mid-1990's, the majority of trenchless work was undertaken by or for larger authorities or organisations. This may be attributed to the relatively high initial costs involved and the ability to accept some of the perceived risk involved in utilising the new technologies.

Since that time, as more work has been undertaken and more industry players have become involved, unit costs have generally decreased and proven track records have been established, reducing some of the associated risks. The result has been a wider embrace of trenchless technologies throughout authorities and organisations of smaller sizes also.

As the community places an increasing demand on infrastructure systems and regulators exert more influence to improve and rationalise infrastructure systems to meet environmental and regulatory requirements, the need to provide new infrastructure and upgrade existing systems will continue to increase.

With trenchless technologies providing effective and beneficial solutions to these demands and controls, an increasing trend in their development and usage should prevail.

Prepared by:

Shaun Nadin
Project Engineer, Pipelines
AWT Engineering

Date 21 September 2000

Verified by:

Rod Mould
Manager, Pipelines
AWT Engineering

Date 21 September 2000

REFERENCES

AJ Lucas Group Ltd 2000, 'Horizontal Directional Drilling – Current and Successfully Completed Projects', August.

APIA 1999, 'Directional Drilling in Australia', **Article** *The Australian Pipeliner*, Official Publication of the Australian Pipeline Industry Association, No. 98, Jul, p40.

The Australasian Society for Trenchless Technology (ASTT) (n.d.:retrieved via Netscape 2000, July 12) <http://users.wantree.com.au:/profile.htm>

Donnelly, S. 1993, *The Development of Directional Drilling in Australia*, **Paper** presented to the Australian Underground Construction and Tunnelling Association, 3 March.

Shooter, J. E. 1993, *Trenchless Down Under*, **Paper** presented to NO-DIG '93 Conference, Birmingham, Sep.

