Australian Government
Asbestos Safety and Eradication Agency

ASEA REPORTS

Case studies of asbestos water pipe management practices

As prepared by rawtec reincarnate prensa

Asbestos Safety and Eradication Agency Report – 05-2018

Case studies of asbestos water pipe management practices

Disclaimer

This report has been prepared for Asbestos Safety and Eradication Agency in accordance with the terms and conditions of appointment dated 23 March 2017. Rawtec has collected and collated information from public and confidential sources, most provided as secondary information and via stakeholder interviews. Whilst we are confident that this information reflects the projects outlined in this report, Rawtec Pty Ltd cannot accept any responsibility for use or reliance of this report or its contents by any third party.

Authors

Matt Genever, Matthew Allan, Greg Menz, Steven Bos

Reviewer

Mark Rawson

Contents

List of acronyms

ACM	Asbestos Containing Material
ACT	Australian Capital Territory
ASBINS	Asbestos in soils
ASEA	Asbestos Safety and Eradication Agency
NATA	National Association of Testing Authorities
NSW	New South Wales
NT	Northern Territory
OHS	Occupational Health and Safety
SA	South Australia
VIC	Victoria
WA	Western Australia
WHS	Work Health and Safety

Introduction

The Asbestos Safety and Eradication Agency (the Agency) has been established to facilitate a national approach to managing asbestos in Australia. Preventing the risk of asbestos exposure is the Agency's core purpose and this is delivered through the National Strategic Plan for Asbestos Management and Awareness. The plan provides a framework that supports each state and territory in working cooperatively and independently to achieve key objectives.

The sharing of knowledge and information on better practice management and removal of asbestos is essential in building government and industry capacity. As part of its role in delivering the national plan, the Agency has developed a series of case studies that aim to analyse existing practice, standards and guidance across Australia in the identification, registration and management of asbestos water pipes.

The fact that asbestos water pipes may be buried deep in the ground means that water authorities must balance repair and removal works with the needs of the community, seeking to minimise disruption caused by the removal or remediation of asbestos-cement water pipes. Asbestos containing (AC) cement has been used extensively in Australia, and whilst no evidence suggests this creates a risk to drinking water, its ageing nature means many of the AC pipes are likely to need remediation in the next ten to fifteen years. The case studies in this report seek to highlight current practice on the management and removal of asbestos water pipes in Australia, including common methods considered by water authorities across the country. Unlike other areas of asbestos management, asbestos water pipes present themselves visually less often than asbestos in buildings or uncovered in contaminated soils. Rather, aging asbestos water pipes fail and leak, requiring water authorities to take remedial action.

This report goes further than just showcasing removal projects and extends into the overarching strategies and decision-making tools that drive activity in this area. This includes showing how projects are managed safely and stakeholder communication is handled. Whether removal and remediation work is small scale or large scale, the health and safety of workers and the general public is a key consideration and the case studies show how these aspects of asbestos-cement water pipe management are handled.

Given the extent of AC pipes in our water infrastructure, it is now timely to review current practices and issues in order to facilitate discussions to establish a safe, effective and consistent approach to managing the risks and costs of ageing AC pipes into the future.

Methodology

The case studies have been developed in collaboration with key government and industry stakeholders, including:

- A review of past work undertaken by the Water Services Association of Australia (WSAA) which looks at the issues and costs associated with asbestos water pipe removal and management across Australia;
- Research and targeted industry consultation to identify suitable projects for the development of case studies, with the assistance of WSAA throughout this process;

- Detailed consultation with water authority stakeholders about asbestos water pipe management and specific project examples; and
- Developing case studies that highlight strategy, general management approaches, processes and procedures and examples of projects that highlight appropriate management of asbestos water pipes.

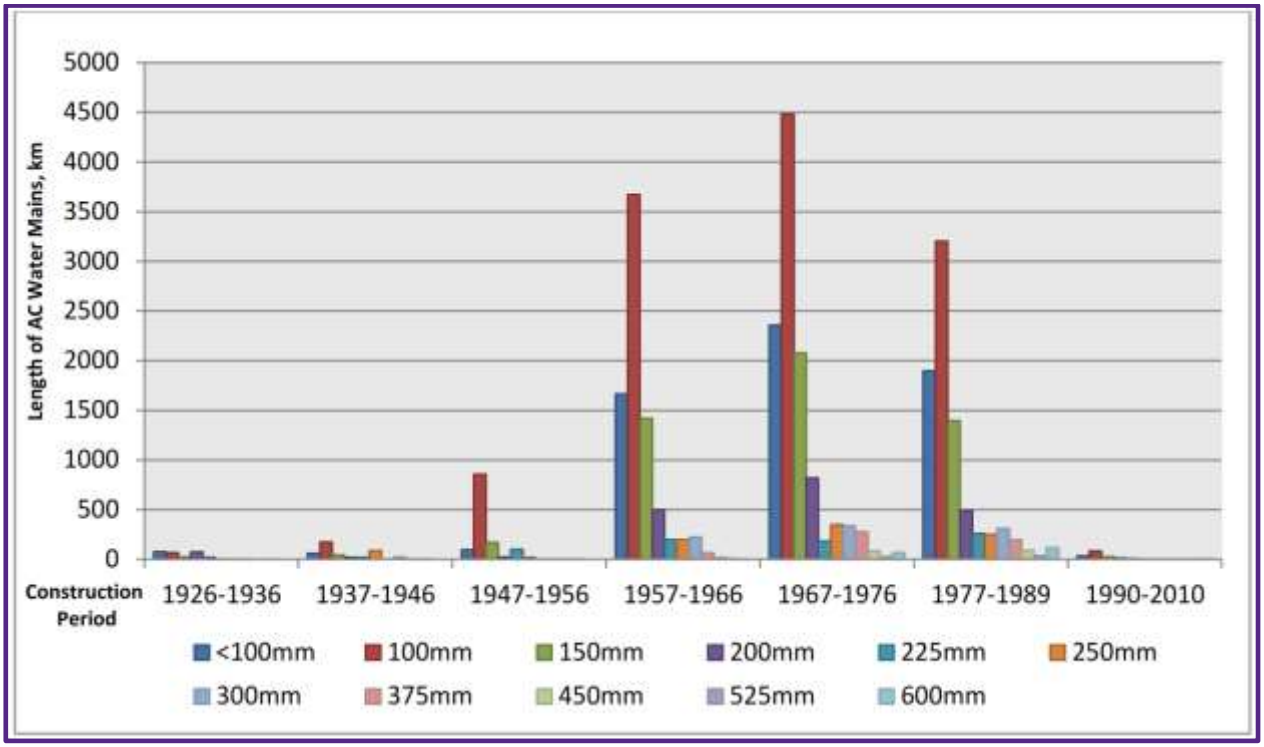
This report presents relevant background information related to key issues and opportunities followed by six case studies of removal, remediation and management of asbestos water pipes in Australia. Rawtec has engaged broadly across the water industry to explore current practices and issues and to highlight relevant findings for future consideration.

Background

The Water Services Association of Australia (WSAA) has completed two critical reports for its members that identify common challenges and approaches in the replacement and rehabilitation of asbestos water pipes in Australia.

Underlying these reports is valuable data that highlights the current and future challenges associated with asbestos cement (AC) water pipes. According to WSAA (2013[1]), there is some 40,000km of asbestos water mains across Australia, which represents around 26% of the total length of water mains in Australia. In addition, approximately 5,000km of pressure and gravity sewer mains are also comprised of asbestos cement. The majority of these pipes were installed between 1926 and the 1980's (see Figure 1) and evidence suggests that they are deteriorating at a faster rate than other pipe materials.

Figure 1 AC water mains by diameter and construction period (from WSAA 2013)



[1] WSAA, 2013. 'WSAA INVESTIGATION REPORT: Management of Asbestos Cement Pipes', *Water Services Association of Australia,* April 2013

Importantly, water from asbestos cement pipes remains safe to drink with the World Health Organisation (WHO) and the Australian Drinking Water Guidelines noting that asbestos fibres have not been shown to pose a risk to health when swallowed.

Common approaches to AC pipe rehabilitation

A WSAA survey of 19 water agencies, of which 14 replied, suggests that there are 5 main approaches to rehabilitating AC water pipes which are outlined in Table 1 below.

Table 1 Main rehabilitation approaches for AC water pipes in Australia (WSAA, 2016[2])

Removal approach	Description
Construction of a new alignment	The most common approach to AC pipe rehabilitation is to make the pipe section redundant through disconnection and to install a brand-new service pipeline alongside, leaving the redundant asbestos pipe in-situ.
Pipe bursting / splitting	Pipe bursting techniques involve machinery that is pushed up the AC pipe section to expand, split or break the pipe, creating a cavity for a replacement pipe to be inserted into the void. Broken AC pipe fragments are left in situ in the surrounding soil however release of asbestos fibres is minimised as the pipe is not excavated and removed.
Spray lining	Spray lining (also known as 'spray in place lining') uses a hose with rotating spray heads to spray a polyurethane-based coating directly onto the interior of the AC pipe. The coating then cures to a hard surface giving the pipe increased strength and resistance to deterioration.
Slip lining	Slip lining (also known as 'cured in place lining') involves insertion of a resin-coated tube into the length of the AC pipe which is then expanded using air or water pressure to fully line the internal pipe surface. The tube is constructed of a mix of plastic coated fabric of polyester or glass fibre.
Excavate and remove	Full removal of the AC pipe and replacement with a new pipe is the only method that does not leave asbestos material in situ. In general, pipe lengths are removed in whole segments from collar to collar, reducing breakage and risk of exposure to airborne fibres. This is also the most expensive rehabilitation option as full excavation is required and asbestos must be removed and disposed of accordingly.

There is ongoing discussion within the industry and with state-based safety regulators on whether any rehabilitation options that leave asbestos material *in situ* fall within national asbestos management guidelines. Water authorities have different preferred methods based on their internal policies and procedures. Advocates of pipe bursting and realignment approaches claim that risks to the community and contractors are minimised as the AC material is not exposed and removed.

However, leaving asbestos pipe within the soil, either whole or in fragments, creates a potential legacy issue. In 2015 the Victorian Government released WorkSafe Guideline WSV1648/01/04.15 *Asbestos-cement water pipe management.* This guidance stated that leaving any asbestos waste underground may be a breach of environment protection regulations. Industry representatives have noted that a clear nationally consistent approach to remediation and replacement of AC pipes would provide industry with greater certainly in planning for long-term maintenance and removal of AC stock.

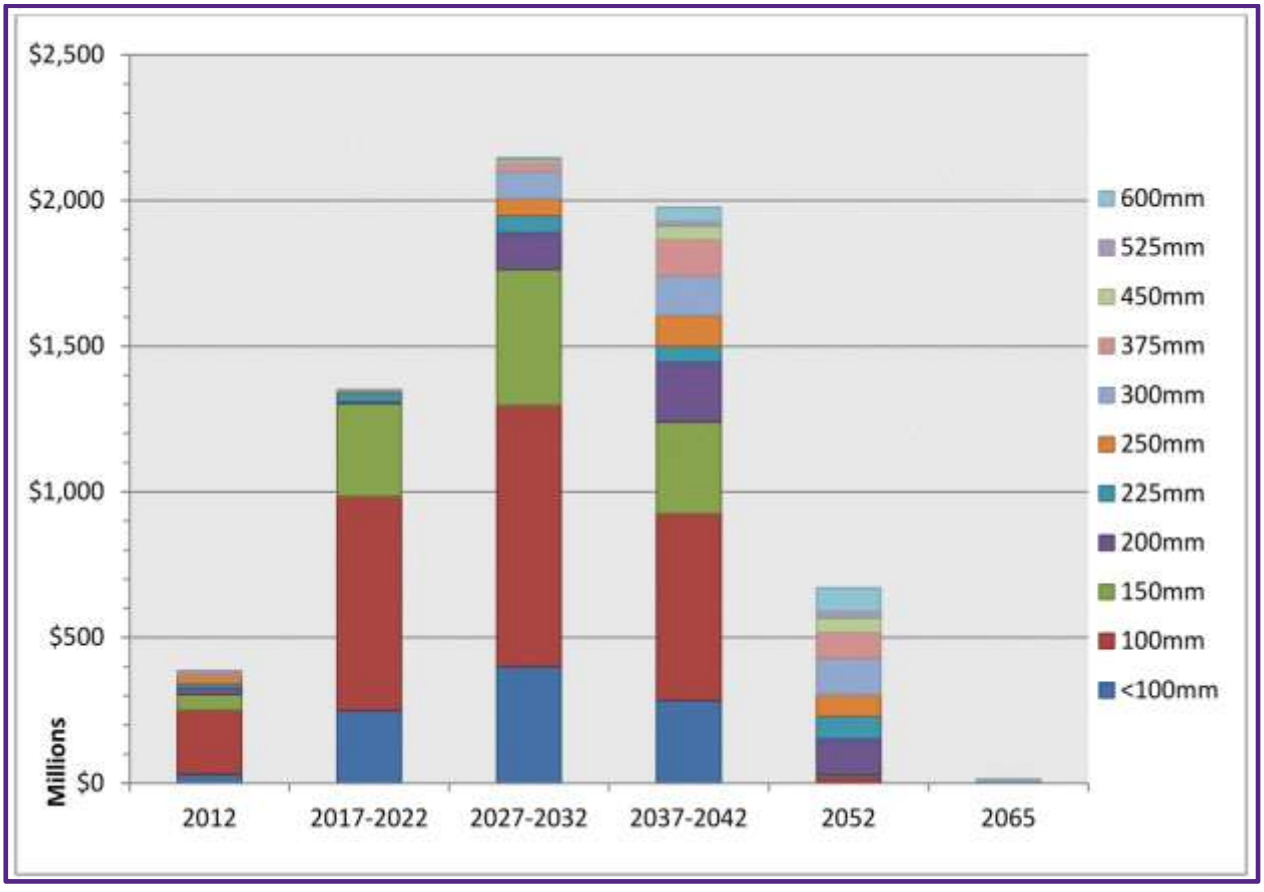
[2] WSAA, 2016. 'PPS8 PROJECT REPORT Asbestos Cement Pipe Risk Management for Renewal Methods', *Water Services Association of Australia*, August 2016.

