Western Australian
Auditor General's Report

Water Corporation: Management of Water Pipes – Follow-Up

Report 7: 2021-22
17 November 2021

Office of the Auditor General
Western Australia

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The Office of the Auditor General acknowledges the traditional custodians throughout Western Australia and their continuing connection to the land, waters and community. We pay our respects to all members of the Aboriginal communities and their cultures, and to Elders both past and present.

WESTERN AUSTRALIAN AUDITOR GENERAL'S REPORT

Water Corporation: Management of Water Pipes – Follow-Up

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THE PRESIDENT
LEGISLATIVE COUNCIL

THE SPEAKER
LEGISLATIVE ASSEMBLY

WATER CORPORATION: MANAGEMENT OF WATER PIPES – FOLLOW-UP

This report has been prepared for submission to Parliament under the provisions of section 25 of the *Auditor General Act 2006*.

Performance audits are an integral part of my Office's overall program of audit and assurance for Parliament. They seek to provide Parliament and the people of WA with assessments of the effectiveness and efficiency of public sector programs and activities, and identify opportunities for improved performance.

This audit assessed Water Corporation's progress towards improving its management of water pipe assets since our 2014 report *Water Corporation: Management of Water Pipes*.

I wish to acknowledge the entities' staff for their cooperation with this audit.

CAROLINE SPENCER
AUDITOR GENERAL
17 November 2021

Contents

Auditor General's overview

Ensuring we have a safe and reliable water supply is crucial for our quality of life and economic well-being. In Western Australia, we are acutely aware that water is a precious resource. It is therefore pleasing to see that Water Corporation has effectively addressed all the recommendations from our 2014 audit on the management of its water pipe network. Projects to renew old pipes, particularly around Perth and Fremantle, have reduced disruption from leaks and bursts in the metropolitan area. The Corporation's engagement with stakeholders is better than it was in 2014 and improvements to its information systems support better decision making.

As Perth's population grows and the climate dries in our part of the world, desalination and wastewater recycling into aquifers help to provide Perth with a high level of water security. But even with these technologies, our water supply is not unlimited. Careful management of natural water sources and usage is also vital. The Corporation has for many years urged its customers to be waterwise, and the community has responded.

In the last audit we highlighted the need for the Corporation to reduce the amount of water lost from the supply network. It is disappointing to find in this audit no evidence of a consistent reduction in water loss. In 2020-21, statewide, just under 52 billion litres of water was supplied but not billed for, lost to factors from firefighting, to theft, to inaccurate meters and pipe leaks and bursts. Around 30 billion litres of this was in metropolitan Perth, nearly 12% of the water supplied in Perth, well above the Corporation's 10% target, and enough water to give over a million Perth residents a 7-minute shower each day for a year.

This should not diminish the community's commitment to responsible water usage or the Corporation's waterwise message to customers. But it should serve as a timely reminder that managing and using water in a sustainable way is a shared responsibility and a plan to make the pipe network less leaky should be high on the Corporation's agenda.

Executive summary

Introduction

The objective of the audit was to assess Water Corporation's (the Corporation) progress towards improving its management of water pipe assets since our 2014 report *Water Corporation: Management of Water Pipes*.

Our 2014 audit found significant gaps in the Corporation's information about the pipe network. This meant it only replaced pipes when they failed rather than on an assessment of their risk of failure, regardless of their size or location. The run-to-fail approach exposed the public and business to significant disruption when a reticulation pipe burst in Wellington Street, Perth CBD, in 2013 (Figure 1).