APPENDICES

**CONSTRUCTION BY HORIZONTAL DIRECTIONAL DRILLING
Australia - @ 31 August 2000**

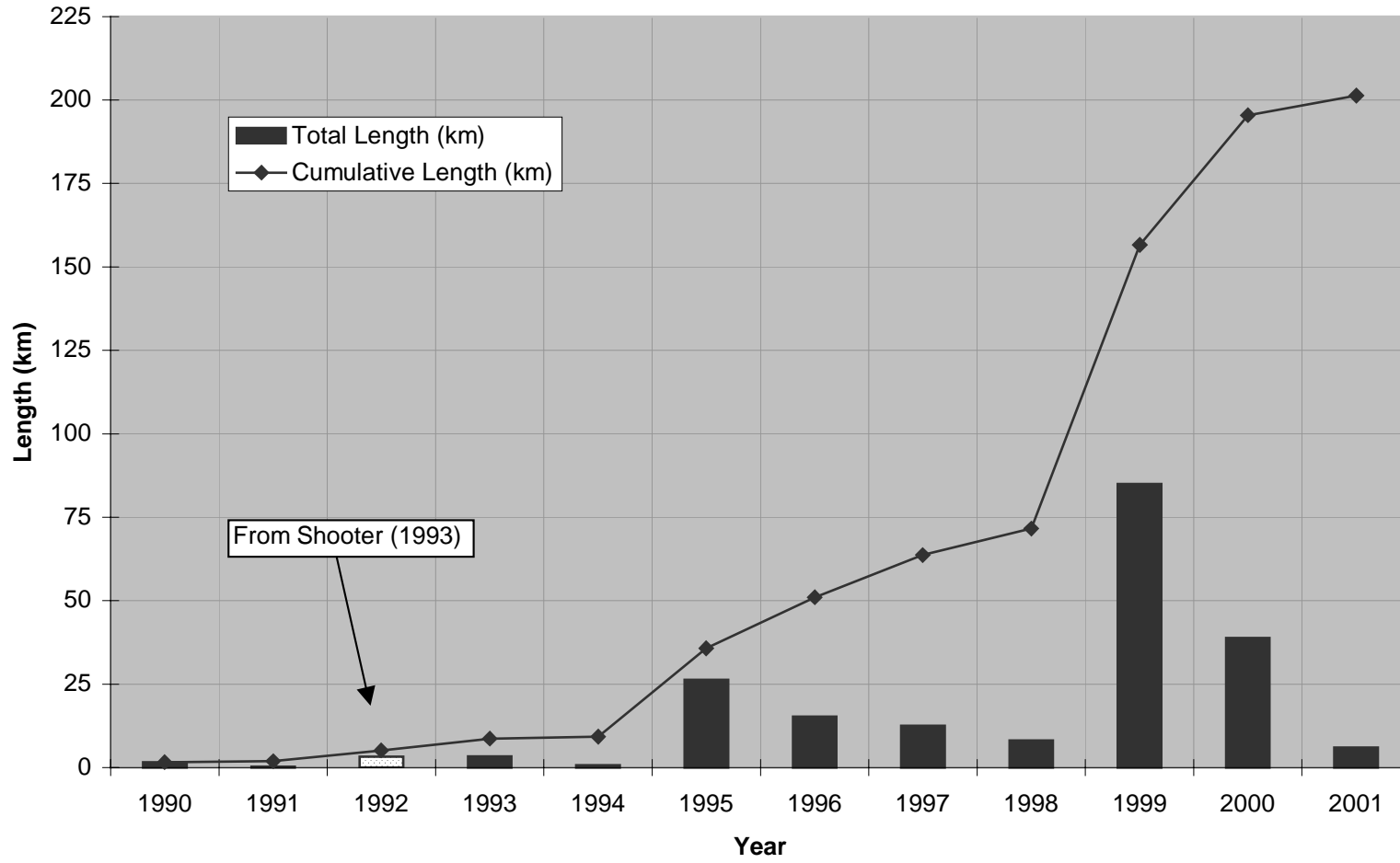


Figure 1.0

**CONSTRUCTION BY MINI - HORIZONTAL DIRECTIONAL DRILLING
Australia - @ 30 June 2000**

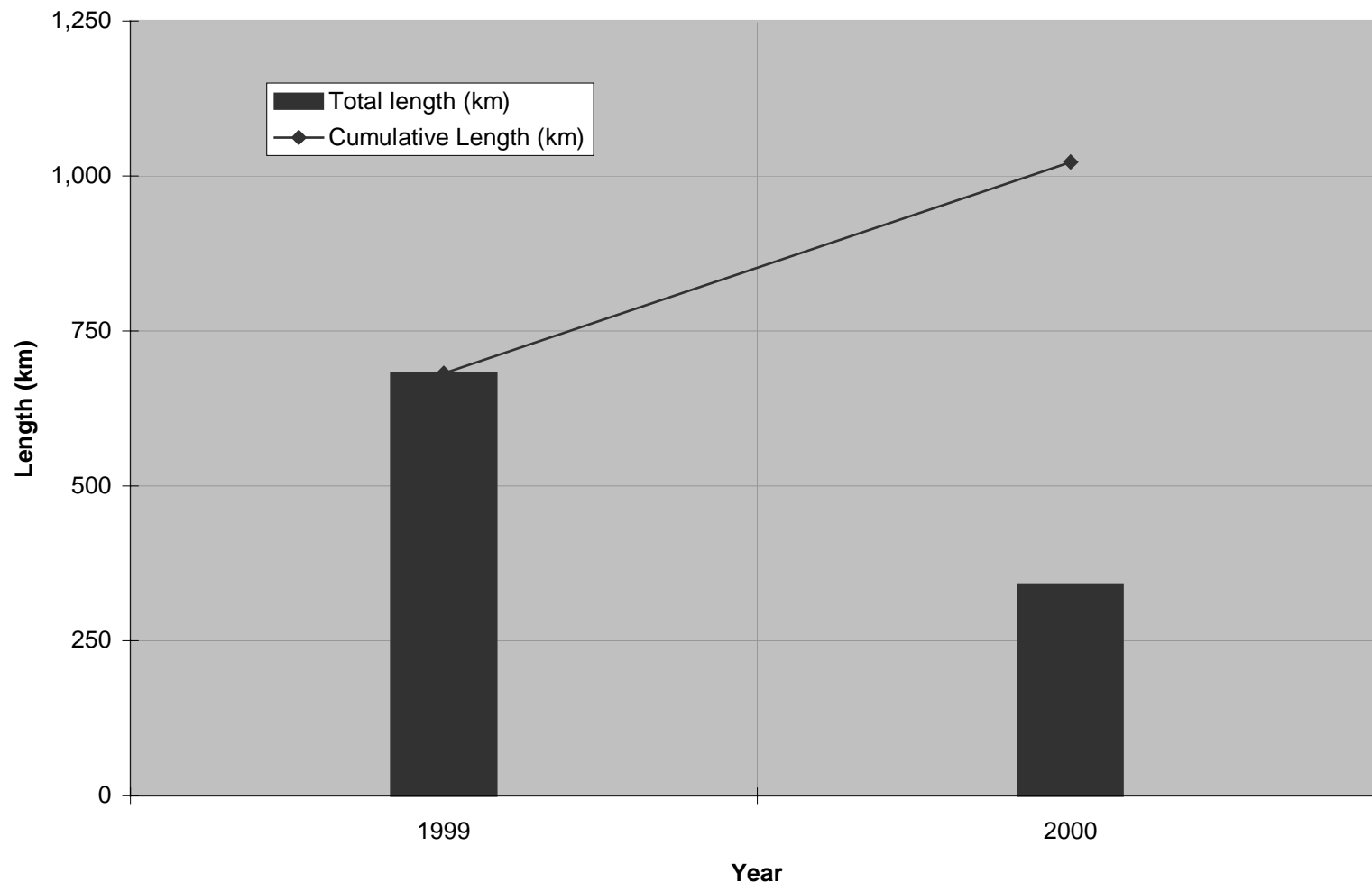


Figure 2.0

**CONSTRUCTION BY MICROTUNNELLING
Australia - @ 31 August 2000**

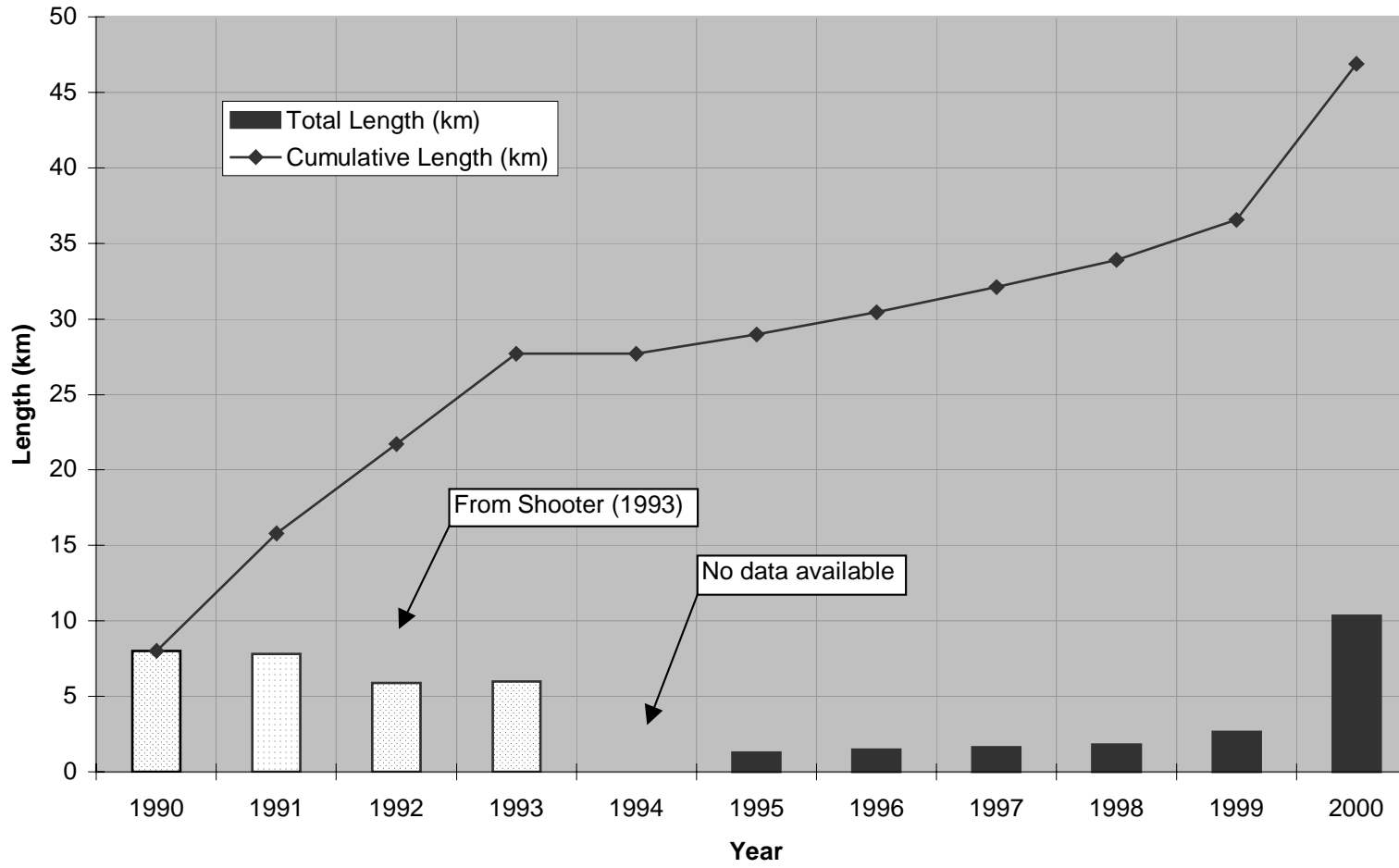


Figure 3.0

CONSTRUCTION BY PIPE BURSTING Australia - @ 31 August 2000

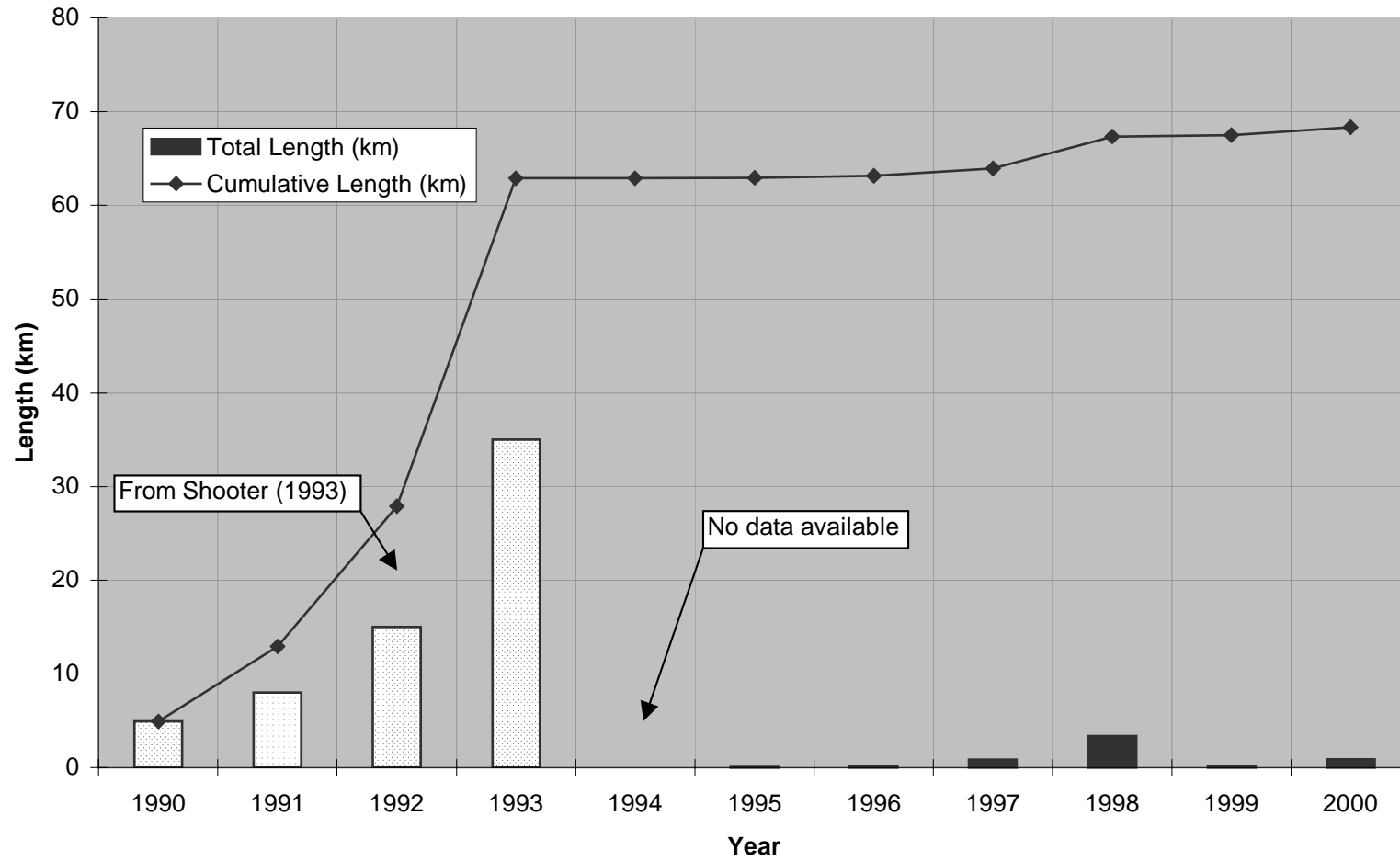


Figure 4.0

**CONDUIT REHABILITATION
Australia - @ 31 August 2000**

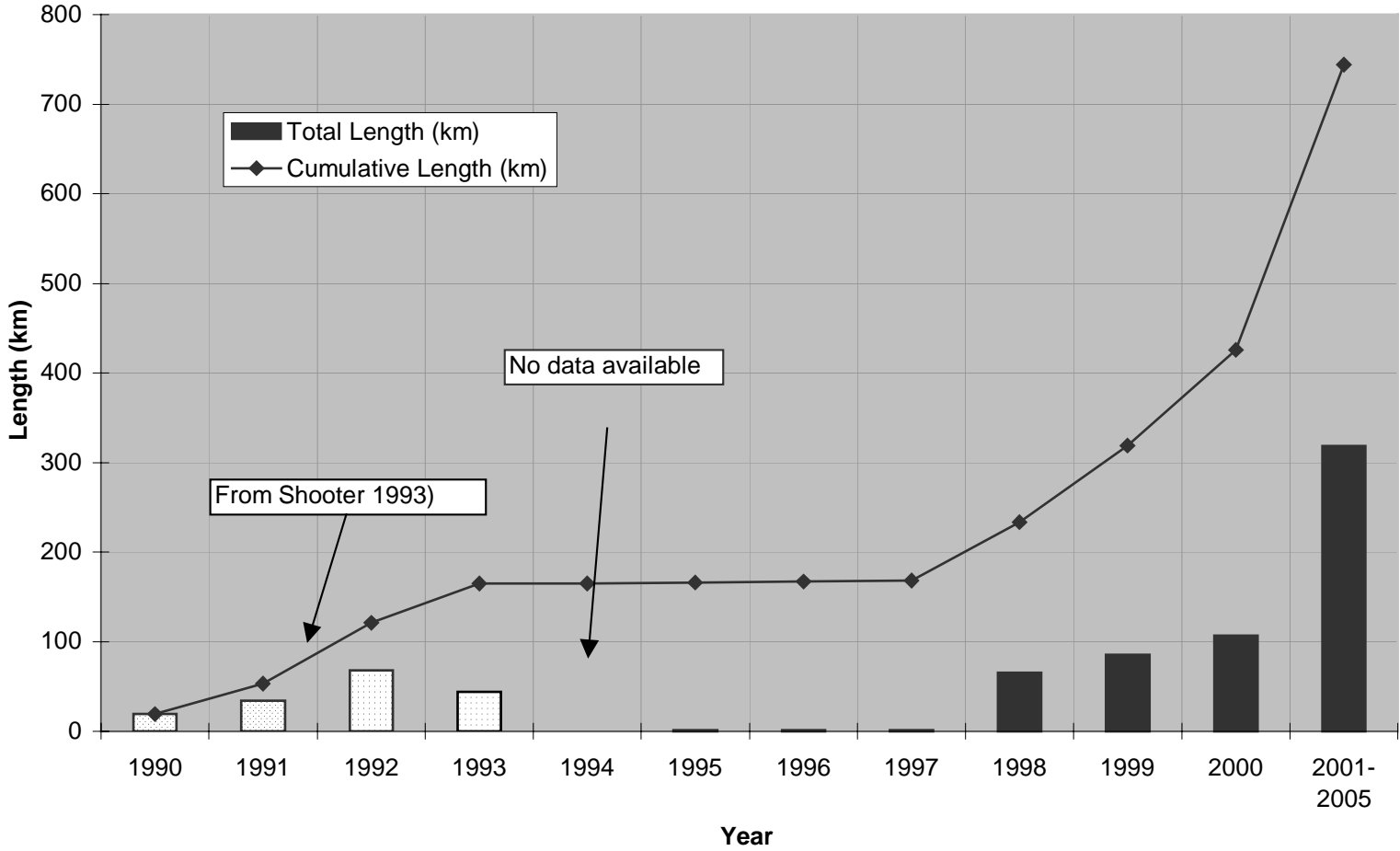


Figure 5.0

TRENCHLESS TECHNOLOGY BY INDUSTRY
Australia - @ 31 August 2000

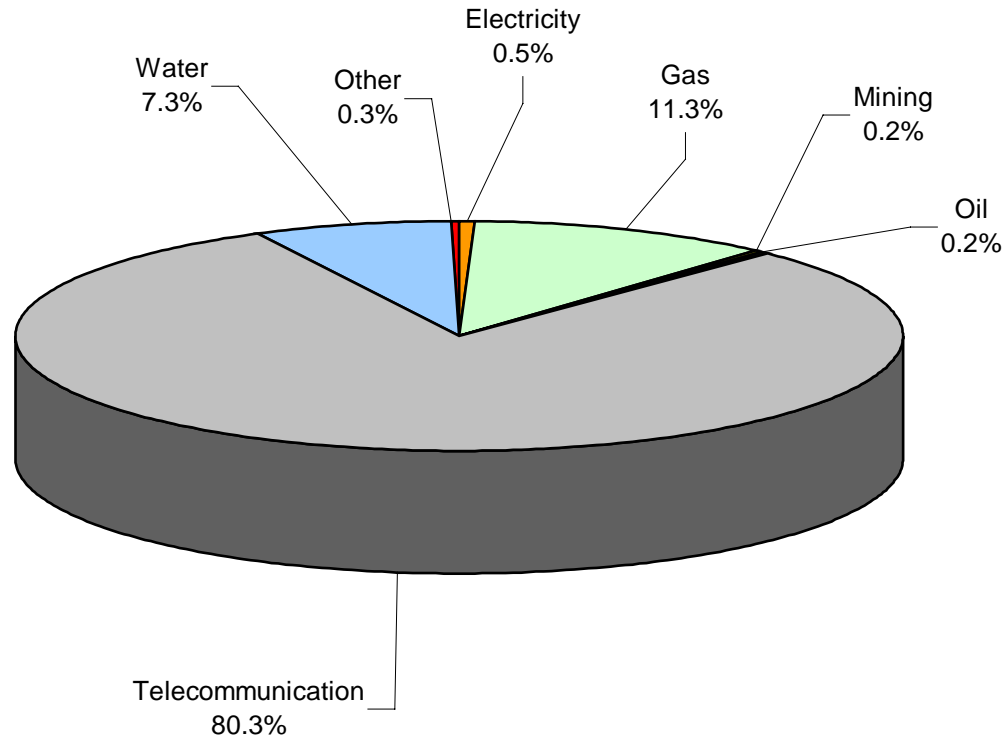


Figure 6.0

Table 1.0 HORIZONTAL DIRECTIONAL DRILLING

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Sydney International Airport Fuel Line, Sydney, NSW	AJ Lucas	OIL	1990	200 mm	180	Soil
Sydney International Airport Fuel Line, Sydney, NSW	AJ Lucas	OIL	1990	350 mm	180	Soil
Various Road Crossings, Adelaide, SA	AJ Lucas	OTHER	1990			Soil
Albert River Crossing, Albert River, QLD	AJ Lucas	TELECOM	1990	100 mm	300	Cobbles
Logan River Crossing, Logan River, QLD	AJ Lucas	TELECOM	1990	100 mm	450	Cobbles
Pikenba Aviation Fuel Line, Pikenba, QLD	AJ Lucas	OIL	1990	200 mm	450	Clay
Sydney International Airport, Sydney, NSW	AJ Lucas	OIL	1991	100 mm	300	Soil
Kingsford Smith Airprt, Brisbane, QLD	AJ Lucas	OIL	1992	200 mm	260	Soil
Collaroy Plateau Escarpment, Collaroy , NSW	AJ Lucas	TELECOM	1993	325 mm	290	Sandstone
PacRim West Optic Fibre Landing, Narrabeen, NSW	AJ Lucas	TELECOM	1993	110 mm	1740	Shale
Wollstonecraft Sewerage Upgrade, Wollstonecraft, NSW	AJ Lucas	WATER	1994	600 mm	200	Sandstone
St Leonards Sewerage Upgrade, St Leonards, NSW	AJ Lucas	WATER	1994	600 mm	230	Sandstone
Hazelbrook Sewerage Borehole, Hazelbrook, NSW	AJ Lucas	WATER	1995	450 mm	300	Sandstone
Mackay Telstra Duct, Mackay, NSW	AJ Lucas	TELECOM	1995	150 mm	150	Rock
Mascot Airport Electricity Conduit, Sydney, NSW	AJ Lucas	ELECTRICITY	1995		200	Soil
Clifton Sewerage Upgrade, Clifton, NSW	AJ Lucas	WATER	1995	400 mm	60	Rock
Pay Television Sydney, Sydney, NSW	AJ Lucas	TELECOM	1995	150 mm	20000	Rock, Soil & Sandstone
Mt White Optic Fibre Installation, Mt White, NSW	AJ Lucas	TELECOM	1995	115 mm	450	Sandstone
Woodford, Railway Pde, Blue Mountains, NSW	AJ Lucas	WATER	1995	525 mm	385	Sandstone

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Woodford, Taylor Road, Blue Mountains, NSW	AJ Lucas	WATER	1995	450 mm	358	Sandstone
Roberts Road Diversion, Chullora, NSW	AJ Lucas	GAS	1995	425 mm	350	Shale
Tumbledick Down Gas Crossing, Tumbledick Down, NSW	AJ Lucas	GAS	1995	320 mm	930	Sandstone
Pittwater Gas Crossing at Bayview, Newport, NSW	AJ Lucas	GAS	1995	168 mm	710	Shale
Linden Sewer Tunnel , Blue Mountains, NSW	AJ Lucas	WATER	1995	450 mm	960	Sandstone
Pay Television Cable Installation, Sydney, NSW	AJ Lucas	TELECOM	1996	150 mm	8000	Shale
Sydney Gas Road Crossings, Sydney, NSW	AJ Lucas	GAS	1996		180	Sandstone
Wagga Water Mains Crossing, Wagga Wagga, NSW	AJ Lucas	WATER	1996	90 mm	80	Soil
Dora Creek Sewer Crossing, Dora Creek, NSW	AJ Lucas	WATER	1996	200 mm	140	Soil
Mackay Telecommunications Tower, Mackay, NSW	AJ Lucas	TELECOM	1996	150 mm	200	Rock
Moomba-Sydney Ethane Pipeline, ICI Drain, NSW	AJ Lucas	GAS	1996	200 mm	250	Shale
Moomba-Sydney Ethane Pipeline, Wattle Grove, NSW	AJ Lucas	GAS	1996	200 mm	180	Shale
Moomba-Sydney Ethane Pipeline, Maldon Railway, NSW	AJ Lucas	GAS	1996	200 mm	180	Shale
Moomba-Sydney Ethane Pipeline, F5 Freeway, NSW	AJ Lucas	GAS	1996	200 mm	180	Shale
Moomba- Sydney Ethane Pipeline, Wingecarribee River, NSW	AJ Lucas	GAS	1996	200 mm	180	Shale
Moomba-Sydney Ethane Pipeline, Paddy's River, NSW	AJ Lucas	GAS	1996	200 mm	200	Shale
Moomba-Sydney Ethane Pipeline, Wollondilly River, NSW	AJ Lucas	GAS	1996	200 mm	200	Shale