Current and projected failure rates

Annual costs for rehabilitation of asbestos cement water pipes in Australia are currently around $400 million (see Figure 3 for the year 2012). However projected failure rates based on period of pipe construction suggest that these costs will rise exponentially over the coming years. This remains one of the most critical considerations for management of AC water pipes in Australia.

The WSAA (2013) report predicts that rehabilitation costs of the remaining AC water pipes will exceed $9.5 billion (based on 2012 costs) over the next 50 years, as is presented in Figure 2. These costs assume that current rehabilitation programs and practices will continue, meaning that much of the asbestos will remain in-situ through either pipe realignment or resealing approaches.

Figure 2 Projected rehabilitation costs for AC water mains by diameter to 2065 (from WSAA 2013) – note that these costs are excluding cost of removal and disposal of AC material.



RECOMMENDATION: It appears that there is some uncertainty about how (or if) future changes in the interpretation of national asbestos regulations may impact AC pipe rehabilitation programs in Australia. Given the significant potential cost exposure and likely flow on impacts to water consumers, the industry and governments should work closely with regulators to define which practices are allowed and which are not. This is particularly important in Victoria as some 70% of all AC pipes constructed in Australia between 1926 to 1947 (which are those currently at the highest risk of failure) were installed in the state.

Industry innovation and research

The Water Services Association of Australia (WSAA) have undertaken research into issues associated with AC pipes, which is quoted throughout this report. WSAA's research and members note that due to the long useful life of water infrastructure much of what has been installed is still in suit, with estimates suggesting less than 5% has been removed but as much as 90% will need to be replaced in the next 15 years.

In 2017, WSAA initiated three projects relating to asbestos pipe deterioration and rehabilitation:

1. A $500k study to confirm the early warning signs that an asbestos pipe is likely to fail. Providing more accurate prediction of remaining pipe life and seeking to prevent failures before they occur.
2. A $300k study to evaluate the effectiveness of different in-situ techniques to extend the life of asbestos and cast iron pipes.
3. A three year project to develop a national and the first international guideline for pipeline rehabilitation with structural liners. Whilst there are number of ISO standards on structural liners, none cover the products the Australian industry is seeking to use with asbestos pipe. These are the most promising technology for extending the life of buried pipes (potentially by up to 50 years). A national guideline would provide confidence to water utilities and the community that an applied structural liner will extend the pipe life, and for how long.

   This project involves some 30 initial collaborators including WSAA, manufacturers, applicators, utilities, and researchers. It seeks to improve and validate product and application knowledge, enabling the development of industry standards, specifications and tools and enhance the demand for lining technologies. Over the life of the project, the Federal Government through the CRC is investing $3M in cash with the combined value of government and participant support being in excess of $20M.

   The tangible industry outcomes expected from this project are:

   - Improvements to design and application of smart lining products
   - Commercialisation of intelligent sensing/robotic technologies
   - Extending the life of critical infrastructure
   - Market growth for Australian lining SMEs
   - Enhanced Australian innovative linings knowledge and capacity

   This will support improved practices in the management and remediation of AC pipes and reduce the risks of asbestos exposure through maintain and removal.

Case study findings

The case studies presented in the report illustrate how organisations have approached the management and removal of asbestos cement water pipes in a practical way. The planning, checks and balances and processes they have put in place provide real examples that illustrate safe, efficient and cost effective ways of managing asbestos water pipes in situ and throughout the removal process.

The following summarises the key findings of the case studies:

Importance of long-term strategy

The current and projected failure rates for AC water pipes suggest Australia will be addressing the issue of AC water pipes for many decades to come. It is clear from the case studies presented that a number of water authorities have developed long-term strategies to plan for the rehabilitation of AC pipes into the future. These strategies are essential not just for works planning but to ensure that adequate funding is embedded into budget estimates for infrastructure works and maintenance.

South East Water provides services to south-east Melbourne, incorporating dense urban areas out to sparsely populated regional areas. In 2016, SE Water developed its *Strategy for Renewal of Asbestos Cement Water Mains* which provides a long-term plan for the rehabilitation of AC water pipes including consideration of current approaches, peak rehabilitation periods and potential costs. Central to the strategy is investment in research on emerging pipe rehabilitation techniques such as non-structural liners using organic polymer sprays.

Key Finding: Water authorities that have developed long-term strategies for rehabilitation of AC water pipes benefit from improved planning for maintenance and upgrades, have clear indications of costs that can be then factored into financial planning and rates charges, and can adjust more nimbly to potential changes in regulations should they occur.

Ensure adequate policies and procedures are in place

Whilst a long-term strategy can set the tone for organisational management of AC water pipes, it is equally important to ensure operational policies and procedures are in place that set the expectation on how AC pipe should be managed day to day. Such policies operate best when embedded into broader workplace health and safety systems such that staff and contractors are receiving adequate information, training and inductions.

Unitywater, which operates from the north of Brisbane up to Noosa Council, has developed a framework for safe management of asbestos containing materials (ACM) across its network. Based around an Asbestos Management Procedure, the framework seeks to ensure that controls are implemented on all activities involving ACM to eliminate or minimise the risk of exposure to workers, visitors and the public. The framework provides for clear lines of accountability and includes a range of supporting documents and procedures, including an Asbestos Removal Control Plan, Safe Work Method Statements and communication tools such as an Asbestos Fact sheet.

Similarly, Barwon Water, working closely with its contractors Programmed Facility Management, has established clear asbestos work practices and standard operating procedures (SOP) for the rehabilitation of AC water pipes. An Asbestos Control Plan is central to this framework and each SOP provides a clear flow chart of processes and the required documentation.

In Western Australia, Water Corporation has developed a detailed Asbestos Policy which outlines the organisations commitment to effective asbestos management. As part of a broader Asbestos Management Framework, the Asbestos Policy has senior management accountability and cascades down into a series of procedural documents on working with asbestos, followed by key operational documents, registers, instructions and forms. Combined, the framework delivers a risk based approach to effective asbestos management.

Key Finding: The management and rehabilitation of AC water pipes must be done in a highly-controlled manner. Water authorities that have detailed policies and procedures, supported by clear documentation and accountability, are able to manage the risk from AC pipe and ensure safety standards are maintained.

Maintain clear lines of communication


Safe work practices
Working with asbestos
FACT SHEET

The removal or rehabilitation of AC water pipes often happen in very public places as pipes tend to exist beneath roads and pavements. Communication with relevant businesses and the community is important in maintaining transparency and reducing the risk of public concern.

The case studies presented highlight the importance of effective communication. Unitywater for example, has developed a simple "Working with Asbestos" Fact Sheet which provides the public with information on why AC pipe rehabilitation is required and how Unitywater works to protect the community during these works.

However, industry consultation suggests that considerably more work can be done in this area to ensure that communications strategies are in place. Water authorities should be addressing this both at a macro level, through a set of clear messages that link into organisational strategy, and on a project by project basis, to ensure that the stakeholders are aware of works that are occurring in their area.

Key Finding: Whilst some water authorities have clear lines of communication with the public on AC pipe rehabilitation, there is an opportunity for a broader approach to communication on this issue.

Additional research required

The case studies presented in the report highlight the need for ongoing research in this area, not only with regard to the size of the potential liability of pipe renewal over the next 30 – 50 years but also as to how best manage and minimise the potential risk of exposure to the community. A number of organisations consulted in the development of the case studies suggested there is a role for government, industry associations and water authorities to work collaboratively on this research.

Feedback from SE Water suggests that some of the research areas could include:

- Further work to develop a clearer understanding of deterioration rates and future renewal requirements for AC pipes
- Development of a more comprehensive evaluation method of all AC pipe renewal options

- Quantification of risk exposure during rehabilitation works and future community risks
- Creation of decision support tools for AC pipe rehabilitation
- Confirmation of structural integrity and longevity of spray liners for AC pipes.

Key finding: WSAA has undertaken valuable industry research that is helping the sector to understand the size and nature of this issue. However, it is clear that there is an opportunity for government, industry associations and water authorities to work together to undertake further research and share research findings on the long-term management of AC water pipes in Australia.

List of case studies within the report

The following projects are profiled as case studies within the report:

No	Project Name	Location	Overview
1	**Goulburn Valley Water**	Victoria	Goulburn Valley Water services some 54 towns in central Victoria. An asbestos removal project from Shepparton is highlighted, along with general strategies for managing AC pipes.
2	**Unitywater**	Queensland	Servicing the areas north of Brisbane up to Noosa, Unitywater has developed a comprehensive framework for asbestos pipe management. The current sewer relining program is using innovative "trenchless technology" to renew the network.
3	**South East Water**	Victoria	SE Water has one of the largest networks of AC pipe in Australia and manages this through its Asbestos Cement Pipes Strategy, employing conventional techniques whilst investing in research on new approaches.
4	**Water Corporation**	Western Australia	Water Corp is the principal supplier of water and drainage services across Western Australia. Long-term planning is paramount to Water Corp and the Asbestos Management Framework provides a policy and management approach for working with AC pipes.
5	**Barwon Water**	Victoria	Barwon Water is responsible for more than 1,200kms of AC water pipes, renewing around 20km per annum. AC pipe management is linked to mild steel cement lined (MSCL) pipes, installed around the same period and likely to contain asbestos.
6	**Central Highlands Water**	Victoria	Central Highlands Water has clear strategies for the management and removal of AC pipes on its network. Removal work on East Street, Daylesford provides an example of these approaches.

The following pages provide detailed case studies on the six-highlighted asbestos water pipe rehabilitation and management programs. They demonstrate effective planning and execution and the

importance of long-term planning and ongoing communication with water authorities, safety regulators and the community. This is an area that is likely to see significant change in the coming years with more and more investment required to manage AC pipe failure. The case studies highlight water authorities who are being proactive in managing asbestos risks to help reduce the risk of asbestos-related illness.

Goulburn Valley Water – Cameron Avenue



Case Study 1 – Goulburn Valley Water, Cameron Avenue

Overview

Goulburn Valley Water (GVW) provides water and wastewater services to over 60,000 customers. These customers are spread across 54 towns in central Victoria, from just north of Melbourne through to the northern Victoria border (see Figure 1.1)[3]. Further details of GVW can be found in Table 1.1. This case study provides information about GVW and discusses the approach taken to manage an asbestos cement (AC) pipe on Cameron Avenue in Shepparton, Victoria.

Asbestos Cement Pipes in GVW

GVW has 690 kilometres of AC mains, which comprises approximately 38% of its total water supply network. These AC pipes were installed between 1930 and 1980, and GVW is conscious of the AC pipes in its region. The organisation has a detailed risk assessment and decision making tool that can be used when faced with AC pipe renewal, and in the 2015-16 financial year, GVW trained 6 employees in asbestos removal.

Table 1.1: GVW key information

Key information	GVW data
Location	Total GVW area approximately 20,000 km^2 with head office in Shepparton, Victoria, 190 kilometres north of Melbourne
Kilometres of water network pipe owned and managed by water company	1,800 (690 kilometres of this is AC mains)
Wastewater management facilities	26
Infrastructure, plant and equipment value	Approx. $1.1 billion[4]

[3] http://www.gvwater.vic.gov.au/about-us/

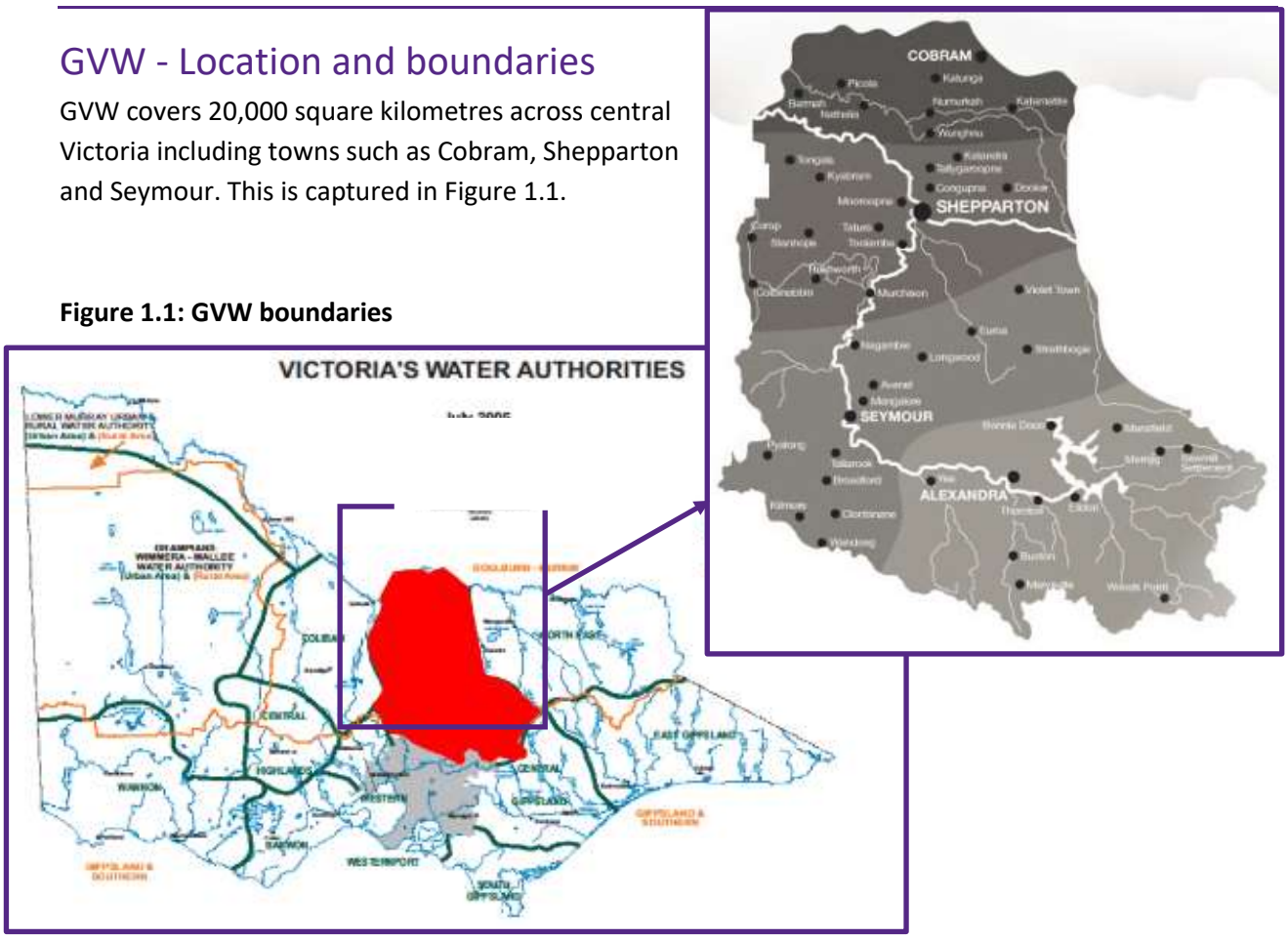
[4] http://www.gvwater.vic.gov.au/publications/images/Water_Plan_2013_2018.pdf

Employees	Approx. 200

GVW - Location and boundaries

GVW covers 20,000 square kilometres across central Victoria including towns such as Cobram, Shepparton and Seymour. This is captured in Figure 1.1.