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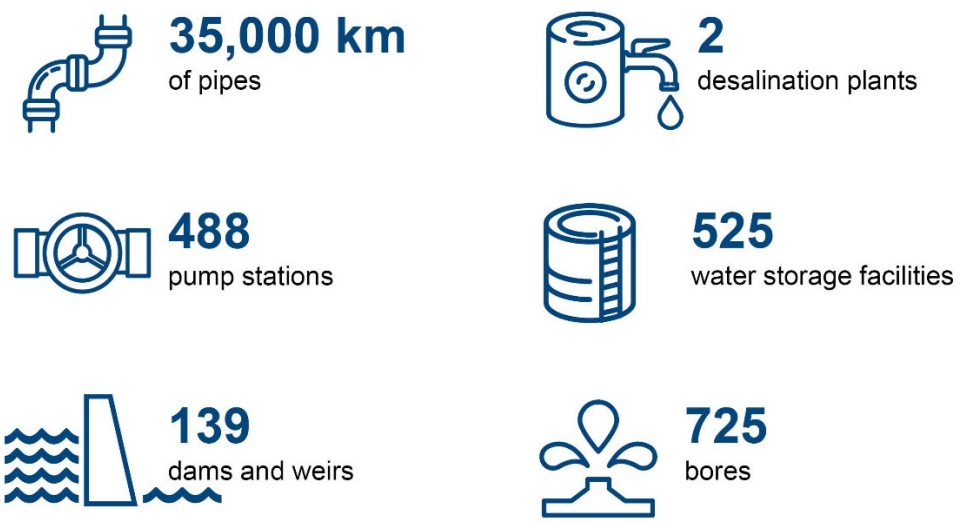
Hayley Roman © 2013 ABC

Figure 1: The long cracks in Wellington Street from a burst water main in 2013

Background

The Corporation is the main water utility supplying water and sewerage services in Western Australia. It takes water from the environment under licences issued by the Department of Water and Environmental Regulation under the *Rights in Water and Irrigation Act 1914*. These licences apply conditions for taking water from natural sources, including investigating and reporting on water loss. The Corporation supplies water to customers under a licence issued by the Economic Regulation Authority under the *Water Services Act 2012*. This licence applies standards of quality, pressure and flow.

The Corporation's water pipe network (Figure 2) distributed over 374 billion litres (the equivalent of 374 Optus (Perth) Stadiums full of water) in 2020-21 to around 2.6 million people in 300 cities and towns. Around 75% by value of the Corporation's assets are underground. The Corporation's pipe assets are currently valued at $4 billion.



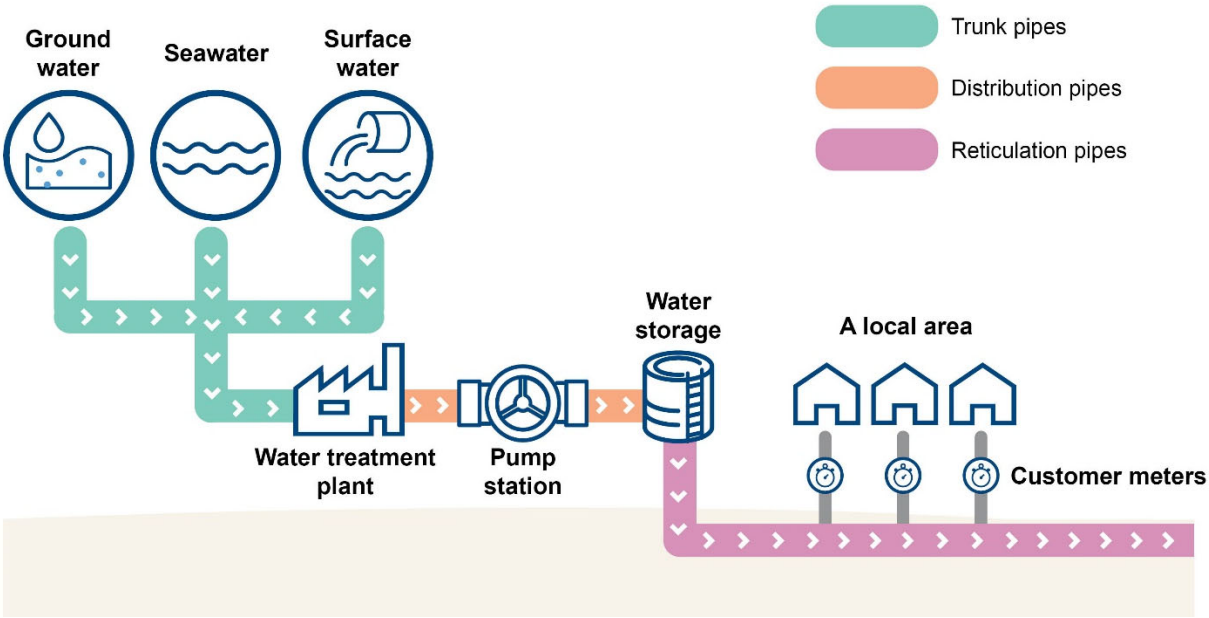
Source: OAG using Water Corporation information

Figure 2: Water Corporation's water supply network 2020-21

To distribute this water supply, the Corporation uses 3 classes of mains pipes:

- trunk (from water source to pump station)
- distribution (from pump station to a local area)
- reticulation (from distribution pipe to metered property).