Moomba-Sydney Ethane Pipeline, Salt Pan Creek, NSW	AJ Lucas	GAS	1996	200 mm	245	Shale
Moomba-Sydney Ethane Pipeline, Georges River, NSW	AJ Lucas	GAS	1996	200 mm	265	Shale

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Moomba-Sydney Ethane Pipeline, Georges River, NSW	AJ Lucas	GAS	1996	200 mm	385	Shale
Moomba-Sydney Ethane Pipeline, Carters Creek, NSW	AJ Lucas	GAS	1996	200 mm	410	Shale
Moomba-Sydney Ethane Pipeline, Cooks River, NSW	AJ Lucas	GAS	1996	200 mm	450	Shale
Moomba-Sydney Ethane Pipeline, Airport Runway, NSW	AJ Lucas	GAS	1996	200 mm	640	Shale
Moomba-Sydney Ethane Pipeline, Bardwell Creek, NSW	AJ Lucas	GAS	1996	200 mm	380	Shale
Moomba-Sydney Ethane Pipeline, Wolli Creek, NSW	AJ Lucas	GAS	1996	200 mm	320	Shale
Cataract River Methane Crossing, Cataract Gorge, NSW	AJ Lucas	GAS	1996	355 mm	620	Sandstone
Clarence River Crossing, Clarence River, NSW	AJ Lucas	TELECOM	1996	115 mm	450	Shale
Cromer Sewerage Line, Cromer, NSW	AJ Lucas	WATER	1996	280 mm	620	Sandstone
Torrens River Gas Crossing, Adeliade, SA	AJ Lucas	ELECTRICITY	1997	450 mm	810	Shale
Cataract River Gas Pipeline Crossing, Cataract River, NSW	AJ Lucas	GAS	1997	600 mm	620	Sandstone
Taren Point Crossing, Taren Point, NSW	AJ Lucas	GAS	1997	355 mm	750	Sandstone
Georges River Optic Fibre Crossing, Appin, NSW	AJ Lucas	TELECOM	1997	115 mm	515	Sandstone
Leure Inclined Bore, Blue Mountains, NSW	AJ Lucas	WATER	1997	450 mm	265	Sandstone
SEA-ME-WE 3 Cable Landing 1, Floreat Beach, NSW	AJ Lucas	TELECOM	1997	125 mm	980	Limestone
SEA-ME-WE 3 Cable Landing 2, Floreat Beach, NSW	AJ Lucas	TELECOM	1997	125 mm	980	Limestone
Brisbane Airport Aviation Fuel Line, Brisbane, QLD	AJ Lucas	OIL	1998	200 mm	950	Rock
North Katoomba Inclined Bore, Blue Mountains, NSW	AJ Lucas	WATER	1998	450 mm	410	Sanstone
Boronia Road Inclined Bore, Blue Mountains, NSW	AJ Lucas	WATER	1998	444 mm	296	Sandstone

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Mt Sugarloaf, Western Side, Newcastle, Australia	AJ Lucas	TELECOM	1998	115 mm	950	Sandstone
Mt Sugarloaf, Eastern Side, Newcastle, Australia	AJ Lucas	TELECOM	1998	115 mm	1195	Sandstone
The Spit, Primary Gas Main crossing , Middle Habour, Sydney, NSW	AJ Lucas	GAS	1999	450 mm	510	Sandstone
The Spit, Telecommunications bundled conduit crossing, Middle Habour, Sydney, NSW	AJ Lucas	TELECOM	1999	450 mm	510	Sandstone
Blue Mountains Sewerage, Wentworth Falls, NSW	AJ Lucas	WATER	1999	450 mm	210	Sandstone
Wentworth Falls Inclined Bore, Blue Mountains, NSW	AJ Lucas	WATER	1999	558 mm	214	Sandstone
Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	AJ Lucas	MINING	1999	300 mm	750	Sandstone sand & Mudstone
Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	AJ Lucas	MINING	1999	300 mm	680	Sandstone sand & Mudstone
Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	AJ Lucas	MINING	1999	300 mm	650	Sandstone sand & Mudstone
Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	AJ Lucas	MINING	1999	300 mm	510	Sandstone sand & Mudstone
Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	AJ Lucas	MINING	1999	300 mm	500	Sandstone sand & Mudstone
Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	AJ Lucas	MINING	1999	300 mm	370	Sandstone sand & Mudstone
Blue Mountains Sewerage, Mt Riverview, NSW	AJ Lucas	WATER	1999	508 mm	500	Sandstone
Leura Directional Drill, Leura, NSW	AJ Lucas	WATER	1999	400 mm	330	Sandstone
Murray River Crossing, Murray River, NSW/VIC	AJ Lucas	ELECTRICITY	1999	100 mm	325	Sand
Pelican Point Crossing, Adelaide, SA	AJ Lucas	ELECTRICITY	1999	350 mm	860	Clay
Eastern Gas Pipeline, Latrobe River, VIC	AJ Lucas	GAS	2000	457 mm	289	Clay
Eastern Gas Pipeline, Snowy River, VIC	AJ Lucas	GAS	2000	457 mm	275	Clay
Eastern Gas Pipeline, Bemm River, VIC	AJ Lucas	GAS	2000	457 mm	278	Limestone
Clarence River Crossing, Grafton, NSW	AJ Lucas	ELECTRICITY	2000	450 mm	510	Shale