Figure 1.1: GVW boundaries



Managing asbestos cement pipes

GVW previous approach to AC pipe management

GVW implemented its AC pipe Replacement Program in the 2010/11 financial year. At this point in time, GVW's methods for removing the AC pipe included a combination of pipe bursting and under-boring as well as some other trenching techniques. Pipe bursting was used due to cost savings (with costs approximately 60 – 80% of the cost of construction of a new water main), retaining alignment while not conflicting with other services, reduced excavation requirements, and the ability to upsize the pipe in some circumstances.

The *GVW Water Plan 2013 to 2018* continues the commitment to replace water mains to maintain service levels, with $18 million allocated to this practice over this five-year period[5], which includes replacement of AC pipe. Up until 2015, GVW continued their current practices of pipe bursting and under-boring, with other methods implemented depending on the situation.

In 2015, part way through the implementation of the GVW Water Plan, the Victorian Government clarified that asbestos fragments left in the ground after pipe bursting are classified as asbestos waste and as a result, required removal and disposal.

[5] http://www.gvwater.vic.gov.au/publications/images/Water_Plan_2013_2018.pdf

Response to this clarification

Since this clarification, GVW has had some troubles determining the best approach to manage and remove AC pipes. Although there was no change in legislation, the Victorian government provided a clear clarification of its interpretation, while it was unclear to GVW whether other states and territories had made this clarification. As a result, GVW notes that the interpretation of the legislation remains varied across Australia, and is interested in clarity from a national perspective as to the implications of the legislation and what water companies across Australia are allowed to do. Nonetheless, pipe bursting, which was previously a common method for AC pipe replacement at GVW, had to be changed due to the updated guidelines from the Victorian Government.

Decision making for GVW AC pipe management and/ or removal requires consideration of a number of factors. With a desire to minimise costs as well as health and safety risk to the community, removing AC pipe by excavation and transport to a licenced landfill from the ground, according to GVW, is not always the ideal solution for GVW pipes. GVW is trying to align with legislative requirements as well as considering costs, risk to public and staff, time, the extent of the damage of the pipe, actions other water companies are taking, and public perception. GVW notes that it is now quite complex to manage AC pipes, with many aspects to consider. It has also impacted its GVW Water Plan.

Current process for managing AC pipe

GVW now predominately uses the realign and leave technique to replace AC pipe. An example of this is covered in the case study below.

Example case study – Cameron Avenue, Shepparton[6]

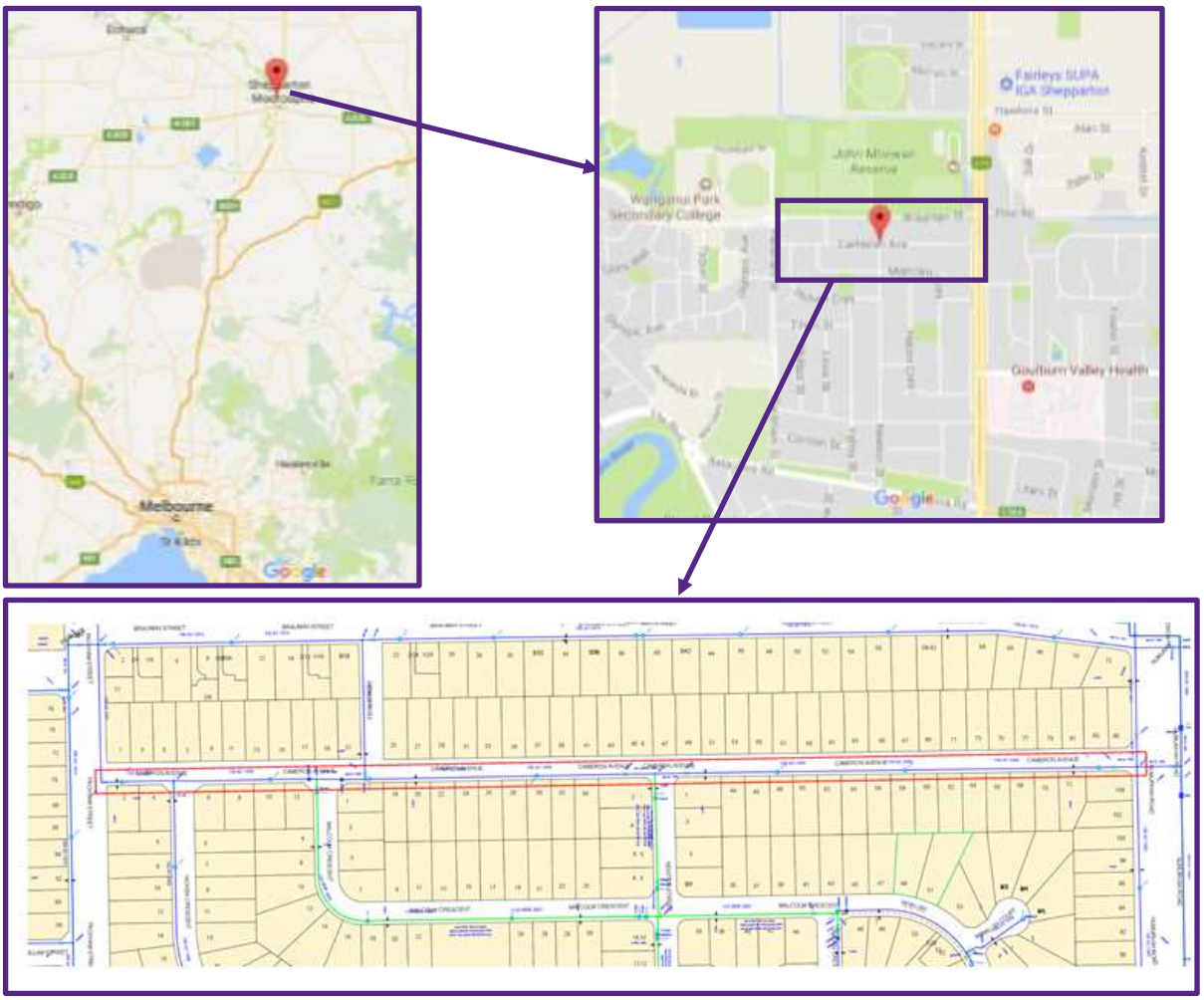
Situation

GVW was tasked with managing an AC pipe in Shepparton in October 2016. This pipe was constructed in the 1950s using a 150mm diameter AC material. The location of Cameron Avenue, where the water pipe was located can be seen in Figure 1.2, and the AC pipe lay along the entire street, with the pipe length a total of 715 metres.

The Cameron Avenue AC pipe had failed on numerous occasions over the last 20 years, and each time had either had a repair band installed (at minimum disruption to residents), or a section had been replaced. The failure rate had been increasing in recent years, with more and more sections needing to be replaced. GVW was faced with making a decision as to whether to renew the AC pipe.

[6] All data and information sourced from discussions with GVW and *Water Main Replacement Case Study – Cameron Avenue Shepparton*, a document written by GVW.

Figure 1.2: Location of the AC pipe (note that the bottom image shows the GIS location of the pipeline in blue, with Cameron Avenue marked in red[7]



Decision to renew the AC pipe

GVW has a standard set of rules that are used to undertake the assessment, prioritisation, and subsequent decision making for the authority's assets. The risk based approach chiefly considers the condition of the water main and its criticality.

Criterion One – condition of water main

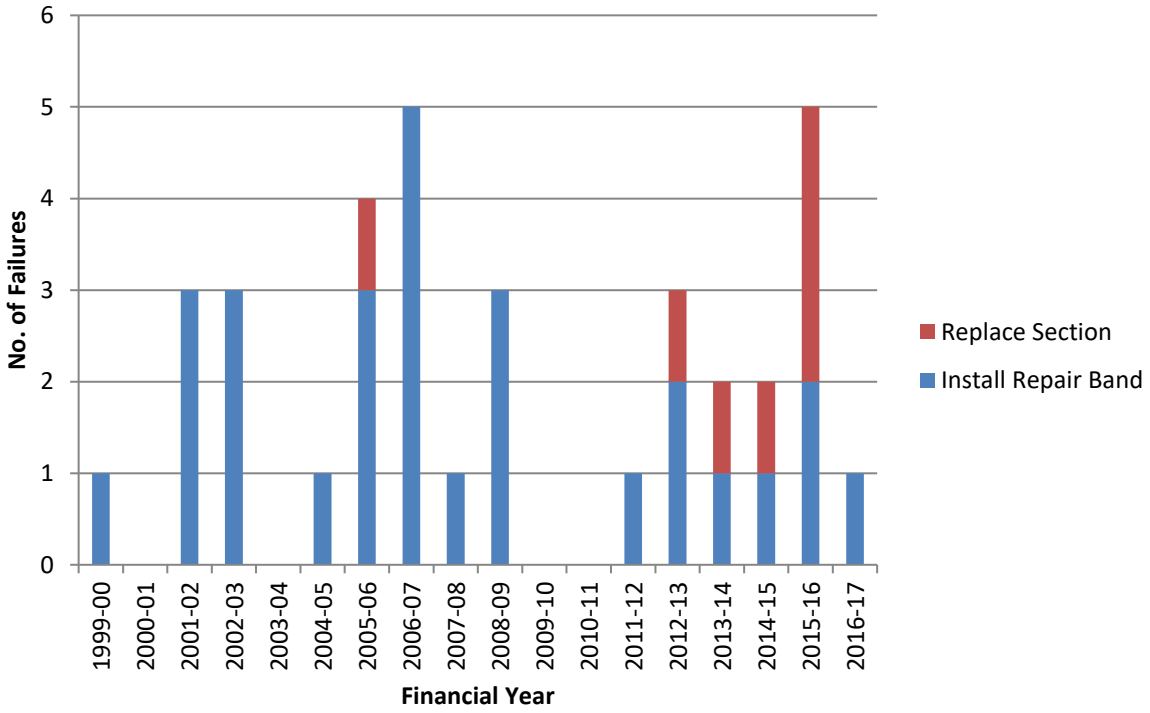
GVW uses a 0 to 5 structural condition grade to quantify the condition of the water main. According to this approach, 1 is the best condition (the pipeline has not failed since it was laid), and 5 is the worst condition (pipeline has burst or leaked more than three times in the past year, or a detailed condition assessment indicates that the pipe has reached the end of its life). A 0 means the pipe has been abandoned or no longer exists.

As can be seen in Figure 1.3, the water main in Cameron Avenue had seen numerous failures from the 1999-2000 to 2016-17 financial years. There had also been an increase in the requirement to replace entire sections of pipeline from 2012-13 to 2015-16. As the AC main had exceeded three failures during the 2015-16 year, the Condition Rating was 5 (worst condition). Note that the most recent assessment

[7] Map data: Google and GVW

of the pipes was conducted in October 2016 and as such, the 2016-17 data is likely to be an underestimate of actual failure rates in this financial year.

Figure 1.3: Failures of the Cameron Avenue Water Main by Financial Year from 1999-00 to 2016-17



Criterion Two – Water Main Criticality

The scoring system for water main criticality at GVW is based on the below factors:

1. Public health and safety (including GVW employees);
2. Risk of environmental pollution;
3. Degree of effect on residential and/or commercial customers;
4. Difficulty of repair; and
5. Cost of repair.

These are assessed, scored and weighted to give a point score, which is summed and placed into a criticality/ consequence rating. These ratings range from small consequence (point score range between 3 and 8, indicating that if the asset failed it would not affect operational reliability), to catastrophic (point score range between 30 and 36, indicating that if the asset failed it would cause disastrous consequences).

Cameron Avenue's Water Main Criticality score was 16, which is a ranking of 2, or minor (on failure this would have a minor impact on operational reliability).

Combining the condition and criticality grades

At GVW, the two criteria above are then combined and viewed in a decision matrix. In the case of Cameron Avenue, with a structure condition grade of 5 and a criticality/consequence of 2, it was placed into the "Prioritise in Replacement Program".

Other considerations

In addition to the decision-making process above, other justifications are sought from the manner in which the water main has failed. As highlighted in Figure 1.3, the main began to require GVW employees to cut out a section of pipe and replace with a new section rather than the repair band installation, the latter of which is more efficient and less impactful on residents. Other considerations were the rebates provided to GVW residents due to numerous unplanned water supply interruptions on Cameron Avenue, and operations staff concern over the condition of the Cameron Avenue Water Main. These factors contributed to the decision to renew the AC water main on Cameron Avenue.