Reticulation mains are generally underground while trunk and distribution mains are a combination of above and below ground (Figure 3). In addition to mains pipes, service pipes are used to connect reticulation pipes to individual end users but these are not included in this audit. In this report, we refer to all 3 categories of mains simply as pipes.



Source: OAG using Water Corporation information

Figure 3: Simplified diagram of pipe network showing the relationships between different classes of pipe

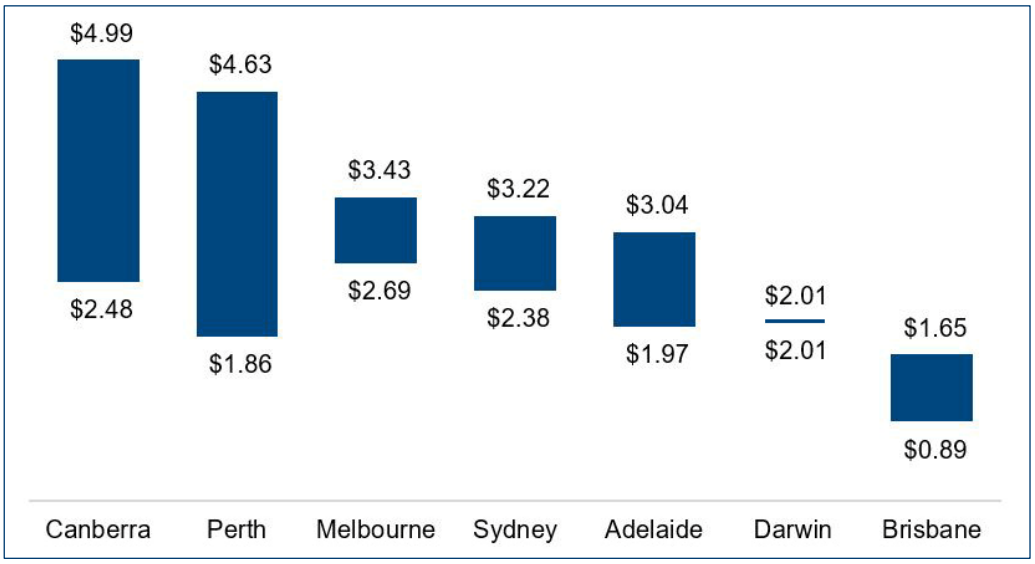
Failure of the Corporation to effectively manage the water pipe network would:

- risk the quality, reliability and sustainability of the water supply
- disrupt services and business, and damage infrastructure if pipes burst
- increase the need for greater investment in new water sources such as desalination plants to make up for water loss
- reduce net revenue, and hence reduce dividends to the Western Australian (WA) Government, resulting from water loss and meter inaccuracies
- reduce net revenue resulting from increased asset maintenance and replacement costs
- undermine broader water saving initiatives, including public campaigns.

These risks would impact the Corporation and the WA Government (reputational and economic risks), the environment (impacts on natural waterways, aquifers and ocean ecosystems near desalination plants) and the public (the price of water supply and perceptions that water is not valued and need not be conserved).

Water supply use and service pricing is approved by Cabinet and is applied uniformly across the State regardless of the cost of supply. Some customers, including pensioners and charities, receive concessions on standard charges. Within these constraints, the Corporation acts on commercial principles to make a profit and maximise its long-term value to its owner, the WA Government, to whom it pays an annual dividend. Where charges do not cover costs, the Corporation can seek subsidy payments from the WA Government.

The price range of water per kilolitre (kL) paid by Perth residential customers is relatively wide. Heavy users pay a higher per kL price than residents in all other capitals except Canberra while light users pay less than everywhere except Brisbane. Figure 4 compares price ranges of select comparable water retailers.