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Brisbane River Crossing, Brisbane Qld	AJ Lucas	WATER	CURRENT	558/1118	850	Soil
Port Hacking Crossing, Sydney NSW	AJ Lucas	WATER	CURRENT	225 mm	830	Sandstone
Port Hacking Crossing, Sydney NSW	AJ Lucas	WATER	CURRENT	250 mm	830	Sandstone
Port Hacking Crossing, Sydney NSW	AJ Lucas	WATER	CURRENT	1240 mm	400	Sandstone
Customer Access Network	Ancon	TELECOM	1999	63	75000	Soft
Southern Cross	Ancon	TELECOM	2000	110	18000	Rock
Southern Cross	Ancon	TELECOM	2000	2*110	2500	Rock/ Soft
RAC Project	Ancon	OTHER	2000	2*40	1700	Rock/ Soft
Effluent Transfer across Brisbane River	Baulderstone - Hornibrook	WATER	1997	315	500	sand/silt/clay
Cranbourne Road, Langwarrin, Victoria	Bayside Boring	TELECOM	2000	100	290	clay/shale
McClelland Drive, Frankston, Victoria	Bayside Boring	TELECOM	2000	63	448	sand
Bellevue Heights Estate, Berwick, Victoria	Bayside Boring	TELECOM	2000	300	162	rock/clay
Eastern Gas Pipeline-Cataract Gorge	Cherrington Australia	GAS	2000	650	860	Rock
Eastern Gas Pipeline-Shoalhaven River	Cherrington Australia	GAS	2000	600	720	Rock
Eastern Gas Pipeline-Ousedale Creek	Cherrington Australia	GAS	2000	600	500	Rock
Eastern Gas Pipeline-Hume Highway	Cherrington Australia	GAS	2000	600	450	Shale
Eastern Gas Pipeline-Tianjarra Creek	Cherrington Australia	GAS	2000	600	350	Rock
Eastern Gas Pipeline-Endrick Escarpment	Cherrington Australia	GAS	2000	600	1025	Rock
Eastern Gas Pipeline-Illawarra Escarpment	Cherrington Australia	GAS	2000	600	580	Rock

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Southern Cross Cable-Narrabeen Beach	Cherrington Australia	TELECOM	2000	2x212mm	2000	Rock
Clovelly Beach	Cherrington Australia	TELECOM	2000	2x212mm	2000	Rock
Directional Bore, Pittwater Rd, Dee Why	Cherrington Australia	WATER	2000	315	160	Alluvial, water-charged sand and sandstone
Swansea River Channel N.S.W	Coe Drilling Australia	TELECOM	1996	219	50	Alluvial Sand Deposits
Roma to Brisbane Gas Pipeline	Coe Drilling Australia	GAS	1996	305	355	Clay over Mudstone
Tamworth Fibre Optic System	Coe Drilling Australia	TELECOM	1996	180	50	Basalt
Manly District Gas Mains Installation	Coe Drilling Australia	GAS	1997	200	200	Sandstone
Queensland Power Project	Coe Drilling Australia	ELECTRICITY	1997	150	2850	Various in Clays To Basalt
Sydney Airport Lighting Runout Project Runway One.	Coe Drilling Australia	OTHER	1997	305	290	Sandy Clay
Marsden – Dubbo Gas Pipeline	Coe Drilling Australia	GAS	1997	219	1150	Sandstone
South Creek at St.Marys N.S.W	Coe Drilling Australia	GAS	1997	219	275	Sandstone
Fibre Optical Roll out In Bowral N.S.W	Coe Drilling Australia	TELECOM	1997	150	380	Sandstone
Picton N.S.W	Coe Drilling Australia	OTHER	1997	305	1150	Sandstone
Inclined Sewer Borehole, Oxford Falls Sydney	Coe Drilling Australia	WATER	1998	355	650	Hawksbury Sandstone
Orica Natural Gas Pipeline Project Constructed By Jasdell Pty Ltd	Coe Drilling Australia	GAS	1999	219	225	Marine Clay & Gravels
Melbourne Docklands Trunk Infrastructure Project, project was design and Build	Coe Drilling Australia	ELECTRICITY	1999	225	550	Clays & Gravels
Wide Bay Pipeline Project Constructed By McConnell Dowell Constructors Pty Ltd	Coe Drilling Australia	ELECTRICITY	1999	125	343	Sandy Clay over Gravels

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Wide Bay Pipeline Project Constructed By McConnell Dowell Constructors Pty Ltd	Coe Drilling Australia	ELECTRICITY	1999	125	288	Sandy Clay
Melbourne Docklands Trunk Infrastructure Project, project was design and Build	Coe Drilling Australia	ELECTRICITY	1999	225	285	Marine Clay
Melbourne City Rail Yard Crossing	Coe Drilling Australia	OTHER	1999	150	300	Weathered Basalt
Inclined Borehole Drilled to grade and position in The Blue Mountains stage 1.	Coe Drilling Australia	WATER	1999	219	1050	Hawkesbury Sandstone
Canberra Mains Extension-Molonglo River Crossing	Coe Drilling Australia	GAS	2000	273	242	Weathered Granite
Roma – Brisbane Looping Project Bremer River Crossing	Coe Drilling Australia	GAS	2000	406	325	Sandstone
Luggage Point Wastewater Reclamation Project-Boggy Creek Crossing	Coe Drilling Australia	WATER	2000	560	320	Marine Clay & Silts
Tweed River Entrance Sand Bypassing Project-Tweed River Crossing.	Coe Drilling Australia	GAS	2000	406	422	Weathered Siltstone & Mudstone, Clay & Marine Silts
Directional Bore, Myall Rd, Mt Colah	Coe Drilling Australia	WATER	2000	315	700	Sandstone
Murray River - River Crossing	Minson-Nacap	GAS	1998	200	210	
Black Swan Lagoon - River Crossing	Minson-Nacap	GAS	1998	200	240	
Sydney Airport-Taxiway 'Alpha' Crossing	Minson-Nacap	OTHER	1998	100	112	
Sydney Airport-Runway 07/25	Minson-Nacap	OTHER	1998	100	155	
Sydney Airport-Taxiway 'Golf' Crossing	Minson-Nacap	OTHER	1998	100	119	
Yarrowongga Main	Minson-Nacap	GAS	1998	200	120	
Ovens River	Minson-Nacap	GAS	1998	200	640	
MT Creek Pressure Main Crossing	The Trenchless Group	WATER	1996	324	130	clay
Elphin 58A to 18 Claremont	TWF - Sub Road Bore	WATER	2000	225	15	Good

Table 2.0 MICROTUNNELLING

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
City Beach - WA	Freemantle Drainage & Microtunnelling	WATER	1999	300	250	Dry Sand
Booragoon 9C -WA	Freemantle Drainage & Microtunnelling	WATER	2000	150	1500	Moist Sand
City Beach - WA	Freemantle Drainage & Microtunnelling	WATER	2000	150	2500	Moist Sand
Cannington - WA	Freemantle Drainage & Microtunnelling	WATER	2000	375	65	Wet Clay
Cannington - WA	Freemantle Drainage & Microtunnelling	WATER	2000	375	75	Wet Clay
Busselton - WA	Freemantle Drainage & Microtunnelling	WATER	2000	300	65	Stiff Clay
Aspendale - VIC	Freemantle Drainage & Microtunnelling	WATER	2000	225	55	Dense
Esperance - WA	Freemantle Drainage & Microtunnelling	WATER	CURRENT	300/150/225	1000	Wet Sand
Toowoomba City Council - QLD	Freemantle Drainage & Microtunnelling	WATER	CURRENT	600/675	485	Moist Clay
Chatswood	Pezzimenti	WATER	1995	375	50	Shale
Chatswood	Pezzimenti	WATER	1995	375	50	Shale
Cowan	Pezzimenti	WATER	1995	460	34	Sandstone
Ryde	Pezzimenti	WATER	1995	375	6.7	clay/ironstone
Ryde	Pezzimenti	WATER	1995	375	13	clay/ironstone
Ryde	Pezzimenti	WATER	1995	375	18	Sandstone
Hazelbrook	Pezzimenti	WATER	1995	300	183	Sandstone
Hazelbrook	Pezzimenti	WATER	1995	300	37	Sandstone
Hazelbrook	Pezzimenti	WATER	1995	300	186	Sandstone
Pymont	Pezzimenti	WATER	1995	460	111.4	Sandstone
Pymont	Pezzimenti	WATER	1995	460	99.6	Sandstone
Pymont	Pezzimenti	WATER	1995	460	51.3	Sandstone
Pymont	Pezzimenti	WATER	1995	460	113	Sandstone
Pymont	Pezzimenti	WATER	1995	1060	106.5	Sandstone

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Pyrmont	Pezzimenti	WATER	1995	1060	78	Sandstone
Pyrmont	Pezzimenti	WATER	1995	730	49.5	Sandstone
Pyrmont	Pezzimenti	WATER	1995	530	28	Sandstone
Pyrmont	Pezzimenti	WATER	1995	530	16.2	Sandstone
Pyrmont	Pezzimenti	WATER	1995	600	30	Sandstone
Pyrmont	Pezzimenti	WATER	1995	460	15.2	Sandstone
Pyrmont	Pezzimenti	WATER	1995	600	8.9	Sandstone
Pyrmont	Pezzimenti	WATER	1996	530	8	Sandstone
Pyrmont	Pezzimenti	WATER	1996	530	13	Sandstone
Pyrmont	Pezzimenti	WATER	1996	460	24	Sandstone
Pyrmont	Pezzimenti	WATER	1996	460	7.5	Sandstone
Pyrmont	Pezzimenti	WATER	1996	460	5	Sandstone
Cammeray	Pezzimenti	WATER	1996	460	59	Sandstone
Ryde	Pezzimenti	WATER	1996	410	45	Shale
Marrickville	Pezzimenti	WATER	1996	730	25	Sandstone
Lawson	Pezzimenti	WATER	1996	460	163	Sandstone
Lawson	Pezzimenti	WATER	1996	530	137	Sandstone
Parklea	Pezzimenti	WATER	1996	410	107	Shale
Parklea	Pezzimenti	WATER	1996	410	107	Shale
Croydon Pk	Pezzimenti	WATER	1996	600	30	Clay
Manly	Pezzimenti	WATER	1996	530	170	Sandstone
Ryde	Pezzimenti	WATER	1996	375	102	Sandstone
Ryde	Pezzimenti	WATER	1996	530	169	Sandstone
Chippendale	Pezzimenti	WATER	1996	1050	160	Boulder/Clay
Windsor Rd	Pezzimenti	WATER	1996	600	16	shale
Oyster Cove	Pezzimenti	WATER	1996	375	15	sandstone
Leura Falls Reserve	Pezzimenti	WATER	1996	460	45	sandstone
Eastwood	Pezzimenti	WATER	1996	750	50	Slipline
Dural	Pezzimenti	TELECOM	1997	375	44	sandstone
Croydon Pk	Pezzimenti	WATER	1997	1060	50	clay
Helensburgh	Pezzimenti	WATER	1997	450	312	sandstone
Coalcliff	Pezzimenti	WATER	1997	375	100	shale