Approach to renewing the AC Water Main

Planning phase

GVW's water main replacement program is finalised in April/May for the following financial year. This program remains flexible and allows for response to changes in the operating landscape, due to budgetary changes or water mains suffering from numerous bursts over a short period, which can change replacement priorities. It was decided that planning for the renewal of the Cameron Avenue AC pipe would commence in May 2016, and be completed in the following financial year. Planning included a number of actions such as notifying the local Council, undertaking site visits, developing a business case, and developing a detailed design for how to conduct the works. The planning stage also includes an options assessment, which considers how the AC pipe will be renewed.

As can be seen in Table 1.2 overleaf, the options assessment for the Cameron Avenue case study considered open trench/ horizontal boring replacement (i.e. the realign and leave technique), slip line the retired sewer rising main across the other side of Cameron Avenue, and do nothing. Lift and relay replacement was not considered as GVW does not consider it a viable replacement method due to slower construction methods leading to higher expenditure on traffic management and impact on community, temporary services are required for longer periods, which can be a hazard for pedestrians, and extensive AC handling and disposal risks and costs. Pipe bursting was also not considered due to guidelines from WorkSafe Victoria in March 2015 on AC pipe fragments in the ground being considered asbestos waste and therefore requiring removal, which increases costs.

Table 1.2: GVW Options Assessment for Cameron Avenue

Option	Description	Pros	Cons
1	Open trench / horizontal boring replacement (realign and leave technique)	• Proven replacement method; • Removal of AC from service.	• Requires deviations in the alignment at each endpoint; • Slow construction method means more disruption to community; • New alignment would need to be in the road pavement.
2	Slip Line retired Sewer Rising Main, located across the other side of the road	• Limited trenching of the road pavement required, less disruption to traffic; • Reuse of a decommissioned asset.	• Requires deviations in the alignment at each endpoint; • Large number of services would need to be transferred across the road; • Initial cost estimates indicated this would be approx. $40,000 more than Option 1 (cost of construction per metre similar, but cost to transfer services across the road high).
3	Do Nothing	• No upfront cost.	• OPEX costs will increase as main continues to fail; • Adverse impact on GVW Performance; • Potential Payments to residents for further disruptions; • Reduced customer satisfaction with reliability of service.

Construction phase

After the planning phase was completed, GVW commenced the construction phase. The majority of works were conducted by a Contractor, with GVW ensuring compliance and alignment with policies and procedures. For Cameron Avenue, the construction phase included:

1. Notifying customers that roadworks were to take place, and to expect traffic disruption;
2. Erecting signage and barricades (with a radius approximately 10 metres around the site);
3. Laying the new water main on the agreed alignment (using Horizontal Directional Drilling, HDD[8], method);
4. Swabbing and disinfecting the new main, taking water samples for lab testing of water quality;
5. Notifying customers that planned shutdowns were to take place (specifying date and time);
6. Undertaking connections and transfer property service connections to new main, and turn off old service connection at the old main;
7. Cutting out old main connection and install blank end gibbault to cap the connection to the AC main, which involved the following steps
    - Wear PPE
    - Prepare the plastic for disposal of the AC pipe
    - Excavate to the AC pipe
    - Wet down the AC pipe
    - Use non-powered tools to cut the asbestos pipe (reed cutters, chain cutters or hand saws)

[8] HDD involves drilling a horizontal pilot hole along the required path from one entrance point (rather than digging an entire trench), which is then enlarged to a size that will accommodate the pipe. The pipe can then be installed (see https://www.uea.com.au/technical-centre/trenchless-technology/horizontal-directional-boring/).

- Remove the section of pipe from the trench, including all off-cuts, residue, soil and any collected dust before disposal as asbestos waste
- Double wrap the AC pipe in plastic sheeting and collect small quantities
- Fully seal with duct tape and label the asbestos bag before transporting back to the depot, which is then transferred to an EPA approved Waste Disposal Site by an approved waste disposal contractor
- Dispose all disposable PPE in the same manner
- Wash down non-disposable PPE, tools and equipment

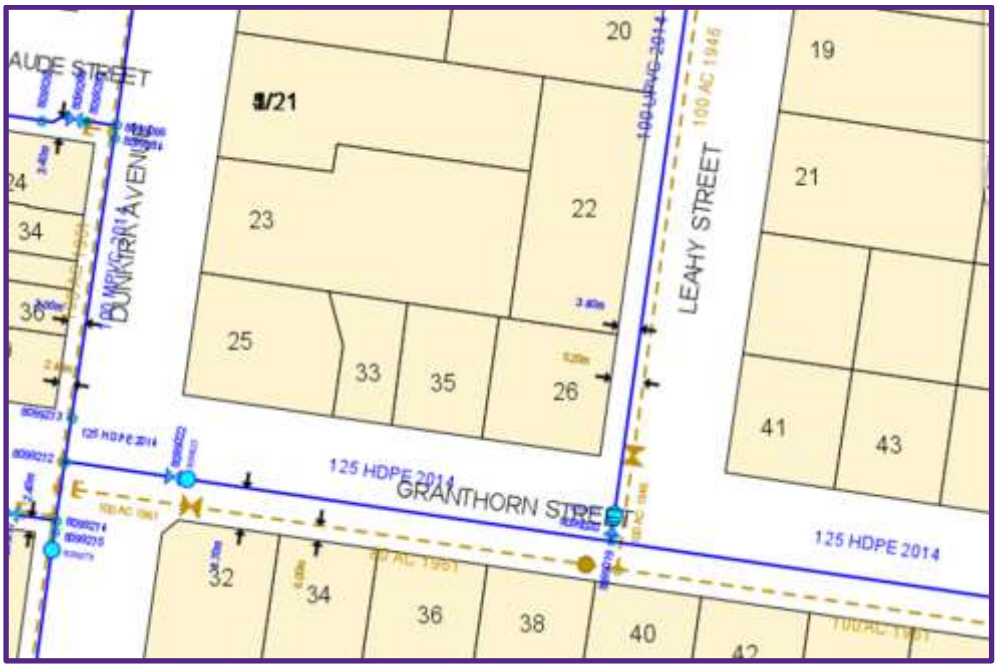
8. Remove the above ground assets (such as valves and hydrants); and
9. Clean up site and demobilise, undertaking reinstatement works as required.

Using the above method, the existing AC main was decommissioned and remains in-situ.

Post-construction phase

A representative from GVW attended the site with the contractor to review clean-up activities and ensure that all reinstatement works were completed to a satisfactory level. Information of the old main location is recorded on the GVW geographic information system (GIS). An example of the GIS snapshot of replaced water mains is provided in Figure 1.4 below.

Figure 1.4: An example of a GIS snapshot of a replaced water main (note the blue line is the replacement main, and the gold/brown dotted line is the old AC main)



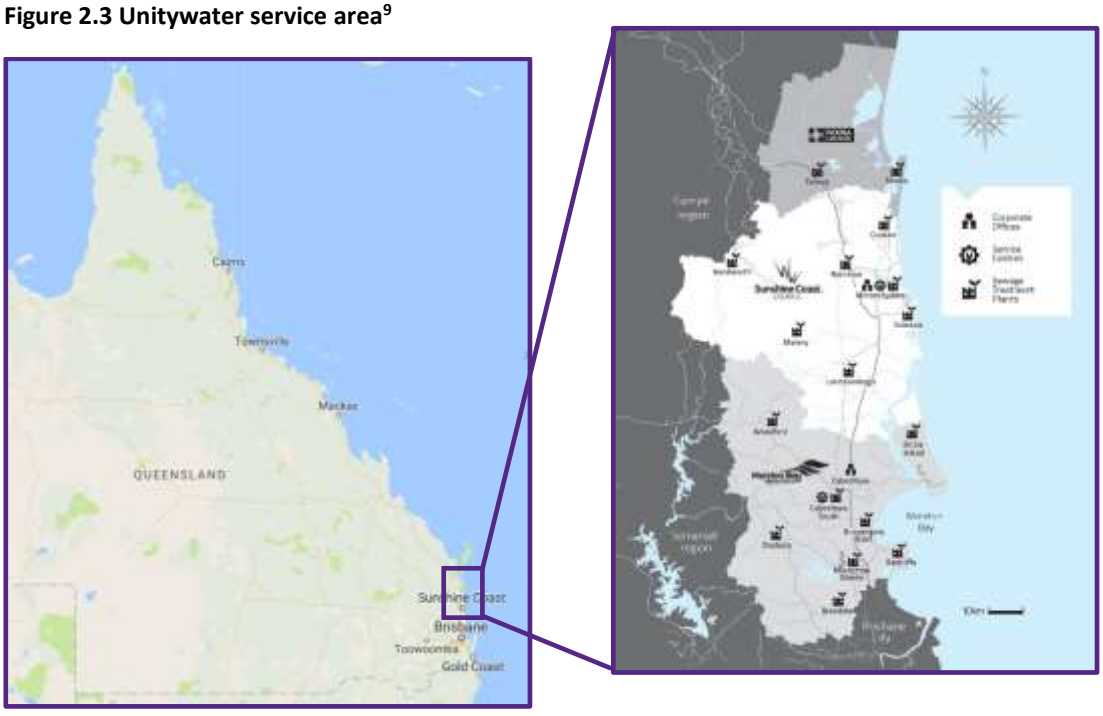
Unitywater Asbestos Management Program

Case Study 2 – Unitywater

Overview

Unitywater is a utilities provider servicing the Moreton Bay, Noosa and Sunshine Coast communities, which is one of the fastest growing regions in Australia. Unitywater provides water supply and sewerage services, including recycled water and trade waste disposal, to some 16% of Queensland's population. The areas of service for Unitywater are presented in Figure 2.1 below with key statistics show in Table 2.1.

Figure 2.3 Unitywater service area[9]



[9] Source: Unitywater website, http://www.unitywater.com.au/ and Google Maps (left image)

Table 2.1: Key information for Unitywater

Key information	Unitywater
Location	Unitywater operates across Moreton Bay, Noosa and Sunshine Coast Councils
Kilometres of pipe owned and managed by water company	5,836
Water pump stations	89
Sewage pump stations	781
Infrastructure and Asset value	Approx. $3.2 billion
Employees	708 FTE

Asbestos Management Practices

Unitywater operates with a clear framework for safe management of asbestos containing materials (ACM), mostly focused on asbestos water pipes across the network. Central to this framework is the Asbestos Management Procedure which seeks to ensure that all activities involving ACM are identified and controls are implemented to eliminate or minimise the risk of exposure to workers, visitors, public and others.

Where asbestos water pipes are damaged and require removal for upgrade or repair works, Unitywater has trained operatives that work within a Class B Asbestos Removal License through Work Health and Safety Queensland (WHSQ).

Asbestos removal methodology

Removal of asbestos water pipes is undertaken using the following methodology:

Step 1 – Complete a Risk Assessment

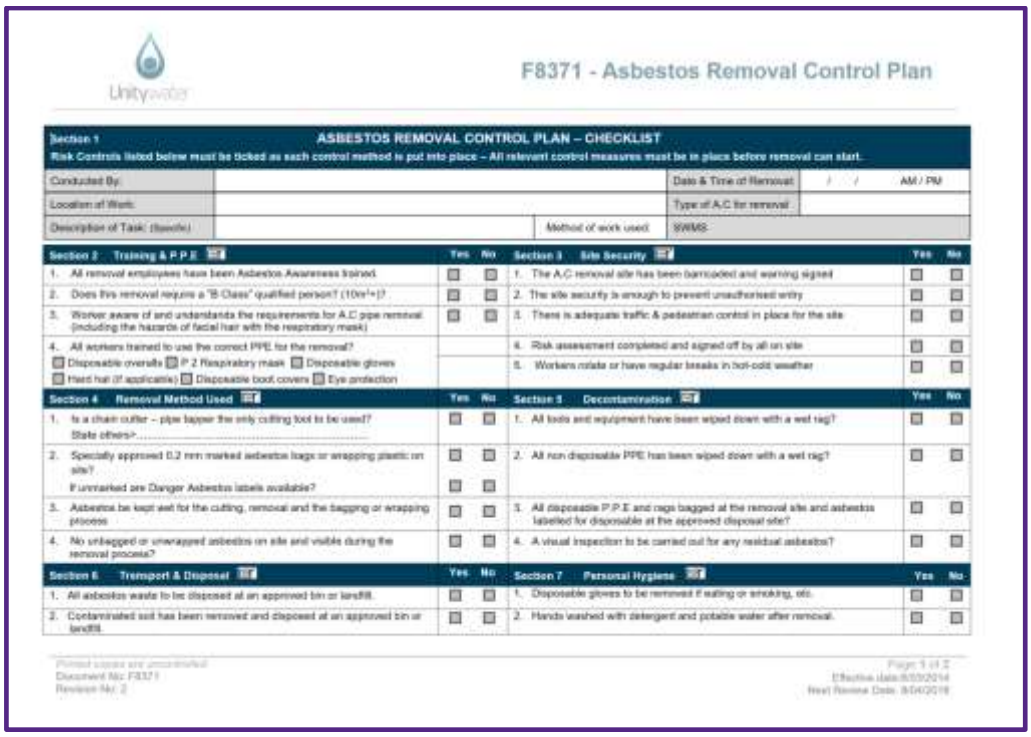
For each work task, a Person in Control of Work (PICOW) is appointed and is responsible for the workplace on site.

Prior to commencing any tasks involving the potential disturbance of ACM, an appropriate risk assessment must be completed and controls identified and implemented as per the Unitywater Hazard Management Procedure. The PICOW must ensure that all workers and visitors sign onto the risk assessment.

Step 2 – Complete an Asbestos Removal Plan

To guide the safe removal of asbestos cement water pipes, an Asbestos Removal Control Plan (ARCP) must be prepared. The ARCP outlines the required processes, personal protective equipment (PPE) and the planned removal methodology. Practices for decontamination and transport and disposal of ACM is also included in the ARCP. Figure 2.2 provides an overview of the ARCP and its requirements.