Source: OAG

Figure 4: Price ranges in Australian capital cities

Note: Water usage price ranges per kL for residential customers in Australian capital cities excluding Hobart. Prices vary according to volume used except for Sydney and are rounded to the nearest cent. The top price for Sydney will apply if dam levels drop below 60% for Greater Sydney until they are back over 70%. Price range for Brisbane is 2020-21. All other prices are 2021-22.

Of the 374 billion litres of water supplied statewide by the Corporation in 2020-21, 86.2% was metered and billed. The remaining 13.8% was unbilled, split 70/30 between losses from leaks and bursts and standard allowances. These allowances are used by all Australian water utilities to account for metering errors, authorised use (for example, in firefighting) and theft.

Water loss cannot be eliminated from any supply system but can be minimised by good management of the water storage and distribution system with achievable targets and effective monitoring. There are internationally accepted ways to measure it and assess what might be considered acceptable or efficient. Failure to manage losses can affect the sustainability of supply and undermine broader water saving initiatives.

Good management of the pipe system requires adequate knowledge of the age, condition and location of pipes, prompt repair of leaks and bursts to keep disruption to a minimum and timely replacement of failing pipes to keep maintenance costs down over the long-term. As reported in our 2014 audit, the rate of leaks and bursts and the amount of water lost are key measures of performance and efficiency.

Conclusion

The Corporation has improved its management of water pipe assets since our previous audit. Information systems are more comprehensive and up-to-date, linking asset information with geospatial data to provide a view of the pipe network that is effectively complete. This provides a basis for the Corporation to make sound decisions about maintaining and replacing pipes.

Using this information, the Corporation has invested $465 million in its pipe network since our last audit to improve its condition, reduce risk of disruption and maintain service levels over time, particularly in the metropolitan area. It has also improved its consultation with stakeholders and collaboration with other utilities to reduce disruption to business and the public caused by major works.

However, there has been no progress overall in reducing water loss. The volume of unbilled water statewide, including losses from leaks and bursts, has risen to nearly 52 billion litres in 2020-21. The 30 billion litres unbilled in metropolitan Perth in 2020-21 was better than last year but roughly the same as in 2014, and at 11.8% of water supplied still well above the Corporation's target of 10% by 2030. The total metropolitan losses are equivalent to 30% of the annual production capacity of the Southern Seawater Desalination Plant, the State's largest desalination facility. The Corporation does not yet have a clear plan for achieving its 10% Perth target, nor does it have a target or plan for reducing the roughly 22 billion litres of unbilled water in the rest of the State.

Key findings

The Corporation now has reasonably current, accurate and comprehensive information about its water pipe network

The Corporation has made significant progress on recommendations made in our 2014 audit. It now has a sound asset management framework for water pipes based on a database of work orders, a geospatial information system (GIS) and a fixed asset register (FAR). The Corporation updates these asset management systems in an accurate and timely manner and makes information accessible to relevant employees and contractors through an online portal.

Based on our testing, the GIS is substantially complete and information in work orders is used to update the FAR. As a result, the Corporation has a better understanding of its pipe network than it did during our original audit in 2014. However, manual updating of some data

across systems creates a risk of transcription errors, but this risk is mitigated by using multiple data sources to support major decisions.

The Corporation assesses and monitors pipe condition and uses this information to manage the pipe network

The Corporation now uses the incidence of leaks and bursts together with leak detection technology and direct inspection to make decisions about the pipes in its network. The risk of leaks and bursts is the key criterion for trunk and distribution pipe replacement. Our tests found that leaks and bursts data and inspection results are used to update all relevant asset management systems.

The Corporation has increased its investment in non-visible leak detection, adding to the information it uses to inform its pipe replacement decisions and carry out planned maintenance. This should lead to better outcomes for the community in the long-term, including reduced disruption from leaks and bursts on trunk and distribution pipes. Improvements in the rate of leaks and bursts per 100 km of pipe since 2016 indicate that better outcomes are being achieved.