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Coalcliff	Pezzimenti	WATER	1997	375	120	shale
Coalcliff	Pezzimenti	WATER	1997	375	90	shale
Coalcliff	Pezzimenti	WATER	1997	375	100	shale
Coalcliff	Pezzimenti	WATER	1997	375	120	shale
Rozelle	Pezzimenti	WATER	1997	850	142	SS
Rozelle	Pezzimenti	WATER	1997	850	106	SS
Cardiff A1	Pezzimenti	WATER	1997	1200	25	silty clay
Cardiff B1	Pezzimenti	WATER	1997	1200	65	wet sandy gravel
Cardiff B2	Pezzimenti	WATER	1997	930	26	sandstone
Cardiff B3	Pezzimenti	WATER	1997	930	112	clay-sandy/gravelly
Olympic Hockey	Pezzimenti	WATER	1997	375	90	clay
Lane Cove	Pezzimenti	WATER	1997	375	102	sandstone
Rydalmere	Pezzimenti	OTHER	1997	860	46	sandstone
Cardiff A2	Pezzimenti	WATER	1998	1200	86	clay/coal
Cardiff A3	Pezzimenti	WATER	1998	1200	42	clay
Cardiff B4	Pezzimenti	WATER	1998	1200	26	loose sandy gravel
Voyager Point	Pezzimenti	WATER	1998	440	84	sandstone
Voyager Point	Pezzimenti	WATER	1998	440	55	sandstone
Campbelltown	Pezzimenti	WATER	1998	530	23	fill
Lidcombe	Pezzimenti	WATER	1998	860	36	shale
Ryde	Pezzimenti	WATER	1998	375	72	shale
Homebush Olympic	Pezzimenti	WATER	1998	375	114	shale
Manly	Pezzimenti	WATER	1998	530	250	sandstone
Epping	Pezzimenti	WATER	1998	530	32	shale
Blacktown	Pezzimenti	WATER	1998	375	12	clay
Top Ryde	Pezzimenti	WATER	1998	440	49	clay shale
Springwood	Pezzimenti	WATER	1998	440	24	sandstone
Springwood	Pezzimenti	WATER	1998	440	69	sandstone
Chatswood	Pezzimenti	WATER	1998	375	8	clay
Chatswood	Pezzimenti	WATER	1998	375	49	clay
Voyager Pt	Pezzimenti	WATER	1998	570	62	clay/ironstone
St Leonards	Pezzimenti	WATER	1998	375	22	sandstone

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
St Leonards	Pezzimenti	WATER	1998	375	22	sandstone
Nth Kat Area 3	Pezzimenti	WATER	1998	440	123	sandstone
Glenmore Park	Pezzimenti	WATER	1998	530	130	shale
Glenmore Park	Pezzimenti	WATER	1998	530	52	shale
Glenmore Park	Pezzimenti	WATER	1998	530	68	shale
Glenmore Park	Pezzimenti	WATER	1998	530	100	shale
Springwood	Pezzimenti	WATER	1998	530	35	clay
Woronora	Pezzimenti	WATER	1998	900	70	sandstone
West Pymble	Pezzimenti	WATER	1998	375	36	vw ss + clay
Epping	Pezzimenti	TELECOM	1998	375	16	sandstone
Tennyson	Pezzimenti	WATER	1998	1120	45	ss,clay,silt
Gabba, Brisbane	Pezzimenti	WATER	1999	690	56	Tuff
St Leonards	Pezzimenti	WATER	1999	1060	11	fill
Bankstown	Pezzimenti	WATER	1999	375	25	shale/clay
Castle Hill	Pezzimenti	WATER	1999	375	20	ss/shale
Glenmore Pk	Pezzimenti	WATER	1999	375	24	shale/clay
Appin	Pezzimenti	WATER	1999	530	50	sandstone
Burwood Stage 1	Pezzimenti	WATER	1999	530	50	shale
Castle Hill	Pezzimenti	WATER	1999	375	14	shale/clay
Merrylands	Pezzimenti	WATER	1999	375	11	shale/clay
Sydney Casino	Pezzimenti	WATER	1999	375	12	sandstone
Burwood Stage 2	Pezzimenti	WATER	1999	530	30	shale
Chullora	Pezzimenti	WATER	1999	375	18	shale/clay
Sth Went Falls-Area 1B	Pezzimenti	WATER	1999	690	74	sandstone
Hoxton Pk	Pezzimenti	WATER	1999	425	24	shale
Ultimo, Harris St	Pezzimenti	WATER	1999	375	8	sandstone
Sth Went Falls-Area 1B	Pezzimenti	WATER	1999	690	63	sandstone
Glebe-Oxley St	Pezzimenti	WATER	1999	375	18	sandstone
Penrith	Pezzimenti	WATER	1999	325	80	sandy clay
Penrith	Pezzimenti	WATER	1999	325	82	sandy clay
Glebe	Pezzimenti	WATER	1999	375	15	clay
Parramatta Nth	Pezzimenti	WATER	1999	375	32	sandstone

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Sth Went Falls-Area 1B	Pezzimenti	WATER	1999	530	61	sandstone
Chatswood,Help St	Pezzimenti	WATER	1999	460	31	shaly/clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	37	shaly/clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	6	shaly/clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	6	shaly/clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	53	shaly/clay
Chatswood	Pezzimenti	WATER	1999	375	12	clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	4	shaly/clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	39	shaly/clay
Chatswood,Help St	Pezzimenti	WATER	1999	460	12	shaly/clay
Glebe-Oxley St	Pezzimenti	WATER	1999	375	34	sandstone
Picton #1	Pezzimenti	WATER	1999	530	31	ss
Sth Went Falls-Area 1B	Pezzimenti	WATER	1999	530	144	sandstone
Picton #2	Pezzimenti	WATER	1999	530	50	clay
Berowra	Pezzimenti	WATER	1999	440	63	sandstone
Doonside	Pezzimenti	WATER	1999	650	43	clay
Picton #3	Pezzimenti	WATER	1999	530	28	ss
The Spit	Pezzimenti	WATER	1999	375	20	sandstone
Lidcombe-Media Village	Pezzimenti	WATER	1999	530	80	clay
Picton #4	Pezzimenti	WATER	1999	440	28	SS Fill
Duncraig	Pezzimenti	WATER	1999	530	280	ss
Syd Uni	Pezzimenti	WATER	1999	375	21	clay
Wollstonecraft, Pacific Hwy	Pezzimenti	WATER	1999	530	45	clay/shale
Windsor	Pezzimenti	WATER	1999	600	10	clay
Picton #5	Pezzimenti	WATER	1999	690	29	shale
Smeaton Grange	Pezzimenti	WATER	1999	375	17	Clay/shale
Picton #6	Pezzimenti	WATER	1999	690	43	shale
Picton #7	Pezzimenti	WATER	1999	375	81	SS
Picton #8	Pezzimenti	WATER	1999	440	98	SS
Manly	Pezzimenti	WATER	1999	900	50	SS
Picton #10	Pezzimenti	WATER	1999	440	132	SS
Picton #11	Pezzimenti	WATER	1999	440	99	SS

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Manly	Pezzimenti	WATER	2000	1450	50	SS
Picton #9	Pezzimenti	WATER	2000	440	72	SS
Manly	Pezzimenti	WATER	2000	1450	50	SS
Windsor	Pezzimenti	WATER	2000	375	20	boulder clay
Lidcombe	Pezzimenti	WATER	2000	375	14	clay
Lane Cove	Pezzimenti	WATER	2000	375	45	clay/ss
Lidcombe	Pezzimenti	WATER	2000	375	47	clay
Picton	Pezzimenti	WATER	2000	440	49	SS
Crows Nest	Pezzimenti	WATER	2000	375	26	shale
Lane Cove	Pezzimenti	WATER	2000	375	50	shale
Penrith	Pezzimenti	WATER	2000	375	10	clay
Lidcombe	Pezzimenti	WATER	2000	375	15	clay
Lidcombe	Pezzimenti	WATER	2000	375	47	clay
Walsh Bay	Pezzimenti	WATER	2000	440	54	ss
Walsh Bay	Pezzimenti	WATER	2000	440	56	ss
Castle Hill	Pezzimenti	WATER	2000	375	21	shale
Pennant Hills	Pezzimenti	WATER	2000	375	40	ss
Picton	Pezzimenti	WATER	2000	440	49	ss
Rouse Hill-Milford Dr Carrier	Pezzimenti	WATER	2000	690	115	ss
Rouse Hill-Milford Dr Carrier	Pezzimenti	WATER	2000	690	83	ss
Rouse Hill-Milford Dr Carrier	Pezzimenti	WATER	2000	690	57	ss
Rouse Hill-Mile End Carrier 6	Pezzimenti	WATER	2000	440	107	ss
Granville	Pezzimenti	WATER	2000	375	27	clay
Yagoona	Pezzimenti	WATER	2000	375	20	clay
Yagoona	Pezzimenti	WATER	2000	375	9	clay
Macquarie Park	Pezzimenti	WATER	2000	375	23	shale
KatoombaPeckmans Rd	Pezzimenti	WATER	2000	440	31	ss
Rouse Hill-Mile End Carrier 7	Pezzimenti	WATER	2000	440	97	ss
Sth Leura	Pezzimenti	WATER	2000	375-530	73	ss
Sth Leura	Pezzimenti	WATER	2000	375-530	76	ss
Tunnel bore	Tunnel Boring Projects	WATER	1996	600	8.5	very hard rock-rhyolite

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Frankland St (Charles to Wellington)	TWF	WATER	PROPOSED	400OD	190	Good
Brisbane St (Wellington to Charles)	TWF	WATER	PROPOSED	400OD	160	Good
St John St (Elizabeth to Frederick)	TWF	WATER	PROPOSED	400OD or PVC liner	130	Good
26 Delamere to Bain Terrace	TWF	WATER	PROPOSED	160OD	200	
Huntingdale Main Sewer	Water Corp	WATER	1990	450	925	wet sandy soil
Kewdale Main Sewer	Water Corp	WATER	1990	450	523	wet sandy soil
Maddington Connecting Sewer	Water Corp	WATER	1990	450	498	wet sandy soil
	Water Corp	WATER	1993	450	82	
Balcatta 15C Infill Sewer	Water Corp	WATER	1993	450	125	wet sandy soil