Figure 2.4: Unitywater service area[10]



F8371 - Asbestos Removal Control Plan

Section 1 — ASBESTOS REMOVAL CONTROL PLAN – CHECKLIST

Risk Controls listed below must be ticked as each control method is put into place – All relevant control measures must be in place before removal can start.

Conducted By:		Date & Time of Removal:	/ / AM / PM
Location of Work:		Type of A.C for removal:	
Description of Task: (Specific)		Method of work used:	SWMS

Section 2 Training & P P E	Yes	No	Section 3 Site Security	Yes	No
1. All removal employees have been Asbestos Awareness trained.	☐	☐	1. The A.C removal site has been barricaded and warning signed	☐	☐
2. Does this removal require a "B Class" qualified person? ($10m^2$+)?	☐	☐	2. The site security is enough to prevent unauthorised entry	☐	☐
3. Worker aware of and understands the requirements for A.C pipe removal (including the hazards of facial hair with the respiratory mask)	☐	☐	3. There is adequate traffic & pedestrian control in place for the site	☐	☐
4. All workers trained to use the correct PPE for the removal? ☐ Disposable overalls ☐ P 2 Respiratory mask ☐ Disposable gloves ☐ Hard hat (if applicable) ☐ Disposable boot covers ☐ Eye protection			4. Risk assessment completed and signed off by all on site	☐	☐
			5. Workers rotate or have regular breaks in hot-cold weather	☐	☐

Section 4 Removal Method Used	Yes	No	Section 5 Decontamination	Yes	No
1. Is a chain cutter – pipe tapper the only cutting tool to be used? State others>.....	☐	☐	1. All tools and equipment have been wiped down with a wet rag?	☐	☐
2. Specially approved 0.2 mm marked asbestos bags or wrapping plastic on site?	☐	☐	2. All non disposable PPE has been wiped down with a wet rag?	☐	☐
If unmarked are Danger Asbestos labels available?	☐	☐			
3. Asbestos be kept wet for the cutting, removal and the bagging or wrapping process	☐	☐	3. All disposable P.P.E and rags bagged at the removal site and asbestos labelled for disposable at the approved disposal site?	☐	☐
4. No unbagged or unwrapped asbestos on site and visible during the removal process?	☐	☐	4. A visual inspection to be carried out for any residual asbestos?	☐	☐

Section 6 Transport & Disposal	Yes	No	Section 7 Personal Hygiene	Yes	No
1. All asbestos waste to be disposed at an approved bin or landfill.	☐	☐	1. Disposable gloves to be removed if eating or smoking, etc.	☐	☐
2. Contaminated soil has been removed and disposed at an approved bin or landfill.	☐	☐	2. Hands washed with detergent and potable water after removal.	☐	☐

Printed copies are uncontrolled — Page 1 of 2
Document No: F8371 — Effective date: 6/03/2014
Revision No: 2 — Next Review Date: 6/04/2016

Step 3 – Review Safe Work Method Statements

Review or establish all relevant Safe Work Method Statements related to ACMs and the works being undertaken.

Step 4 – Personal protective equipment, barricading and equipment

The PICOW must ensure that suitable PPE is worn, including:

- Class P2 half face respirator
- Disposable coveralls (including for shoes and boots)

In addition, suitable barricading and equipment should be in place to remove the ACM, such as asbestos bags, warning signs, barrier tape and an asbestos vacuum cleaner.

Step 5 – Remove ACM

The ACM is then removed in accordance with the Unitywater Class B License requirements and related Safe Work Method Statements. Removal of asbestos may be carried out by Unitywater workers only if a worker has undertaken competency training or the task is being supervised by a person who has undertaken competency training.

Asbestos waste must be removed in whole pieces where possible and double wrapped in 0.2mm thick plastic bags and sealed with tape and adequately labelled.

Step 6 – Clean and Remediate the Worksite

At the completion of works, the site must be cleaned and remediated to ensure that any risks to the public are eliminated and controlled.

[10] Source: Unitywater website, http://www.unitywater.com.au/

Step 7 - Disposal and Transport of ACM and Asbestos Waste

Asbestos waste must be disposed of and transported in accordance with Unitywater license requirements and relevant environmental and Work Health and Safety legislation.

Clearance Inspections

Where required, an independent competent person is engaged to carry out a clearance inspection for class B asbestos removal work. The results are recorded on the Unitywater Asbestos Site Clearance Form and retained in the job folder.

A competent person can be from the business that carried out the class B asbestos removal work, provided the competent person was not involved in the removal of the asbestos. The competent person must not issue a clearance certificate unless satisfied that the asbestos removal area and the area immediately surrounding it are free from visible asbestos contamination.

Air Clearance Monitoring

Where required under the ARCP, workplace airborne respirable fibre monitoring is conducted by an independent competent person who issues an Air Clearance Certificate when they are satisfied the area is clear.

Other approaches to managing ACM

In some instances, it is not practicable to remove ACM, for example in low risk areas where ACMs are in good condition and can be appropriately managed in-situ.

Where it is not practicable to remove asbestos, Unitywater's preferred alternative control measure is enclosure. This requires the creation of an airtight barrier around the asbestos which is subsequently documented in the Asbestos Management Plan.

If the asbestos cannot be removed or enclosed, encapsulation or sealing is the next appropriate control measure utilized by Unitywater, considering a range of issues including productivity, the condition of the asbestos, the risk it poses to health and cost. Unitywater treats encapsulation as an interim control measure which is supported through regular inspections by a competent person to identify if the asbestos requires removal due to damage or deterioration.


Safe work practices
Working with asbestos
FACT SHEET

Communications

Communication is an essential element of asbestos management practices at Unitywater. To keep the community informed about the management of asbestos water pipes, Unitywater developed a 'Working with Asbestos' Fact Sheet as an engagement tool.

The fact sheet provides relevant information and contact details to ensure that the community understands the protocols and practices being put in place.

Case Study – Sewer relining program

Unitywater invests in an ongoing sewer relining program that aims to extend the life of Sunshine Coast and Moreton Bay sewerage infrastructure. The pipe network consists of various material types, including polyvinyl chloride, vitrified clay or earthen ware, concrete and asbestos cement.

To reduce costs and lessen the impact of invasive works, Unitywater is using 'trenchless technology' to renew the life of the sewer network. The process involves the use of market leading technology to reline aging pipes to increase their structural integrity and reduce the risk of cracking and breakage.

In the first instance, cameras are used to assess the sewer network, identifying areas of degradation that are subsequently targeted for relining.

Figure 2.3: Manholes showing signs of deterioration being repaired. A special coating is applied to restore them to original condition.

The remediation work is then undertaken across two phases. Firstly, manholes showing signs of deterioration are sprayed with a special coating that looks to restore them to their prior level of performance. This technique can be done directly into the manhole without the need for excavation and removal. Figure 2.3 shows a manhole being repaired using the relining technology.

Secondly, pipe areas targeted through the camera investigation are repaired using innovative trenchless relining techniques to correct faults, rather than being replaced. This is a 'no-dig' and cost-effective way of renewing the pipe. In most cases, the new pipes are formed on site by taking a continuous strip of profile and spirally winding it inside the damaged pipe, forming a new, water-tight structural pipe within the host pipe (see Figure 2.4).

Figure 2.3: Pipes being repaired via trenchless technology

"Using Trenchless Technology, this no-dig, cost-saving pipe renewal process will help prolong the life of our sewer network, defer the need for expensive infrastructure upgrades and minimise any inconvenience to our customers.

"Relining pipes and rehabilitating manholes also helps protect the environment and public health by reducing the amount of groundwater infiltration entering the sewer via pipeline cracks or faulty joints, allowing us to better manage sewage flows, especially in times of extreme wet weather." – Unitywater Manager Network Projects, Ashley Massie.

South East Water – Management of AC pipes

Case Study 3 – South East Water

Overview

South East Water (SE Water) provides water to residents and businesses in a large region south-east of Melbourne in Victoria. SE Water owns and manages over 24,000 kilometres of pipeline, spread across an area of approximately 3,600 square kilometres (see Table 3.1).

Asbestos Cement Pipes in SE Water

SE Water has around 1,600 kilometres of asbestos cement (AC) pipe remaining in its network, which constitutes around 7% of its entire pipeline by length. In recent years, some 400 kilometres of AC water mains have been removed due to breakage and pipe degradation or through scheduled upgrade works. These AC mains were installed between the 1920s and 1970s, and they make up around 4% of the estimated 40,000 kilometres of AC pipeline in Australia[11].

Table 3.1: Key information from SE Water

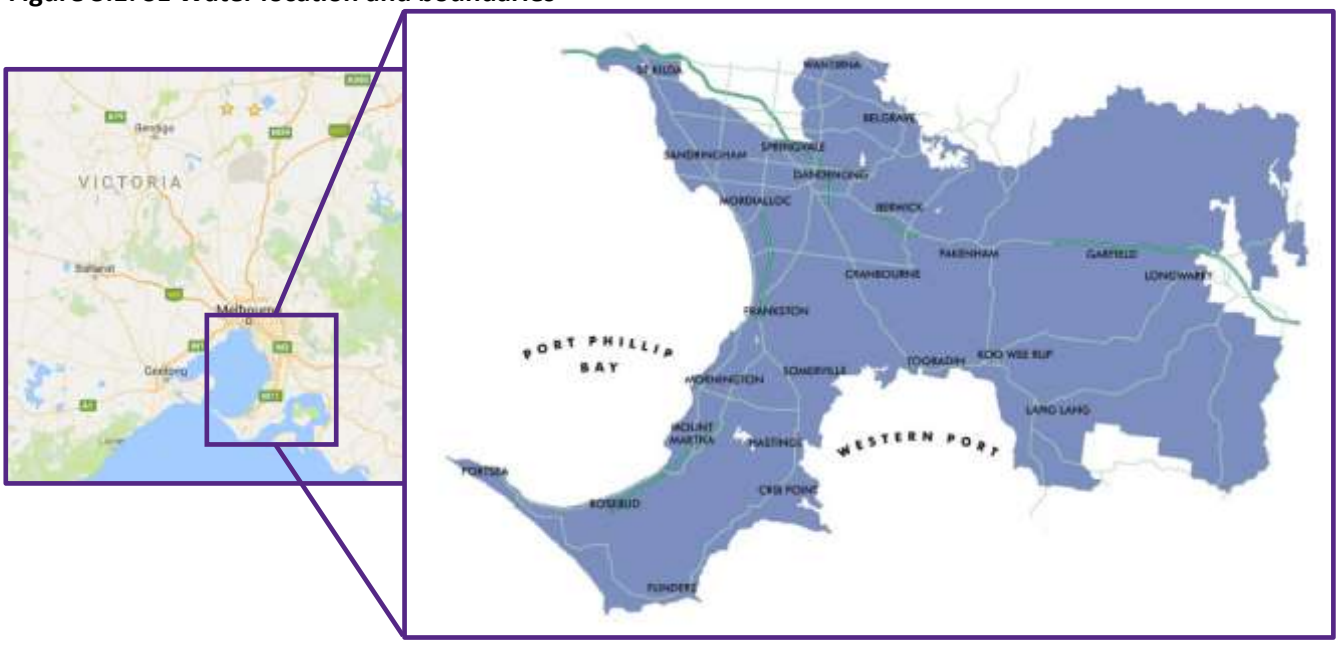
Key information	SE Water Overall
Location and service area	3,640 km^2 south east of Melbourne (head office Frankston, Victoria)
Kilometres of pipe owned and managed by SE Water	24,700
Pump stations	352
Recycling plants	8
Infrastructure and Asset value	Approx. $4 billion
Employees	598 FTE

[11] WSAA INVESTIGATION REPORT: Management of Asbestos Cement Pipes, April 2013

Location and boundaries

SE Water services a large area of Melbourne, along the east coast of Port Phillip Bay to south of the CBD and inland as far as Longwarry, taking in Western Port and surrounds. The service areas of SE Water and its boundaries are captured in Figure 3.1 below.

Figure 3.1: SE Water location and boundaries



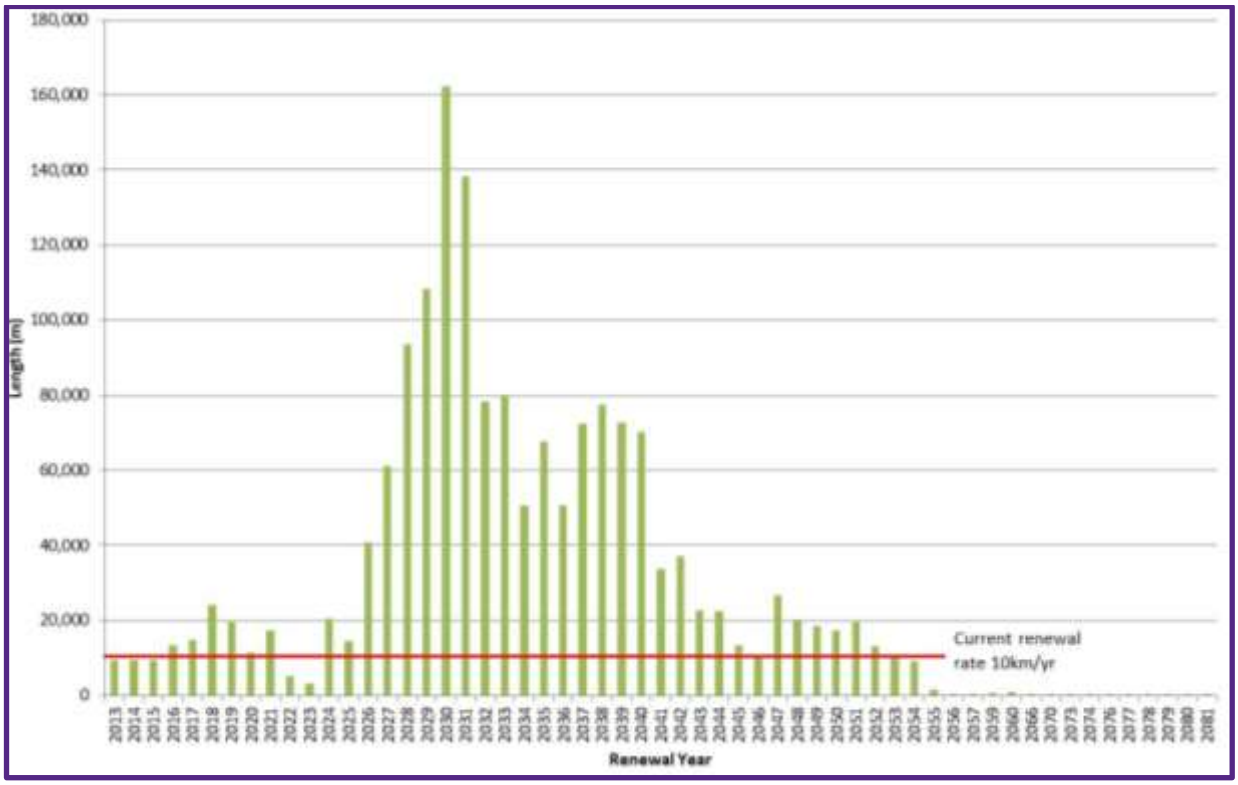
Asbestos Cement Pipes Renewal

Managing asbestos cement pipes in SE Water

SE Water is currently renewing around 10 kilometres of AC pipes per annum, which aligns with current pipe failure rates. However, projection modelling which extrapolates pipe failures into the future suggests that this figure is likely to rise significantly in future. The modelling indicates the AC pipe failure is likely to increase significantly from around 2026 to a peak of around 160km per annum by 2030. It is likely that renewal rates will remain significantly higher than the current rate through to around 2053. The projected peak, which is around 16 times higher than the current renewal rate, is likely to constitute a considerable cost to the business. The AC pipe renewal projection data is captured in Figure 3.2.