The Corporation effectively coordinates with other utilities and engages with key stakeholders on major projects

The Corporation works with other utilities to minimise disruption, including carrying out works jointly where possible. Improved coordination with other utilities and effective stakeholder management was evident in the Pipes for Fremantle project since it commenced in 2019 to renew old pipes in the Fremantle CBD. Opportunities to coordinate works with other utilities arise mainly with planned replacements of trunk and distribution pipes where other services such as gas pipes run alongside water pipes.

The Corporation's stakeholder engagement has improved but it is not always possible to give advance notice of works. It shares information with stakeholders and coordinates activities with other utilities where possible. It has established mechanisms to ensure works are coordinated with other State entities such as Main Roads and has increased community engagement when major disruptions are planned. However, around 75% of the pipe network is only repaired once leaks are detected and when these repairs are urgent it is not always possible to provide advance notice to affected businesses and residents.

The Corporation does not have a clear plan to limit its long-term water loss to its 10% target for metropolitan Perth and to reduce losses in the regions

Total unbilled water, including standard allowances for unmetered usage, inaccurate meters and theft as well as leaks and bursts, is above the Corporation's target of 10% for metropolitan Perth by 2030 and has increased in recent years. While 2020-21 data shows a slight reduction in unbilled water for the Perth region, this was more than offset by increases in other regions to produce a slight rise statewide. High levels of water loss pose a reputational and financial risk to the Corporation but it does not yet have a clear plan to address it.

In 2020-21, unbilled water statewide was 51.6 billion litres out of 374 billion litres supplied, or 13.8%, up from 12.6% at our previous audit. Both unbilled water and total water supplied show an upward trend over the past decade despite some improvement in unbilled water since it peaked in 2018-19 at 54 billion litres or 14.7% of water supplied. For metropolitan Perth, unbilled water in 2020-21 was 30 billion litres or 11.8%, similar to the 11.6% result in in 2013-14 after having peaked at 13.3% in 2016-17.

Reducing unbilled water has not played a significant role in decisions around water security or in pipe investment decisions. However, the costs of unbilled water are passed on to

customers and the WA Government. Industry standards indicate that 15.6 billion litres of unbilled water, approximately 1 third of current statewide losses, is potentially recoverable. For metropolitan Perth, recoverable losses are around 6.7 billion litres. Based on 2020-21 supply, achieving this would reduce losses to within the Corporations 10% target for metropolitan Perth.

The Corporation estimates that it could cost-effectively recover around 6.5 billion litres of losses in metropolitan Perth using available approaches such as pressure management and meter replacements. It estimates this would lead to efficiency gains worth $2.5 million a year by 2030 and achieve its metropolitan Perth target for unbilled water. Reaching the target at the same time as the pipe network expands with population growth will require the Corporation to incorporate these or other effective measures into an effective implementation plan.

Recommendation

Water Corporation should develop an evidence-based and costed strategy and action plan to significantly reduce levels of unbilled water, including regional schemes experiencing high loss rates.

Implementation timeframe: June 2022

Entity response:

The Corporation agrees with the recommendation and will ensure water loss management will be explicitly addressed as part of the asset management strategy review which currently in progress. The Corporation will:

1. Continue with the current program of work aimed at reducing Water Losses in the Metropolitan Integrated Water Supply Scheme, based upon the principle of “Economic Level of Leakage” where the investment is less than the Marginal Cost of Water.

2. Continue to investigate any regional scheme where Non-Revenue Water (unbilled water) is greater than 15% and implement any identified cost-effective remediations to reduce regional Non-Revenue Water.

Response from Water Corporation

The Corporation appreciates the professionalism and effort put into this audit by the Office of the Auditor General. We will continue with the work to reduce unbilled water across the State.

The Water Corporation welcomes the acknowledgement of the improvements made in our information systems and in establishing a water pipes renewal capital program. This investment program seeks to reduce the risk of customer disruption whilst optimising the overall capital program to ensure best value to the community.

The same criteria is applied to the Non-Revenue Water program for the regions, where a target has been set to achieve 10% by 2030 for the metropolitan Integrated Water Supply Scheme (IWSS). This will be achieved by a combination of:

- A Pressure Management Program in selected areas
- Non-Visible Detection and Repair
- A Revenue Meter Replacement Program
- A Reservoir Relining Program

Each program has a varying level of effectiveness and the principle Economic Level of Leakage is applied to ascertain if the investment in the program is less than the Marginal Cost of Water, i.e. if it costs more to find and repair the water loss than to produce the water, it does not make financial sense to continue with that part of the program. This ensures an efficient allocation of capital funds throughout the entire investment portfolio. The program has been in place since 2016/17 and is on track to deliver the target of 10% by 2030 for the IWSS.