Table 3.0 PIPE BURSTING

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
St John St (Frederick to Balfour)	Nick Peel - Sub Road Bore	WATER	2000	400OD	150	Good
Watermain Replacement Pittwater Rd, Dee Why	NO-DIG Pipe laying	WATER	1998	250	1000	
Collapsed VC Sewermain Reinstatement	NO-DIG Pipe laying	WATER	1998	150	100	water-charged running sand
Deteriorated VC sewermain Reinstatement, Falcon Street, Norrth Sydney	NO-DIG Pipe laying	WATER	1998	400	120	
Concrete stormwater replacement, Canberra	NO-DIG Pipe laying	WATER	1998	630	135	
Sewermain Reinstatement and Amplification, Brighton, Melbourne	NO-DIG Pipe laying	WATER	1998	400	1500	
Sewermain Amplification, Penrith	NO-DIG Pipe laying	WATER	1998	630	500	extremely hard strata and cobbles
Stormwater Rehabilitation, Neilson Park, Vaucluse	NO-DIG Pipe laying	WATER	1999	450	90	root infiltration
Sewer Upgrade, Teneriffe	Trenchless Replacement Systems	WATER	1997	440	820	river mud and contaminated soil
Legana/ Lawrence Vale Rd	TWF - Sub Road Bore	WATER	1999	260OD	20	Good
Philip St	TWF - Sub Road Bore	WATER	2000	200OD		Good
Brisbane St 15A to 13A	TWF - Sub Road Bore	WATER	2000	160OD	25	Good
Queechy Rd		WATER	1995	160OD	58	
Holbrook St/ Mayne St Intersection		WATER	1996	160OD	42	
Delamere Cres		WATER	1996	160OD	18	
Richards Ave		WATER	1996	250OD	53	Hard
Pedder St		WATER	1996	225OD	48	
Trevallyn Rd		WATER	1996	160OD	20	
Pipe Bursting Samdon St Hamilton gravity sewer		WATER	1999	150	49	sandy water charged ground, sewermain 4.5 metres deep
Pipe Bursting Benton St Kahibah gravity sewer		WATER	2000	375	80	fill and clay, no rock

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Pipe bursting Lindsay St Hamilton gravity sewer		WATER	2000	150	72	sandy water charged ground, sewermain 3 metres deep.
Pipe Bursting Cram St Merewether gravity sewer		WATER	2000	150	100	sandy watercharged ground conditions 2metres deep
Pipe Bursting Pell St Merewether gravity sewer		WATER	2000	225	100	Clay soil
Pipe Bursting Antill St Mayfield gravity sewer		WATER	2000	225	75	Sandy watercharged ground conditions 2.5metres deep
Pipe Bursting Contay St Mayfield gravity sewer		WATER	2000	150	46	Sandy watercharged ground conditions 2 metres deep
Pipe Bursting Deakin St Kurri Kurri gravity sewer		WATER	2000	150	75	Clay soil
Pipe Bursting Northcote St Kurri Kurri gravity sewer		WATER	2000	150	80	Clay soil
Pipe Bursting Doyle St Bellbird gravity sewer		WATER	2000	150	76	Clay soil

Table 4.0 CONDUIT REHABILITATION

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Inflow/Exfiltration Programme	Various	WATER	1999	150-300	12277	
Inflow/Exfiltration Programme	Various	WATER	PROPOSED	150-300	259122	
Inflow/Exfiltration Programme	Various	WATER	PROPOSED	>300	187	
Shakespeare Grove Main Drain		WATER	2000	1200 & 900	800	
Elphin/ David Intersection		WATER	1996	225	66	
Stormwater Rehabilitation, Neilson Park, Vaucluse	NO-DIG Pipe laying	WATER	1999	630	100	root infiltration
Eagle Farm Sewer Rising main	Tubemakers Water	WATER	1998	1295	40	
SWSOOS Sewerage System	Various	WATER	1995/1996	various	2000	
SWSOOS Sewerage System	Various	WATER	1997/1998	various	2000	
Inflow/Exfiltration Programme	Various	WATER	1999	150-300	7182	
Inflow/Exfiltration Programme	Various	WATER	PROPOSED	150-300	46828	
Inflow/Exfiltration Programme	Various	WATER	PROPOSED	>300	3555	
Sydney Water – all sewerage systems	Various	WATER	PROPOSED	150-300	52200	
Sydney Water – all sewerage systems	Various	WATER	PROPOSED	>300	15600	
NSOOS-Warriewood Sewerage Systems	Various	WATER	to 1999	150-300	25000	
NSOOS-Warriewood Sewerage Systems	Various	WATER	to 1999	>300	10400	
Holbrook St/ Mayne St Intersection		WATER	1996	150	91	
Pipe Lining Metford Rd Tenambit East Maitland Golf Course gravity sewer		WATER	1999	675	615	Clay soil
Pipe Lining Lambton and Bridges Rd Lambton gravity sewer		WATER	1999	300	143	
Pipe lining Pokolbin St Broadmeadow gravity sewer		WATER	1999	150	62	sand and clay water charged ground 3 metres deep

PROJECT DESCRIPTION	COMPANY	INDUSTRY	DATE	DIAMETER (mm)	LENGTH (m)	GROUND CONDITIONS
Pipe Lining Burwood Beach sewer		WATER	1999	450	156	Sand and Rock
Pipe lining South St Cessnock gravity sewer		WATER	1999	300	57	Clay soil
Box Hill South Main Drain		WATER	1999	1200	200	
twin -Lok Port Stephen Drive Raymond Terrace gravity sewer		WATER	2000	375	98	River sandy soil, water charged ground.
Lygon St Main Drain		WATER	2000	1350	260	
Goldline Rehabilitation Project		GAS	ongoing	various 18mm to 160mm	140000	all fill material
Slip lining of CICL watermain under railway at Prince St Waratah		WATER		500	50	fill, clay, rock etc

Table 5.0 TELECOMMUNICATIONS INDUSTRY

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	McClelland Drive, Frankston, Victoria	Australian Future Communications	2000	63	448
HDD	Bellevue Heights Estate, Berwick, Victoria	Australian Future Communications	2000	300	162
HDD	Cranbourne Road, Langwarrin, Victoria	Enetech	2000	100	290
HDD	Albert River Crossing, Albert River, QLD	Optus	1990	100 mm	300
HDD	Logan River Crossing, Logan River, QLD	Optus	1990	100 mm	450
HDD	Pay Television Cable Installation, Sydney, NSW	Optus	1996	150 mm	8000
HDD	Southern Cross Cable-Narrabeen Beach	Optus	2000	2x212mm	2000
HDD	Clovelly Beach	Optus	2000	2x212mm	2000
HDD	Southern Cross	Optus	2000	110	18000
HDD	Tamworth Fibre Optic System	Optus Communications	1996	180	50
HDD	Collaroy Plateau Escarpment, Collaroy , NSW	Telstra	1993	325 mm	290
HDD	PacRim West Optic Fibre Landing, Narrabeen, NSW	Telstra	1993	110 mm	1740
HDD	Mackay Telstra Duct, Mackay, NSW	Telstra	1995	150 mm	150
HDD	Pay Television Sydney, Sydney, NSW	Telstra	1995	150 mm	20000
HDD	Mt White Optic Fibre Installation, Mt White, NSW	Telstra	1995	115 mm	450
HDD	Mackay Telecommunications Tower, Mackay, NSW	Telstra	1996	150 mm	200
HDD	Clarence River Crossing, Clarence River, NSW	Telstra	1996	115 mm	450
HDD	Georges River Optic Fibre Crossing, Appin, NSW	Telstra	1997	115 mm	515
HDD	SEA-ME-WE 3 Cable Landing 1, Floreat Beach, NSW	Telstra	1997	125 mm	980
HDD	SEA-ME-WE 3 Cable Landing 2, Floreat Beach, NSW	Telstra	1997	125 mm	980
HDD	Mt Sugarloaf, Western Side, Newcastle, Australia	Telstra	1998	115 mm	950
HDD	Mt Sugarloaf, Eastern Side, Newcastle, Australia	Telstra	1998	115 mm	1195
HDD	Customer Access Network	Telstra	1999	63	75000
HDD	Swansea River Channel N.S.W	Telstra	1996	219	50
HDD	Fibre Optical Roll out In Bowral N.S.W	Telstra	1997	150	380

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	Sydney Total	Telstra	01/01/99-30/06/00		59509
HDD	Melbourne Total	Telstra	01/01/99-30/06/00		11103
HDD	Brisbane Total	Telstra	01/01/99-30/06/00		36707
HDD	Adelaide Total	Telstra	01/01/99-30/06/00		80350
HDD	Perth Total	Telstra	01/01/99-30/06/00		54382
HDD	NSW Total	Telstra	01/01/99-30/06/00		453107
HDD	VIC Total	Telstra	01/01/99-30/06/00		50097
HDD	TAS Total	Telstra	01/01/99-30/06/00		3243
HDD	QLD Total	Telstra	01/01/99-30/06/00		246779
HDD	SA Total	Telstra	01/01/99-30/06/00		9683
HDD	NT Total	Telstra	01/01/99-30/06/00		8249
HDD	WA Total	Telstra	01/01/99-30/06/00		8,980
HDD	Southern Cross	Worldcom	2000	2*110	2500
MICRO	Dural		1997	375	44
MICRO	Epping		1998	375	16

Table 6.0 GAS INDUSTRY

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	Pittwater Bayview Secondary Main Crossing	AGL	1995	150	710
HDD	Ingleside Tumble Down Dick Hill	AGL	1995	250	800
HDD	Chullora Roberts Road Relocation	AGL	1995	350	300
HDD	Roberts Road Diversion, Chullora, NSW	AGL	1995	425 mm	350
HDD	Tumbledick Down Gas Crossing, Tumbledick Down, NSW	AGL	1995	320 mm	930
HDD	Pittwater Gas Crossing at Bayview, Newport, NSW	AGL	1995	168 mm	710
HDD	Roma to Brisbane Gas Pipeline	AGL	1996	305	355
HDD	Taren Point Georges River Secondary Main Crossing	AGL	1997	300	850
HDD	Taren Point Crossing, Taren Point, NSW	AGL	1997	355 mm	750
HDD	Manly District Gas Mains Installation	AGL	1997	200	200
HDD	Marsden – Dubbo Gas Pipeline	AGL	1997	219	1150
HDD	South Creek at St.Marys N.S.W	AGL	1997	219	275
HDD	Mosman Middle Harbour Secondary Gas Mains and Telstra Crossing	AGL	1998	250	1000
HDD	The Spit, Primary Gas Main crossing , Middle Harbour, Sydney, NSW	AGL	1999	450 mm	510
HDD	Glenmore Park Medium Pressure Gas Interconnection	AGL	2000	200NB inserted with 110PE	145
HDD	Canberra Mains Extension-Molonglo River Crossing	AGL	2000	273	242
HDD	Roma – Brisbane Looping Project Bremer River Crossing	AGL	2000	406	325
BORE	Road bores for connecting retail customers	AGL	ongoing	various 18mm to 160mm	8000 crossings per annum
RELINE	Goldline Rehabilitation Project	AGL	ongoing	various 18mm to 160mm	140000
HDD	Cataract River Gas Pipeline Crossing, Cataract River, NSW	Civil & Civic	1997	600 mm	620
HDD	Eastern Gas Pipeline, Latrobe River, VIC	Duke Energy	2000	457 mm	289
HDD	Eastern Gas Pipeline, Snowy River, VIC	Duke Energy	2000	457 mm	275
HDD	Eastern Gas Pipeline, Bemm River, VIC	Duke Energy	2000	457 mm	278
HDD	Moomba-Sydney Ethane Pipeline, Maldon Railway, NSW	East Australian Pipelines	1996	200 mm	180
HDD	Moomba-Sydney Ethane Pipeline, Georges River, NSW	East Australian Pipelines	1996	200 mm	265
HDD	Moomba-Sydney Ethane Pipeline, ICI Drain, NSW	East Aust Pipes	1996	200 mm	250