SE Water is taking a long-term strategic approach to ensure efficient and cost-effective management of failing AC pipes. This includes considering the available options for AC water pipe management, associated costs, legislative requirements and exploring alternative options and indicative costs through research. In 2016, SE Water developed its *Strategy for Renewal of Asbestos Cement Water Mains*, which summarises these actions.

Figure 3.2: Estimated Failure Profiles for AC water mains in SE Water



SE Water Asbestos Cement Pipes Strategy

SE Water has an overall objective to become a leader in AC rehabilitation techniques to ensure that their customers and the broader water industry deliver the optimal response in respect to these assets. To support this objective, SE Water developed a *Strategy for Renewal of Asbestos Cement Water Mains* ("Strategy"), which discusses a range of areas, summarised below.

Conventional AC water pipe renewal techniques adopted by SE Water

There are a number of conventional renewal techniques that SE Water has trialled in the past including methods such as pipe bursting and pipe realignment approaches. The techniques applied by SE Water include:

- *Slip-lining* where a smaller pipe is inserted into the AC main.
- *Pipe cracking/bursting* which involves a cracking head which is pulled through the host AC water main with a new high density polyethylene (HDPE) pipe attached. This technique has the advantage of not undertaking any surface reinstatement, reducing the inconvenience to the community. Prior to 2015, SE Water had renewed approx. 150 kilometres of AC pipe using this technique.
- *Realign and leave* where a new pipe is constructed on a new alignment and the AC main is left in situ. Prior to 2015, SE Water had renewed approx. 250 kilometres of AC pipe using this technique.
- *Lift and relay* where the AC main is removed and a new pipe is laid in the same trench.

Cost comparison of conventional AC water pipe renewal techniques

SE Water compared costs for three of the four above techniques (pipe cracking/bursting, realign and leave, and lift and relay). As can be seen in Table 3.2, the lift and relay approach shows higher cost compared to the other techniques. This is due to increased time on-site, the use of heavy machinery for significant excavation and the level of exposure to asbestos (handling, disposal, WorkSafe practices). However, the benefit of this method is the complete removal of asbestos from the ground.

Table 3.2: AC Pipe renewal techniques and associated costs[12]

Technique	Estimated cost for SE Water (next 5 years) [13]
Pipe cracking/bursting	Approx. $11 million
Realign and leave	Approx. $14 million
Lift and relay	Approx. $21 million (note that this also takes twice as long as the alternative methods)

Changes in the regulatory context

Until 2015, many water authorities including SE Water used the pipe cracking/bursting technique as a key part of their AC pipe renewal program. This approach was favoured not only for the lower upfront cost but it avoids the need to excavate large areas, thus reducing the overall inconvenience to the community. In March 2015, WorkSafe Victoria issued new guidelines that require any asbestos waste created by pipeline replacement, including fragments generated by pipe bursting techniques, must be removed and disposed of in accordance with occupational health and safety regulations[14].

Essentially a clarification of the national Occupational Health and Safety Regulations (2007), the new guidelines mean that pipe cracking/bursting techniques are no longer acceptable in Victoria given asbestos pipe fragments are left in the ground.

Current approach adopted by SE Water

In response to the release of WorkSafe Victoria's guidelines in March 2015, SE Water now favours the 'realign and leave' technique (often referred to as "by-passing")[15]. This was decided after consideration of the risks and benefits associated with each technique, OHS requirements and approval by the SE Water Board. There is an expectation that SE Water will continue extensive customer engagement as well as exploring emerging alternatives (see next section). Figure 3.3 shows SE Water conducting pipe renewal using the realign and leave technique.

According to SE Water, a risk assessment was undertaken which confirmed that this was currently the appropriate course of action rather than a lift and relay approach. SE Water noted that although the latter approach eliminates the risk in the long term, it significantly increases the cost of renewal in the order of 100% in the short term.

[12] Sourced from SE Water's Asbestos cement mains – renewals strategy, items for discussion for meeting with the Board

[13] Note these are estimations only. For example, Realign and leave costs are difficult to measure as they are site specific.

[14] From http://www.premier.vic.gov.au/new-asbestos-guidelines-to-protect-workers/

[15] Whilst this technique is recognised by WorkSafe Victoria as acceptable, any broken or fragmented pieces of asbestos must be dealt with as asbestos waste in accordance with the regulations

Figure 3.3: SE Water using the realign and leave technique for pipe renewal

Consideration of alternatives

SE Water's strategic approach to AC water pipe renewal includes consideration of new and emerging techniques that may be safer and more cost effective. These are outlined below (and presented in Figure 3.4):

- Non-Structural liners, where an organic polymer is sprayed on the internal pipe wall. This can span gaps and prevent leakage.
- Semi-Structural Spray on linings, which is a thicker layer of organic polymer that provides some structural properties.
- Cured in place semi-structural liners, where an inflated hose is placed in the pipe and cured or sealed in place using steam/hot air.
- Cured in place structural liners, which is the same as the cured in place semi-structural liners but the lining is reinforced with fibreglass to provide structural strength (the liner does not rely on the host pipe)[16].

Figure 3.4: Example AC pipe renewal techniques that have been considered (left image is exhumed cured in place samples that were extracted to be laboratory tested, right is cured in place break test apparatus being tested)

[16] Comparison of techniques sourced from the *Strategy for Renewal of Asbestos Cement Water Mains, South East Water, 2016*

According to SE Water, key advantages of these techniques over conventional techniques include:

- host pipe remains intact;
- significant reduction in leakage from the host pipe;
- reduction of internal corrosion;
- same day return to service (in the case of spray lining techniques);
- minimal reduction in hydraulic capacity.

There are also risks that need to be considered with these new techniques, such as:

- There are currently no commonly accepted standard or testing requirements that would allow a water authority to have confidence in the expected useful service life of liner;
- There is uncertainty over the longevity of these products;
- Current testing is limited as laboratories are reluctant to handle asbestos;
- There is a lack of established markets in Australia for these products, which means there are limited experienced contractors available and high costs for installation.

In addition to the risks and drawbacks highlighted by SE Water, these techniques all leave the AC pipe in the ground, which presents potential issues for removal of these pipes for future generations and projects that require excavation of these pipes.

Future actions for SE Water

Based on the high level of uncertainty with the new products, the realign and leave technique continues to be adopted by SE Water. SE Water believes that further research is needed in the industry to enable 1) a better understanding of deterioration rates and future renewal requirements for AC pipes, 2) a more comprehensive evaluation method of all AC pipe renewal options, 3) quantification of risk exposure during rehabilitation works and future community risks, and 4) decision support tools for AC pipe rehabilitation. SE Water continues to implement its own further research and development programs, which include the following elements:

- **Material Testing** with a local university to assess the feasibility of developing a testing facility for AC pipes and associated rehabilitation products.
- **Industry collaboration** with the Water Services Association of Australia (WSAA) and industry to develop a product specification for lining products for use with AC pipes that can be used to evaluate lining products.
- **Improve pipe network understanding,** where SE Water will undertake studies to understand where sufficient hydraulic capacity may be available to allow slip-lining of AC pipe to occur.
- **Knowledge building**, from an international context, through attending relevant conferences from across the globe and reviewing international research in this space.

"SE Water is taking a strategic and evidence-based approach to managing the upcoming significant increase in AC pipe failures."

SE Water

Water Corporation: Asbestos Management Framework

Case Study 4 – Water Corporation

Overview

Water Corporation is the principal supplier of water, wastewater and drainage services in Western Australia. Their services span over 2.6 million square kilometres, encompassing the entire state. Water Corporation owns and manages almost 35,000 km of pipeline and has approximately 2,500 employees. Table 4.1 provides an overview of key organisational data.

This case study covers Water Corporation's general approach to asbestos pipe management, which involves ongoing data collection and registration of asbestos pipes, assessment of risk and subsequent prioritisation of pipe renewal.

Table 4.1: Water Corporation key information[17]

Key information	Water Corporation data
Location	Water Corporation covers all of Western Australia, approx. 2.6 million km^2
Kilometres of pipe owned and managed by water company	34,680 km
Pumping stations	1,151
Wastewater treatment plants	112
Infrastructure, plant and equipment value	Approx. $15 billion
Employees	Approx. 2,500

[17] Data sourced from https://www.watercorporation.com.au/about-us/the-way-we-work?pid=res-au-np-www and the Water Corporation 2016 Annual Report, https://www.watercorporation.com.au/-/media/files/about-us/our-performance/annual-report-2016/final-annual-report-sept-2016.pdf

Managing asbestos pipes at Water Corporation

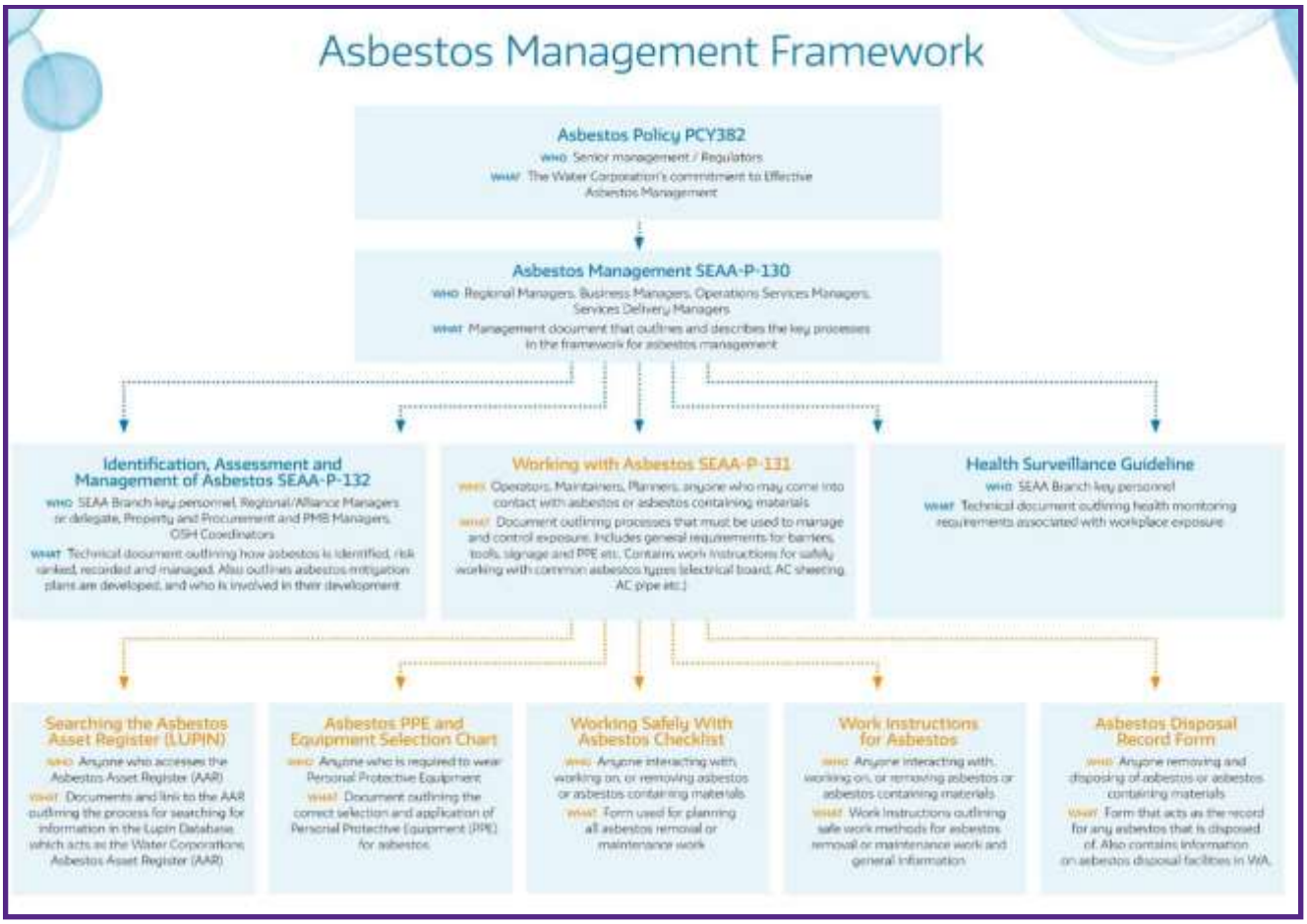
Asbestos Pipes at Water Corporation

Water Corporation owns and manages many assets, some of which are constructed with asbestos containing materials (ACMs). Among its assets are almost 35,000 kilometres of water pipes, including asbestos pipes. Common types of asbestos pipes at Water Corporation include bituminous wrapped pipes that contain asbestos in the sprayed/ wrapped lining, and asbestos cement (AC) pipes.