Audit focus and scope

This audit assessed the Corporation's progress towards improving its management of water pipe assets since our 2014 report *Water Corporation: Management of Water Pipes*. It focused on recommendations made in our 2014 audit and the management of the pipe network that delivers water to customers. In this context, the pipe network refers to trunk, distribution and reticulation pipes, and excludes service pipes connecting reticulation pipes to end users.

Appendix 1 includes the recommendations from the 2014 audit and their current status. The audit criteria for the current audit were:

- Does the Corporation have current and accurate information about the condition and performance of its water pipe assets?
- Does the Corporation apply a consistent, transparent and documented approach to prioritise water pipes for maintenance and/or replacement?
- Does the Corporation monitor and review the performance of the water pipe maintenance and replacement program and use this information to improve performance?

The audit did not include regional water utilities or other services provided by the Corporation such as wastewater management, water recycling or management of aquifers and reservoirs.

We reviewed documentation provided by the Corporation and extracted data directly from the Corporation's information systems. The audit also interviewed Water Corporation staff and obtained either comment or documentation on key criteria from the following entities:

- Main Roads WA
- Public Transport Authority
- Alinta Energy
- City of Fremantle
- City of Victoria Park
- Fremantle Chamber of Commerce.

The audit also engaged Cardno, a global engineering advisory firm, to provide independent technical advice.

This was an independent performance audit, conducted under Section 18 of the *Auditor General Act 2006*, in accordance with Australian Standard on Assurance Engagements ASAE 3500 *Performance Engagements*. We complied with the independence and other ethical requirements related to assurance engagements. Performance audits focus primarily on the effective management and operations of entity programs and activities. The approximate cost of undertaking the audit and reporting was $376,000.

Audit findings

Water pipe information in the Corporation's systems is now reasonably current, accurate and comprehensive

The Corporation has made significant progress on implementing recommendations made in our 2014 audit, including gaining a better understanding of its pipe network. The Corporation has a sound asset management system for water pipes based on a database of work orders, a geospatial information system (GIS) and a fixed asset register (FAR). It updates these systems in a timely manner, correcting errors and filling gaps in the course of normal operations. Based on our testing, the GIS is substantially complete and information in work orders is used to update the FAR. As a result, its information systems provide management with a largely current, substantially complete and reasonably accurate picture of the pipe network.

Information about the pipe network is now readily accessible, with some limitations

All original pipe construction drawings and survey field books data is accessible in the asset management system. We tested a sample of 11 'as constructed' drawings prepared by property developers to determine whether pipe information is accurately reflected in the GIS system. These drawings are provided to the Asset Registration Group and verified by project managers in the Engineering Business Unit. Our testing showed no significant discrepancies between the drawings and GIS.

Pipe data can be hard to verify as most of the pipe network is underground. While there are many ways to assess pipe condition without a direct external or internal inspection, it can be hard to be certain of construction material, date of construction and condition of all old pipes still in use. Original data about some older pipes were never recorded, have been lost or were recorded incorrectly and 0.58 km (0.002%) of pipe is of unknown age. Lack of verification introduces a degree of uncertainty to pipe network data but not enough to significantly impact management decision making.

Information in the FAR does not include all pipe repairs and replacements in the network because it is limited to material assets. For pipes, the threshold is at least 18 metres long and valued at $2,000 or more. This means that the FAR cannot by itself provide a complete picture of the pipe network. However, all these informational risks are mitigated by using more than 1 data source.

Manual updating of some data across systems creates a risk of transcription errors, but the risk is low

Some, but not all, key information systems are physically linked by data held on a separate SAP database and are accessible to relevant employees and contractors through an online interface. The SAP database contains reports of leaks and bursts, work orders and details of repairs carried out. This is the primary source of information used to monitor performance and manage the pipe network with the GIS acting as a secondary visualisation tool while the FAR captures all material assets. This gives management access to complementary data sources to inform its decisions.