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	Moomba-Sydney Ethane Pipeline, Wattle Grove, NSW	East Australian Pipelines	1996	200 mm	180
HDD	Moomba-Sydney Ethane Pipeline, F5 Freeway, NSW	East Australian Pipelines	1996	200 mm	180
HDD	Moomba- Sydney Ethane Pipeline, Wingecarribee River, NSW	East Australian Pipelines	1996	200 mm	180
HDD	Moomba-Sydney Ethane Pipeline, Paddy's River, NSW	East Australian Pipelines	1996	200 mm	200
HDD	Moomba-Sydney Ethane Pipeline, Wollondilly River, NSW	East Australian Pipelines	1996	200 mm	200
HDD	Moomba-Sydney Ethane Pipeline, Salt Pan Creek, NSW	East Australian Pipelines	1996	200 mm	245
HDD	Moomba-Sydney Ethane Pipeline, Georges River, NSW	East Australian Pipelines	1996	200 mm	385
HDD	Moomba-Sydney Ethane Pipeline, Carters Creek, NSW	East Australian Pipelines	1996	200 mm	410
HDD	Moomba-Sydney Ethane Pipeline, Cooks River, NSW	East Australian Pipelines	1996	200 mm	450
HDD	Moomba-Sydney Ethane Pipeline, Airport Runway, NSW	East Australian Pipelines	1996	200 mm	640
HDD	Moomba-Sydney Ethane Pipeline, Bardwell Creek, NSW	East Australian Pipelines	1996	200 mm	380
HDD	Moomba-Sydney Ethane Pipeline, Wolli Creek, NSW	East Australian Pipelines	1996	200 mm	320
HDD	Cataract River Methane Crossing, Cataract Gorge, NSW	Energy Developments	1996	355 mm	620
HDD	Yarrowongga Main	Gas Transmission Corporation	1998	200	120
HDD	Ovens River	Gas Transmission Corporation	1998	200	640
HDD	Tweed River Entrance Sand Bypassing Project- Tweed River Crossing.	NSW/QLD Govts	2000	406	422
HDD	Orica Natural Gas Pipeline Project Constructed By Jasdell Pty Ltd	Orica Pipeline (ICI)	1999	219	225
HDD	Murray River - River Crossing	Albury Gas Co.	1998	200	210

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	Black Swan Lagoon - River Crossing	The Albury Gas Co. Ltd.	1998	200	240
HDD	Eastern Gas Pipeline-Cataract Gorge	Transfield	2000	650	860
HDD	Eastern Gas Pipeline-Shoalhaven River	Transfield	2000	600	720
HDD	Eastern Gas Pipeline-Ousedale Creek	Transfield	2000	600	500
HDD	Eastern Gas Pipeline-Hume Highway	Transfield	2000	600	450
HDD	Eastern Gas Pipeline-Tianjarra Creek	Transfield	2000	600	350
HDD	Eastern Gas Pipeline-Endrick Escarpment	Transfield	2000	600	1025
HDD	Eastern Gas Pipeline-Illawarra Escarpment	Transfield	2000	600	580
HDD	Sydney Gas Road Crossings, Sydney, NSW	United Excavations	1996		180

Table 7.0 Water Industry

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
BURST	Concrete stormwater replacement, Canberra	ACTEW	1998	630	135
BURST	Sewer Upgrade, Teneriffe	Brisbane Water	1997	440	820
BURST	Collapsed VC Sewermain Reinstatement	Hunter Water	1998	150	100
BURST	Pipe Bursting Samdon St Hamilton gravity sewer	Hunter Water	1999	150	49
BURST	Pipe Bursting Benton St Kahibah gravity sewer	Hunter Water	2000	375	80
BURST	Pipe bursting Lindsay St Hamilton gravity sewer	Hunter Water	2000	150	72
BURST	Pipe Bursting Cram St Merewether gravity sewer	Hunter Water	2000	150	100
BURST	Pipe Bursting Pell St Merewether gravity sewer	Hunter Water	2000	225	100
BURST	Pipe Bursting Antill St Mayfield gravity sewer	Hunter Water	2000	225	75
BURST	Pipe Bursting Contay St Mayfield gravity sewer	Hunter Water	2000	150	46
BURST	Pipe Bursting Deakin St Kurri Kurri gravity sewer	Hunter Water	2000	150	75
BURST	Pipe Bursting Northcote St Kurri Kurri gravity sewer	Hunter Water	2000	150	80
BURST	Pipe Bursting Doyle St Bellbird gravity sewer	Hunter Water	2000	150	76
BURST	Queechy Rd	Launceston City Council	1995	160OD	58
BURST	Holbrook St/ Mayne St Intersection	Launceston City Council	1996	160OD	42
BURST	Delamere Cres	Launceston City Council	1996	160OD	18
BURST	Richards Ave	Launceston City Council	1996	250OD	53
BURST	Pedder St	Launceston City Council	1996	225OD	48
BURST	Trevallyn Rd	Launceston City Council	1996	160OD	20
BURST	Legana/ Lawrence Vale Rd	Launceston City Council	1999	260OD	20
BURST	Philip St	Launceston City Council	2000	200OD	
BURST	Brisbane St 15A to 13A	Launceston City Council	2000	160OD	25
BURST	St John St (Frederick to Balfour)	Launceston City Council	2000	400OD	150
BURST	Sewermain Reinstatement and Amplification, Brighton, Melbourne	South East Water	1998	400	1500
BURST	Watermain Replacement Pittwater Rd, Dee Why	Sydney Water	1998	250	1000

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
BURST	Deteriorated VC sewermain Reinstatement, Falcon Street, Norrth Sydney	Sydney Water	1998	400	120
BURST	Sewermain Amplification, Penrith	Sydney Water	1998	630	500
BURST	Stormwater Rehabilitation, Neilson Park, Vaucuse	Woollahra Council	1999	450	90
HDD	Blue Mountains Sewerage, Mt Riverview, NSW	AWT	1999	508 mm	500
HDD	Leura Directional Drill, Leura, NSW	AWT	1999	400 mm	330
HDD	Effluent Transfer across Brisbane River	Brisbane Water	1997	315	500
HDD	Creekside and Chadstone Close Pump Stations By-pass	Brisbane Water	1998	225 and 2x100	100
HDD	Ambara Street Rising main	Brisbane Water	1998	150	900
HDD	Sunset Rd Pump Station Rising Main (Directional Drilling)	Brisbane Water	2000	180	143
HDD	Fisherman Islands River Crossing (Directional Drilling)	Brisbane Water	2000	1100	720
HDD	Heroes Avenue (Directional Drilling - Part 1)	Brisbane Water	2000	2 x 450	1000
HDD	Heroes Avenue (Directional Drilling - Part 2)	Brisbane Water	2000	3 x 603	840
HDD	St Conel St (Directional Drilling)	Brisbane Water	2000	525	495
HDD	BP Effluent Reuse (Directional Drilling)	Brisbane Water	2000	500	300
HDD	Luggage Point Wastewater Reclamation Project- Boggy Creek Crossing	John Holland Construction & Engineering	2000	560	320
HDD	Elphin 58A to 18 Claremont	Launceston City Council	2000	225	15
HDD	Dora Creek Sewer Crossing, Dora Creek, NSW	Ledonne Constructions	1996	200 mm	140
HDD	MT Creek Pressure Main Crossing	Maroochy Shire Council	1996	324	130
HDD	Clifton Sewerage Upgrade, Clifton, NSW	Pan Civil	1995	400 mm	60
HDD	Wollstonecraft Sewerage Upgrade, Wollstonecraft, NSW	State Rail	1994	600 mm	200
HDD	St Leonards Sewerage Upgrade, St Leonards, NSW	State Rail	1994	600 mm	230
HDD	Hazelbrook Sewerage Borehole, Hazelbrook, NSW	Sydney Water	1995	450 mm	300
HDD	Woodford, Railway Pde, Blue Mountains, NSW	Sydney Water	1995	525 mm	385
HDD	Woodford, Taylor Road, Blue Mountains, NSW	Sydney Water	1995	450 mm	358
HDD	Linden Sewer Tunnel , Blue Mountains, NSW	Sydney Water	1995	450 mm	960
HDD	Cromer Sewerage Line, Cromer, NSW	Sydney Water	1996	280 mm	620

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	Leure Inclined Bore, Blue Mountains, NSW	Sydney Water	1997	450 mm	265
HDD	North Katoomba Inclined Bore, Blue Mountains, NSW	Sydney Water	1998	450 mm	410
HDD	Boronia Road Inclined Bore, Blue Mountains, NSW	Sydney Water	1998	444 mm	296
HDD	Blue Mountains Sewerage, Wentworth Falls, NSW	Sydney Water	1999	450 mm	210
HDD	Wentworth Falls Inclined Bore, Blue Mountains, NSW	Sydney Water	1999	558 mm	214
HDD	Inclined Sewer Borehole, Oxford Falls Sydney	Sydney Water Corporation	1998	355	650
HDD	Inclined Borehole Drilled to grade and position in The Blue Mountains	Sydney Water Corporation	1999	219	1050
HDD	Wagga Water Mains Crossing, Wagga Wagga, NSW	Wagga Council	1996	90 mm	80
HDD	Brisbane River Crossing, Brisbane Qld	Brisbane Water	CURRENT	558 mm & 1118 mm	850
HDD	Directional Bore, Myall Rd, Mt Colah	Sydney Water	2000	315	700
HDD	Directional Bore, Pittwater Rd, Dee Why	Sydney Water	2000	315	160
HDD	Crossing of Georges River at Pleasure Point	Sydney Water	2001	160	180
HDD	Crossing of Georges River at Pleasure Point	Sydney Water	2001	180	180
HDD	Directional Bore, Sublime Point, Leura	Sydney Water	2001	400	1230
HDD	Directional Bore, Myall Ave, Leura	Sydney Water	2001	400	620
HDD	Directional Bore from SPS 594, Hornsby Heights	Sydney Water	2001	250	350
HDD	Directional Bore from SPS 595, Hornsby Heights	Sydney Water	2001	250	500
HDD	Port Hacking Crossing, Sydney NSW	Sydney Water	CURRENT	225 mm	830
HDD	Port Hacking Crossing, Sydney NSW	Sydney Water	CURRENT	250 mm	830
HDD	Port Hacking Crossing, Sydney NSW	Sydney Water	CURRENT	1240 mm	400
JACKING	Watermain crossing under railway	Melbourne Water - Water	PROPOSED	1800	50
MICRO	Norman Creek (Microtunnelling)	Brisbane Water	2000	600	740
MICRO	Bulimba Creek (Microtunnelling)	Brisbane Water	2000	1350	500
MICRO	Heroes Avenue (Microtunnelling)	Brisbane Water	2000	900	1000
MICRO	Creek St (Microtunnelling)	Brisbane Water	2000	600	170
MICRO	City Beach - WA	Foothills Drainage	1999	300	250
MICRO	City Beach - WA	Foothills Drainage	2000	150	2500