The Asbestos Management Framework

To improve safety around asbestos management and removal, the organisation recently updated its Asbestos Management Framework. This framework guides the organisation's approach to asbestos management of all its assets, including asbestos water pipes, and it was developed to ensure the risks associated with asbestos are well managed and widely understood. The Asbestos Management Framework is highlighted in Figure 4.1 below, which shows that the Asbestos Policy sits at the top and drives all other documents and decisions.

Figure 4.1: Water Corporation's Asbestos Management Framework



Identification and Assessment of Asbestos Pipes

A *State-Wide Inspection Program* at Water Corporation has been established to conduct inspections in assets commissioned prior to the Australian prohibition date of 31 December 2003, to identify the presence of asbestos. Water Corporation is undertaking an ongoing inspection program where it identifies and tracks asbestos assets, and decides how best to manage these and the priority of removal.

All asbestos pipes that are identified are updated on the asbestos register accordingly. When the asbestos pipe is identified, Water Corporation conducts a risk assessment to establish a course of action to managing and removing the asbestos pipe. This is based on the identified *material's potential to release fibres* and the *likelihood of disturbance*. These scores are combined to provide a risk ranking. The risk ranking determines the appropriate management controls that Water Corporation will implement until the asbestos pipe is removed or renewed. High risk ranking pipes will have controls implemented immediately, and be prioritised for renewal.

Renewing the asbestos pipe

Water Corporation's *Working with Asbestos* policy outlines the management and removal process for all ACM on or in the company's assets. This includes AC pipes and bitumen coated steel pipes (see Figure 4.1). This document indicates that these pipes "should be removed from the ground when decommissioned unless operational or safety constraints would it [sic] unfeasible". If asbestos pipes are left in the ground, this is tracked through data management programs such as LiteSpatial and MyWorld.

Figure 4.1: Common asbestos pipes found at Water Corporation (left image - AC Pipe Exterior of Compound in Karratha, right image – asbestos bitumen coated pipe in Karrinyup

Removal processes

Within Water Corporation's Asbestos Management Framework, the broad process for removing asbestos across the network includes:

1. Planning the work, including a risk assessment, determining asbestos licences required and the work method (complete removal of asbestos pipe, removal of asbestos spray lining only, wet or dry[18] removal etc);

[18] Wet removal involves using water on the asbestos or ACM to bind and suppress the fibres to decrease their potential of becoming airborne. Dry removal is used when it is unsafe to use water.

2. Undertaking the asbestos pipe removal work, which at Water Corporation may include either complete removal, or removing the asbestos spray lining only. These methods are covered below.
    a. Complete removal of asbestos pipe steps and considerations:
        i. Installing asbestos signs and/or barricades;
        ii. If removing buried asbestos pipe, workers must take care when uncovering the pipe to expose the repair section. Once exposed, manual excavation is recommended, as this minimises risk of damage to the pipe;
        iii. If cutting the asbestos pipe, workers must thoroughly wet area before cutting starts and during cutting, ensuring it remains wet at all times;
        iv. Only use non-powered hand tools;
        v. If removing buried asbestos pipe, workers must remove the entire section of the pipe from the trench including all off-cuts, residue, soil and any collected dust, before disposal as asbestos waste;
        vi. The ACM is double-wrapped in plastic sheeting, fully sealed with duct tape and labelled. Water Corporation has asbestos disposal bags for the asbestos pipe (see Figure 4.2);
        vii. Exposed edges of the asbestos pipe are painted with a water based paint, or a PVA based adhesive.
    b. Removal of asbestos sprayed lining on pipe, steps and considerations:
        i. For asbestos coated pipes, workers must place a plastic drop sheet under the pipe to collect the loose pieces of stripped coating (large enough to contain all the material);
        ii. They then mark or score the area on the pipe to be removed with a utility knife or shrouded brick chisel;
        iii. Again, the material must be wet for removal (unless this is deemed unsafe);
        iv. Use manual tools (hammer, chisel, wire brush) to chip or break away the wrapping between scored sections;
        v. Wet all the materials on the drop sheet, and tightly wrap up stripped coating material by folding sheeting inwards.
        vi. Place sheeting in asbestos waste bag (0.2mm thick plastic bag) and seal bag securely with tape. All waste to be double bagged;
        vii. Place all waste contained within the thick plastic bag into a drum and seal the drum, storing away from interference from personnel and site activities;
        viii. Paint any exposed edges of the wrapping with water based paint[19].

For both options, appropriate PPE is worn at all times.

As can be seen above, in most cases, Water Corporation will either remove the asbestos pipe through manual excavation and use of non-powered hand tools to cut the pipe at each end, or chisel off the asbestos coating from the pipe.

[19] Note – when Water Corporation's procedure was developed, the final procedure for the management, transport, storage and treatment/disposal of these wastes was not determined

Figure 4.2: Equipment used by Water Corporation for asbestos removal (left image – disposal sheets (200 nm) or bags, right image – duct tape used to seal bags/wrapping

Figure 4.3: Coal tar or bituminous wrapped pipe pieces (on Water Corporation's assets, these may contain asbestos and as such is treated as though it contains asbestos)

"With the ongoing collection of data in asbestos related assets and updating of processes we ensure the safety of our workers, leaving no unacceptable legacy contaminated sites as per our guidelines."

Water Corporation

Barwon Water Asbestos Pipe

Case Study 5 – Barwon Water

Overview

Barwon Water provides water, recycled water and sewerage services to almost 300,000 residents across an area of 8,000 square kilometres in Victoria (see Table 5.1 and Figure 5.1). The organisation has approximately 300 employees and owns and operates around 6,600 kilometres of pipes, including approximately 1,270 kilometres of asbestos cement pipes[20]. Barwon Water replaces around 20 kilometres of asbestos cement (AC) water pipes each year at an annual cost of approximately $4 million (approximately $200 per metre[21]).

This case study outlines Barwon Water's approach to maintenance and repair work on AC and mild steel cement lined pipes. Barwon Water currently outsources these maintenance services, and strict processes are followed to ensure safety of staff, surrounding businesses and residents.

Table 5.1: Key information from Barwon Water[22]

Key information	Barwon Water Data
Location and service area	8,100 km^2 in Victoria, 75 km south west of Melbourne
Kilometres of pipe owned and managed by Barwon Water	6,633
Pump stations	243
Recycled water, treatment, pre-treatment, and reclamation plants	23
Infrastructure and Asset value	Approx. $2.3 billion
Employees	Approx. 300

[20] Sourced from Geelong Advertiser

[21] Sourced from https://www.barwonwater.vic.gov.au/projects/water-mains-replacements

[22] Sourced from https://www.barwonwater.vic.gov.au/about/about

Location and boundaries

Barwon Water services an area of some 8,100km^2 in and around Geelong, approximately 75 kilometres south west of Melbourne. The service area boundaries are captured in Figure 5.1 below.

Figure 5.1: Barwon Water location and boundaries[23]

Asbestos Cement Pipe Maintenance at Barwon Water

At Barwon Water, it is assumed that all mild steel cement lined (MSCL) pipes installed from 1954 to 1982 are wrapped in asbestos type lining, until proven otherwise. As such, the 1,270 kilometres of asbestos cement pipes at Barwon Water include both AC pipes and in some cases, MSCL pipes.

Maintenance and renewal of these asbestos pipes as they burst or crack is an ongoing and important task. When asbestos water pipes fail, Barwon Water generally follows the 'remove and replace' method for asbestos pipe maintenance, which involves removing the section of pipe with asbestos, disposing this to a licenced landfill, and replacing the pipe with a non-asbestos section of water pipe. This removal approach is guided by an Asbestos Handling Policy, and involves early planning and consideration of risk prior to commencing the works, as outlined on the following pages.

[23] Sourced from https://www.barwonwater.vic.gov.au/about/about

Asbestos Handling Policy at Barwon Water – overarching principles and key requirements

The Asbestos Handling Policy provides a framework to ensure that risks associated with asbestos pipe management are removed or reduced. The overarching principles and key requirements from the Asbestos Handling Policy include:

- **Training**
    - Anyone required to cut or handle asbestos cement products and asbestos wrapping must receive appropriate training in respect of the hazards and risks associated with asbestos, in accordance with Occupational Health and Safety (OHS) Regulations.
- **Licences**
    - Occupational Health and Safety Regulations require the asbestos removalist to hold a Class B (Specific) licence for the removal of non-friable asbestos.
    - If the asbestos wrapping is partially or fully deteriorated when uncovered, the asbestos is deemed as friable. Friable asbestos must be removed by a Class A removalist.
- **Personal Protective Equipment (PPE)**
    - The operator and anyone assisting with the cutting or in the vicinity of the cutting operation must (see Figure 5.2 for further details):
        - Wear appropriate respiratory protective equipment, protective clothing and/or safety equipment.
        - Wear approved waterproof trousers, waterproof jackets, shower cap, or disposable overalls, rubber boots and rubber gloves taped to the outside of the jacket / overalls.
        - Wear a respirator fitted with an approved respiratory P2 Filter.

Figure 5.2: PPE that employees and contractors must wear when cutting or in the vicinity of cutting asbestos pipes (including the special requirements)

Special requirements:

- P2 Mask Respirator - Fit check before use.
- Disposable overalls - tight cuffs (or taped to gloves and boots) and fitted with hood. Legs of overalls must be outside of gum boots.
- Nylex gloves
- Safety glasses
- Safety signage

Asbestos Removal - preparation

Barwon Water and its contractors take a planned and considered approach to asbestos removal. Prior to removal, the following steps are taken.

1. Audit site, assess risk and complete an Asbestos Management Plan and Control Plan;
2. Notify WorkSafe Victoria (using a Notification of Asbestos Removal form)
    a. For works less than $10m^2$ (about 18 lm of 150mm pipe), Barwon Water or the contractor notify WorkSafe Victoria at least 24 hours prior to works commencing.
    b. For removals in excess of $10m^2$, WorkSafe Victoria is notified at least 5 days prior to works commencing.
3. Complete a Safe Work Method Statement;
4. If work is near a business or businesses, send them an asbestos notification card;
5. Prepare for removal
    a. Pipes are replaced from fitting to fitting, gibault to gibault or socket-to-socket where possible. For all pipes up to and including 150mm diameter, gibaults must be pre-rasped (reamed).
    b. Pipes are to be exposed using a backhoe hydro excavation or hand tools. The damaged pipe can be lifted to the surface using the backhoe or manually.

Asbestos Removal Procedure

After the preparation phase, the asbestos removal commences. The removal process is tailored to the type of pipe being removed, for example an AC main, or a MSCL pipe. Both processes are outlined below.

AC Main Pipe Removal

1. Wear appropriate PPE (see Figure 5.2);
2. Excavate to the depth of pipe, expose length of pipe using hand dig methods;
3. Barricade area;
4. Where pipes must be cut, the removalists use a hand saw or chain cutters. If unable to cut, removalists place a wet rag around the collar, wet the area down and hit the collar with a mash hammer and chisel away the collar. Power tools are never used;
5. All cutting operations (including, grinding, bevelling, shaping, rasping and filing) on asbestos-cement materials must be kept continuously wetted down at the leading edge of the cutting tool, and at any other point where dust could be formed, to effectively suppress any dust. Sawing and grinding is only undertaken when it is not practicable to use other cutting operations;
6. Replace the pipe;
7. Wash down tools, equipment and PPE (if for re-use);
8. When complete, place PPE in AC disposal bag (see Figure 5.3 below), which is taken to a licenced landfill.

Figure 5.3: AC disposal bag, goose necked and sealed

MSCL pipe removal

1. The pipe is taken out of the ground and removalists coat the area on the pipe to be removed with a mix of water/PVA or water based paint;
2. They then barricade the area and place a 200 micron sheet or bag under section of the pipe to be removed to capture waste as it is chipped away from the pipe;
3. The asbestos is then removed by chipping it away using a hammer and chisel (see Figure 5.4). If the wrapping is not totally removed from the pipe, the area is rasped to ensure all wrapping material is removed;

Figure 5.4: The hammer and chisel method used to remove asbestos from MSCL pipes

4. The Class A removalist must ensure air monitoring occurs and the results are available to employees at the workplace. On the completion of any cutting operation, all equipment, overalls and boots must be thoroughly washed down;
5. Clean up and disposal
    a. All major sections of pipe and asbestos wrapping, any disposable protective apparel and respirators / filters are placed in heavy duty (200 micron) polyethylene plastic wrapping, with small amounts of broken pipe and asbestos wrapping cleared from the trench and added to the bags,
    b. These are disposed at a licensed landfill.

Figure 5.5: Asbestos pipe removalists undertaking removal works

After removal

After the removal of AC pipe or MSCL asbestos pipe, asbestos supervisors conduct random site inspections of 10% of the completed jobs to validate that the work is being carried out in accordance with this procedure.

Important considerations for water companies
Barwon Water ensures its contractors follow strict safety measures when removing asbestos cement pipes, and there is follow up to ensure the work is carried out in accordance with policies and procedures.

Central Highlands

Case Study 6 – Central Highlands Water

Overview

Central Highlands Water is a Victorian regional water corporation that provides drinking water, sewerage, trade waste and recycled water services to more than 140,000 customers in Ballarat and the surrounding towns. It services over 9,000 square kilometres, and owns and manages almost 4,000 kilometres of pipe of which approximately 1,600 kilometres are AC mains (see Table 6.1).