However, integration of the information systems is incomplete, with manual input still required for some processes creating a risk of transcription errors. For example, the FAR is updated manually from information in the SAP database. Together with errors in the GIS and uncertainty about the condition of older pipes in some areas, this contributes to a risk that data used by management contain inaccuracies.

While there is some room for transcription error, the overall level of this risk is low. The errors and omissions we found in testing were minor and would likely be corrected during normal operations. All significant pipe information gets updated over time. GIS updates occur as soon as new information is available while financial information, including asset valuations, is updated within 90 days. This ensures information systems maintain reliability.

The risk of error is also offset by using multiple sources of data. For example, reports of leaks are derived from work orders while details of repairs are then used to update the GIS and FAR and enable any discrepancies to be resolved.

Better information now informs business cases for major asset decisions

Business cases for major asset investments and programs of activity now bring together several decision factors with more complete data sources. For example, the business case for investment in detection and repair of non-visible leaks makes extensive use of data covering actual leaks in both metropolitan and country areas. The business case for Pipes for Fremantle relied on more complete data covering pipe location, age and length.

The need to ensure information can support major decisions has led to operational changes that affect the way information is collected and stored to make it more complete and readily available to decision makers. For example, the Corporation told us it is currently making changes to its asset management systems to align with international standards (ISO 55001) and improve data integration. This will be assisted by a new information system currently being implemented that will improve visibility of resource use for planning. The aim is to improve the overall asset management system to enable mature asset management decision making.

The Corporation assesses and monitors pipe condition and uses this information to manage the pipe network

A sample of the Corporation's business cases confirmed that it uses the incidence of leaks and bursts together with leak detection technology and direct inspection to inform its pipe replacement decisions and schedule planned maintenance. The risk of leaks and bursts is the key criterion for trunk and distribution pipe replacement. This information has guided investment in pipe projects since our last audit in 2014. Evidence shows that leaks and bursts per 100 km of trunk and distribution pipes statewide have declined since 2016. This should mean that the community can expect reduced disruption from leaks and bursts in coming years.

The Corporation proactively inspects trunk and distribution pipes

Of the 3 classes of pipes (trunk, distribution and reticulation) trunk and distribution pipes, being larger in diameter, are directly inspected internally and externally where possible. This enables trunk and distribution pipes to be repaired before they burst and cause disruption. Only reticulation pipes are still managed on a purely run-to-fail basis. They are repaired when they leak or burst and are considered for inclusion in the renewal program when repairs exceed a benchmark frequency of 3 or more leaks/bursts in a 12-month (rolling) period. This is a practical approach, given they are underground, are narrow in diameter and make up 76% of the network.

The Corporation has increased investment in non-visible leak detection statewide. It is using listening units on pipes throughout the Perth CBD to detect the sounds of leaks before they cause major damage and a leak detection dog to find leaks outside built-up areas (Figure 5). It is also trialling the use of satellite imagery. Adding leak detection to other existing asset information has helped ensure pipe repair and replacement decisions are soundly based and timely.