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
MICRO	Busselton - WA	G & B Drainage	2000	300	65
MICRO	Esperance - WA	G & B Drainage	CURRENT	300/150/225	1000
MICRO	Cannington - WA	Garherst	2000	375	65
MICRO	Cannington - WA	Garherst	2000	375	75
MICRO	Booragoon 9C -WA	GNC Contractors	2000	150	1500
MICRO	New gravity sewermain under road at Adelaide St Raymond Terrace	Hunter Water	2000	150	59
MICRO	Tunnel bore	Maroochy Shire Council	1996	600	8.5
MICRO	Yandina-Nambour Sewage Transport System - sewer gravity main	Maroochy Shire Council			
MICRO		Melbourne Water - Sewer	1993	450	82
MICRO	Aspendale - VIC	Standard Roads	2000	225	55
MICRO	Hazelbrook	Sydney Water	1995	300	183
MICRO	Hazelbrook	Sydney Water	1995	300	37
MICRO	Hazelbrook	Sydney Water	1995	300	186
MICRO	Pymont	Sydney Water	1995	460	111.4
MICRO	Pymont	Sydney Water	1995	460	99.6
MICRO	Pymont	Sydney Water	1995	460	51.3
MICRO	Pymont	Sydney Water	1995	460	113
MICRO	Pymont	Sydney Water	1995	1060	106.5
MICRO	Pymont	Sydney Water	1995	1060	78
MICRO	Pymont	Sydney Water	1995	730	49.5
MICRO	Pymont	Sydney Water	1995	530	28
MICRO	Pymont	Sydney Water	1995	530	16.2
MICRO	Pymont	Sydney Water	1995	600	30
MICRO	Pymont	Sydney Water	1995	460	15.2
MICRO	Pymont	Sydney Water	1995	600	8.9
MICRO	Pymont	Sydney Water	1996	530	8
MICRO	Pymont	Sydney Water	1996	530	13

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
MICRO	Pyrmont	Sydney Water	1996	460	24
MICRO	Pyrmont	Sydney Water	1996	460	7.5
MICRO	Pyrmont	Sydney Water	1996	460	5
MICRO	Cammeray	Sydney Water	1996	460	59
MICRO	Marrickville	Sydney Water	1996	730	25
MICRO	Lawson	Sydney Water	1996	460	163
MICRO	Lawson	Sydney Water	1996	530	137
MICRO	Manly	Sydney Water	1996	530	170
MICRO	Chippendale	Sydney Water	1996	1050	160
MICRO	Windsor Rd	Sydney Water	1996	600	16
MICRO	Leura Falls Reserve	Sydney Water	1996	460	45
MICRO	Olympic Hockey	Sydney Water	1997	375	90
MICRO	Lidcombe	Sydney Water	1998	860	36
MICRO	Manly	Sydney Water	1998	530	250
MICRO	Epping	Sydney Water	1998	530	32
MICRO	Top Ryde	Sydney Water	1998	440	49
MICRO	Nth Kat Area 3	Sydney Water	1998	440	123
MICRO	Tennyson	Sydney Water	1998	1120	45
MICRO	Sth Went Falls-Area 1B	Sydney Water	1999	690	74
MICRO	Sth Went Falls-Area 1B	Sydney Water	1999	690	63
MICRO	Sth Went Falls-Area 1B	Sydney Water	1999	530	61
MICRO	Picton #1	Sydney Water	1999	530	31
MICRO	Sth Went Falls-Area 1B	Sydney Water	1999	530	144
MICRO	Picton #2	Sydney Water	1999	530	50
MICRO	Picton #3	Sydney Water	1999	530	28
MICRO	Picton #5	Sydney Water	1999	690	29
MICRO	Picton #6	Sydney Water	1999	690	43

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
MICRO	Picton #7	Sydney Water	1999	375	81
MICRO	Picton #8	Sydney Water	1999	440	98
MICRO	Picton #10	Sydney Water	1999	440	132
MICRO	Picton #11	Sydney Water	1999	440	99
MICRO	Picton #9	Sydney Water	2000	440	72
MICRO	KatoombaPeckmans Rd	Sydney Water	2000	440	31
MICRO	Sth Leura	Sydney Water	2000	375-530	73
MICRO	Sth Leura	Sydney Water	2000	375-530	76
MICRO	Toowoomba City Council - QLD	Toowoomba City Council	CURRENT	600/675	485
MICRO	Huntingdale Main Sewer	Water Corp	1990	450	925
MICRO	Kewdale Main Sewer	Water Corp	1990	450	523
MICRO	Maddington Connecting Sewer	Water Corp	1990	450	498
MICRO	Kardinya 1KK infill sewer	Water Corp	1993	100 / 150	1417
MICRO	Balcatta 15C Infill Sewer	Water Corp	1993	450	125
MICRO	Frankland St (Charles to Wellington)	Launceston City Council	PROPOSED	400OD	190
MICRO	Brisbane St (Wellington to Charles)	Launceston City Council	PROPOSED	400OD	160
MICRO	St John St (Elizabeth to Frederick)	Launceston City Council	PROPOSED	400OD or PVC liner	130
MICRO	26 Delamere to Bain Terrace	Launceston City Council	PROPOSED	160OD	200
MICRO	Lime Avenue	Launceston City Council	PROPOSED	250OD	
OTHER	New watermain under railway at High St Maitland	Hunter Water	2000	250	40
REHAB	Elphin/ David Intersection	Launceston City Council	1996	225	66
REHAB	Inflow/Exfiltration Programme	Sydney Water	1999	150-300	12277
REHAB	Shakespeare Grove Main Drain	Melbourne Water - Drainage	2000	1200 & 900	800
REHAB	Inflow/Exfiltration Programme	Sydney Water	PROPOSED	150-300	259122
REHAB	Inflow/Exfiltration Programme	Sydney Water	PROPOSED	>300	187
RELIN	Eagle Farm Sewer Rising main	Brisbane Water	1998	1295	40

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
RELINE	Pipe Lining Metford Rd Tenambit East Maitland Golf Course gravity sewer	Hunter Water	1999	675	615
RELINE	Pipe Lining Lambton and Bridges Rd Lambton gravity sewer	Hunter Water	1999	300	143
RELINE	Pipe lining Pokolbin St Broadmeadow gravity sewer	Hunter Water	1999	150	62
RELINE	Pipe Lining Glenrock State Recreation Area burwood Beach gravity sewer	Hunter Water	1999	450	156
RELINE	Pipe lining South St Cessnock gravity sewer	Hunter Water	1999	300	57
RELINE	twin -Lok Port Stephen Drive Raymond Terrace gravity sewer	Hunter Water	2000	375	98
RELINE	Holbrook St/ Mayne St Intersection	Launceston City Council	1996	150	91
RELINE	Box Hill South Main Drain	Melbourne Water - Drainage	1999	1200	200
RELINE	Lygon St Main Drain	Melbourne Water - Drainage	2000	1350	260
RELINE	SWSOOS Sewerage System	Sydney Water	1995/1996	various	2000
RELINE	SWSOOS Sewerage System	Sydney Water	1997/1998	various	2000
RELINE	Inflow/Exfiltration Programme	Sydney Water	1999	150-300	7182
RELINE	NSOOS-Warriewood Sewerage Systems	Sydney Water	to 1999	150-300	25000
RELINE	NSOOS-Warriewood Sewerage Systems	Sydney Water	to 1999	>300	10400
RELINE	Stormwater Rehabilitation, Neilson Park, Vaocluse	Woollahra Council	1999	630	100
RELINE	Slip lining of CICL watermain under railway at Prince St Waratah	Hunter Water		500	50
RELINE	Inflow/Exfiltration Programme	Sydney Water	PROPOSED	150-300	46828
RELINE	Inflow/Exfiltration Programme	Sydney Water	PROPOSED	>300	3555
RELINE	All sewerage systems	Sydney Water	PROPOSED	150-300	52200
RELINE	All sewerage systems	Sydney Water	PROPOSED	>300	15600

Table 8.0 ELECTRICITY INDUSTRY

Technology	Project Description	Client Details	Date completed	Diameter (mm)	Length (m)
HDD	Mascot Airport Electricity Conduit, Sydney, NSW	NACE	1995		200
HDD	Torrens River Gas Crossing, Adelaide, SA	Epic Energy	1997	450 mm	810
HDD	Queensland Power Project	Nu-Power Toowoomba	1997	150	2850
HDD	Murray River Crossing, Murray River, NSW/VIC	Boral Energy	1999	100 mm	325
HDD	Pelican Point Crossing, Adelaide, SA	Epic Energy	1999	350 mm	860
HDD	Melbourne Docklands Trunk Infrastructure Project	PowerCor / Transfield Consortium	1999	225	550
HDD	Wide Bay Pipeline Project Constructed By McConnell Dowell Constructors Pty Ltd	Envestra/Boral Energy	1999	125	343
HDD	Wide Bay Pipeline Project Constructed By McConnell Dowell Constructors Pty Ltd	Envestra/Boral Energy	1999	125	288
HDD	Melbourne Docklands Trunk Infrastructure Project	PowerCor / Transfield Consortium	1999	225	285
HDD	Clarence River Crossing, Grafton, NSW	North Power	2000	450 mm	510

Table 9.0 OTHER INDUSTRIES

Technology	Project Description	Client Details	Industry	Date completed	Diameter (mm)	Length (m)
HDD	Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	Transfield	MINING	1999	300 mm	750
HDD	Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	Transfield	MINING	1999	300 mm	680
HDD	Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	Transfield	MINING	1999	300 mm	650
HDD	Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	Transfield	MINING	1999	300 mm	510
HDD	Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	Transfield	MINING	1999	300 mm	500
HDD	Century Mine Slurry Pipeline, Mt Isa, to Karumba, Qld	Transfield	MINING	1999	300 mm	370
HDD	Sydney International Airport Fuel Line, Sydney, NSW	Caltex Oil	OIL	1990	200 mm	180
HDD	Sydney International Airport Fuel Line, Sydney, NSW	Caltex Oil	OIL	1990	350 mm	180
HDD	Pikenba Aviation Fuel Line, Pikenba, QLD	BP Australia	OIL	1990	200 mm	450
HDD	Sydney International Airport, Sydney, NSW	Caltex Oil	OIL	1991	100 mm	300
HDD	Kingsford Smith Airprt, Brisbane, QLD	Caltex Oil	OIL	1992	200 mm	260
HDD	Brisbane Airport Aviation Fuel Line, Brisbane, QLD	BP Australia	OIL	1998	200 mm	950
HDD	Various Road Crossings, Adeliade, SA	Pipelines Authority of SA	OTHER	1990		
HDD	Sydney Airport Lighting Runout Project Runway One.	Federal Airports Commision	OTHER	1997	305	290
HDD	Picton N.S.W	Bevan Constructions	OTHER	1997	305	1150
HDD	Sydney Airport-Taxiway 'Alpha' Crossing	Nace Civil Engineering Pty. Ltd.	OTHER	1998	100	112
HDD	Sydney Airport-Runway 07/25	Nace Civil Engineering Pty. Ltd.	OTHER	1998	100	155
HDD	Sydney Airport-Taxiway 'Golf' Crossing	Nace Civil Engineering Pty. Ltd.	OTHER	1998	100	119
HDD	Melbourne City Rail Yard Crossing	Network Design & Construction	OTHER	1999	150	300
HDD	RAC Project	State Rail	OTHER	2000	2*40	1700
MICRO	Rydalmere		OTHER	1997	860	46