This case study discusses Central Highlands Water's approach to removing asbestos cement pipes, which is dependent on the state of the pipe. If cracked, the works are outsourced to a licenced asbestos Class A removalist and if the pipe is not cracked, a Class B removalist employed by Central Highlands Water removes the pipe. This approach minimises risk and costs for Central Highlands Water, and further details are provided in the following pages.

Table 6.1: Key information from Central Highlands Water[24]

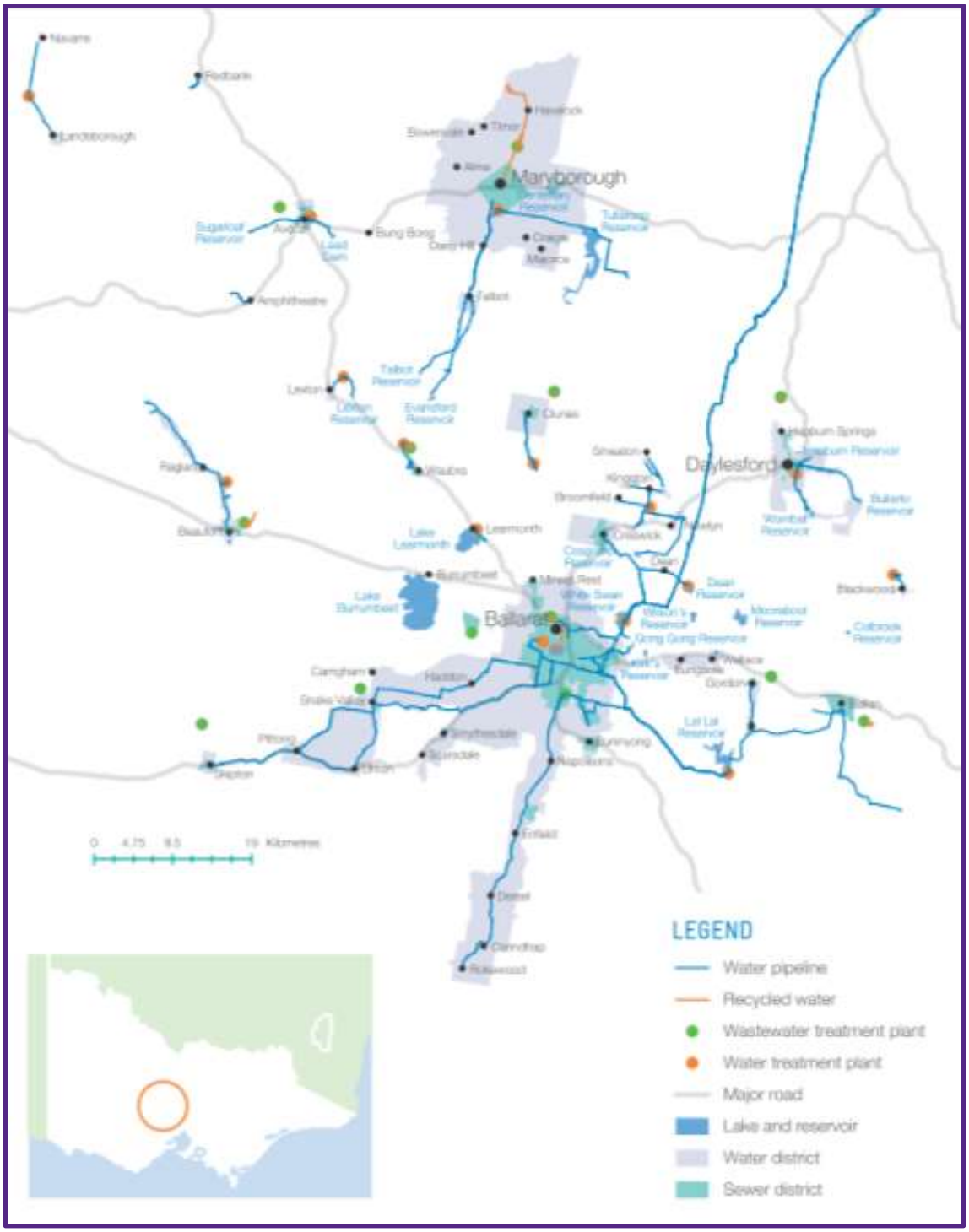
Key information	Central Highlands Water Data
Location and service area	9,275 km^2 north west of Melbourne
Kilometres of pipe owned and managed by Central Highlands Water	2,483 + 1,393 sewer mains (1,620 are AC mains)
Pump stations	41
Water and wastewater treatment plants	28
Infrastructure and Asset value	Approx. $1.1 billon
Employees	Approx. 180

[24] Sourced from http://www.chw.net.au/about-us/our-organisation

Location and boundaries

Figure 6.1 below includes the area serviced by Central Highlands Water.

Figure 6.1: Central Highlands Water location and boundaries[25]



[25] Sourced from 2015-16 Annual Report, Central Highlands Water, http://www.chw.net.au/sites/default/files/documents/20152016annualreportfinal.pdf

Asbestos Cement Pipe Maintenance at Central Highlands Water

Previous approach

Prior to its current approach to pipe removal, Central Highlands Water was replacing asbestos cement pipes using the 'pipe bursting' technique and leaving fragments in the ground. However, in 2015, the Victorian Government clarified that asbestos fragments left in the ground after pipe bursting classified as asbestos waste and as a result these required removal and disposal. Based on this clarification, Central Highlands Water transitioned to its current asbestos removal methods.

Current approaches

Central Highlands Water currently has two approaches for removing asbestos pipes. Both methods follow the 'excavate and remove' strategy, but the specific approach depends on the nature of the pipe. If an AC pipe cracks, Central Highlands Water assumes that the removal process will involve friable asbestos. In response, a Class A licenced contractor is engaged to remove the pipe. If the AC pipe is not cracked, the asbestos is bonded (or non-friable) and can be managed internally by the appropriately trained and licenced Central Highlands Water staff. Further details on these two approaches are provided below.

Approach One – A non-cracked AC pipe

Appropriately trained Central Highlands Water staff undertake the removal of a non-cracked AC pipe. Training covers the hazards associated with asbestos in accordance with the Regulations, and for a staff member to conduct the removal, training must have occurred within the past two years. Mandatory requirements for the removal of non-cracked AC pipe includes:

- Completion of a job safety and environment analysis (JSEA), which includes an outline of the necessary Personal Protective Equipment (PPE);
- Handling, transport and disposal carried out in accordance with EP regulations;
- Notifying adjoining commercial businesses (including schools, retail etc) immediately after it is determined necessary to cut and or remove AC pipe;
- If cutting is required, Central Highlands Water will remove an entire section of pipe (6 metres), rather than limiting the removal to the damaged area;
- Completion of an Asbestos Removal Control Plan.

The procedure for removing non-cracked AC pipe at Central Highlands Water is outlined overleaf, followed by a real-life example of this removal process.

Procedure

1. Before commencing, fill out a JSEA and erect barricades and traffic control as required;
2. Manually excavate to the pipe and complete an Asbestos Removal Control Plan;
3. The removalist will then determine whether the pipes must be cut, or if a repair patch can be used. The preference is to use a repair patch, as this is more economical and efficient;
4. If the pipe needs to be cut, anyone working within a 10 metre radius of the operating area must wear the appropriate PPE (disposable overalls, rubber boots, safety glasses, rubber gloves taped to the outside of the overalls and an approved respirator with disposable cartridges, class P3);
5. Ensure there are adequate AC waste bags for the disposal of AC pipes and PPE;
6. Ensure atmospheric monitoring is taking place by an Occupational Hygienist;
7. When ready to cut, wet the pipes prior to cutting, ensuring there is adequate water supply on hand for the entire operation, with a flow rate of 2.4L/ minute (100 litre container on the asbestos removal trailer is accepted);
8. Use manually operated compression chain cutters or handsaws to cut pipes if possible (although note that a demolition saw[26] stored in Central Highland Water's asbestos removal trailer (see Figure 6.3) is permitted if water is continuously running on the blade and is pumped using the electronic pump located on the asbestos removal trailer);
9. When cut, move the section of AC pipe to the side of the trench then place in the asbestos disposal bags and double wrap;
10. Asbestos waste (including PPE) is loaded onto a locked and fully enclosed asbestos removal trailer and transported from the worksite to Central Highland Water's Ballarat depot where it is transferred into a secure skip bin;
11. This is transported to an approved EPA disposal site by an approved waste transportation and disposal contractor;
12. The supervisor signs off the completion of works by completing the Asbestos Removal Control Plan.

An example of this process is provided overleaf.

[26] Demolition saws may be used at Central Highlands Water as the organisation has tested this method with an Occupational Hygienist and WorkSafe Vic.

Example of non-cracked AC pipe removal at Central Highlands Water – East Street

Central Highlands Water staff removed 6 metres of AC pipe on East Street in Daylesford (see Figure 6.2). Class B trained removalists from Central Highland Water used a demolition saw with water tank and pump to cut the pipe, with water continuously running on the blade (see Figure 6.3). This task took approximately three hours and required two staff members. Labour and equipment costs to repair the AC water main were estimated to be $500 (this does not include training costs for staff).

Figure 6.2: Location of AC pipe[27]

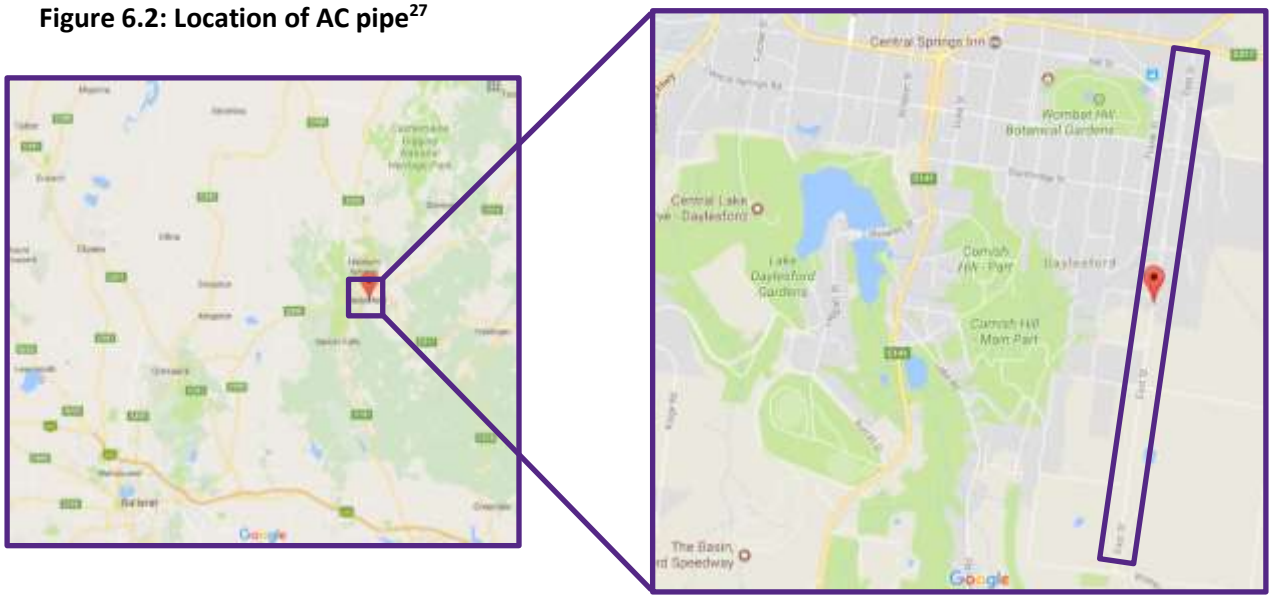


Figure 6.3: AC water main pipe removal using a demolition saw and with water continuously running

[27] Map data: Google

Approach Two – Cracked AC pipe

Cracked AC pipe is assumed to require removal of friable asbestos and as such, replacement is undertaken by an external contractor. To reduce costs, Central Highlands Water uses a computer system that maps all asbestos water pipes. Using this system, when a pipe bursts or cracks, Central Highlands Water is notified immediately and can efficiently and cost effectively check whether the pipe has asbestos. This means there is no need to physically excavate and check the pipe to determine whether Central Highlands Water can repair the pipe, or whether it is necessary to contract in Class A removalists.

When the pipe is identified as a cracked AC pipe, Central Highlands Water contact the external contractor, who must have a Class A removal licence, provide a JSEA to Central Highlands Water prior to works for approval, and provide a clearance certificate following the completion of the works.

Cost saving measures

The new approaches to AC pipe replacement adopted by Central Highlands Water are more expensive and time consuming than the previous pipe bursting technique. However, to align with legislative requirements, the organisation has moved to remove and replace method (or repair if possible), acknowledging that the water pipes are the organisation's assets and therefore its responsibility. Central Highlands Water reduces costs through:

- **Training internal staff to remove non-cracked AC pipes.** By training staff to be Class B asbestos removalists, Central Highlands Water can manage much of the AC pipe maintenance, which is more cost effective than contracting these services.
- **Use of an online mapping system.** This system maps all Central Highlands Water pipes as well as their state and what they are made from (e.g. AC). Cracked pipes appear on the online system, and the organisation can quickly determine whether the pipe is asbestos or not. If it is a cracked AC pipe, it is assumed to require removal by a Class A removalist as it is likely to be friable. This saves time and cost excavating the pipe to check its state and whether it is asbestos and requires a Class A removalist.
- **Use of a demolition saw to cut AC pipe.** This saves time when compared to manually cutting the pipe. Importantly, the organisation has tested the use of these saws with an Occupational Hygienist and has demonstrated that the airborne asbestos levels are significantly below the threshold exposure level (staff are exposed to one tenth of the Safe Work Australia exposure standard). This process has also been audited numerous times by WorkSafe Victoria and is deemed safe and compliant with the Regulations.

To align with legislative requirements, Central Highlands Water has moved to the 'remove and replace' method (or repair if possible). Although this is more expensive than pipe bursting, the AC pipes are our assets and therefore our responsibility to remove safely for customers and businesses today and for future generations.

Central Highlands Water