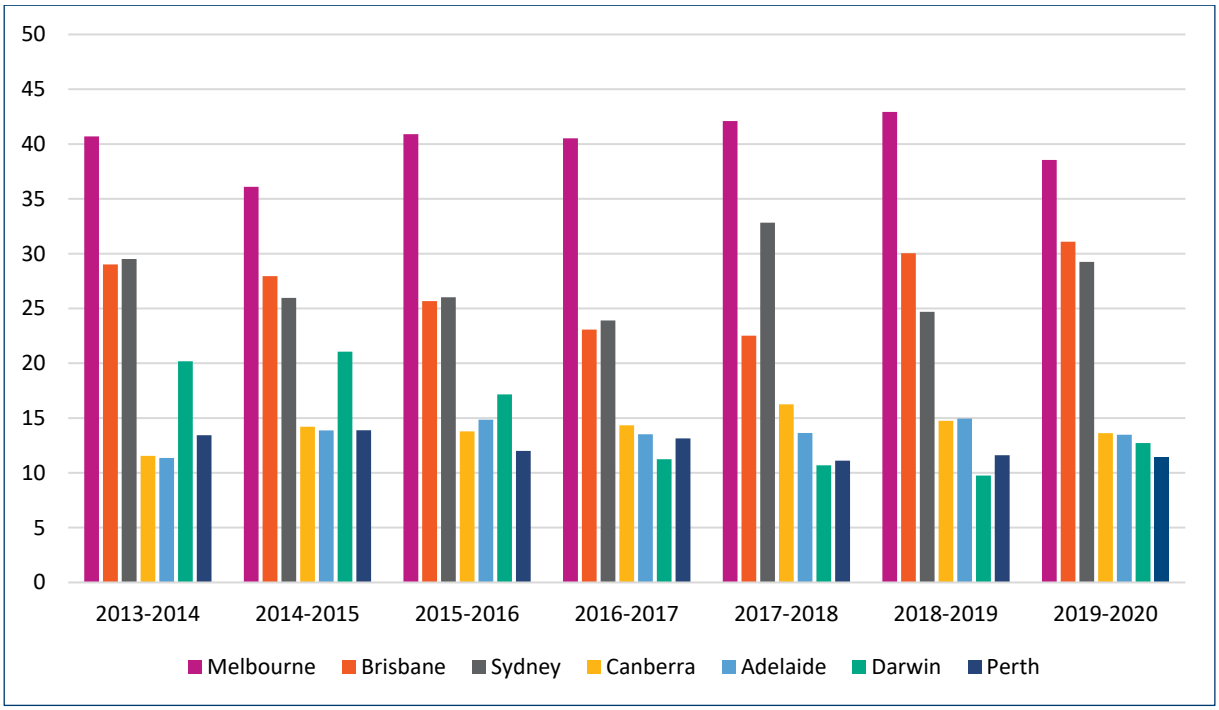
Source: Water Corporation

Figure 5: Kep, the Corporation's leak detection dog, formally designated a Scent Detection Canine Employee

The Corporation has invested over $460 million in the pipe network since 2014, reducing disruption from leaks and bursts

Risk assessments of the potential for major disruption from leaks and bursts, primarily in urban business centres, have led to the Corporation investing $464.7 million in pipe projects since the last audit. Around $214 million of this was on Pipes for Perth, including $9.9 million on Pipes for Fremantle. Pipes for Perth has been underway since 2016, replacing old trunk and distribution pipes and strategically important reticulation pipes showing signs of deterioration. These projects extend throughout the metropolitan area.

Compared to other states, the Corporation performs relatively well for leak and burst rates. This is driven by good performance in the Perth metropolitan area which has 45% by length of the Corporation's water pipes. The rate of leaks and bursts in Perth was 11.5 per 100 km in 2019-20, the lowest of any Australian capital city (Figure 6). This may be explained in part by the sandy ground in and around Perth which is a more forgiving medium in which to lay pipes than rockier ground in other parts of the state or the clay prevalent on the east coast. Pipe networks in country areas have not performed as well, with networks in Geraldton and Kalgoorlie-Boulder having leak and burst rates around double that in Perth.



Source: OAG, based on 2019-20 National Performance Report data, Bureau of Meteorology

Figure 6: Rate of leaks and bursts per 100 km of pipes for utilities in Australian capital cities

Note: Data for TasWater is not available before 2018-19. It reported 32.6 breaks per 100 km in 2019-20 - the second highest of all capital cities.

The Corporation coordinates major projects with other utilities when it can and keeps key stakeholders informed

The Corporation shares information with stakeholders and coordinates activities with other utilities when it is able to. It has established mechanisms to ensure works are coordinated with other State entities such as Main Roads and has increased community engagement when major disruptions are planned. Opportunities to coordinate works with other utilities arise mainly with planned replacements of trunk and distribution pipes where other services such as gas pipes run alongside water pipes.

The Corporation coordinates major works with other utilities where it can

The Corporation works with other utilities to minimise disruption, including carrying out works jointly where possible. For example, the Corporation worked with a gas utility to enable underground works by both utilities to be completed during one period of road closure in the Pipes for Fremantle stage of the Pipes for Perth project. Use of a joint contract between the gas utility and the Corporation's contractor meant planning the project took longer but roads were closed for only a few months rather than several times over 2 years.

The Corporation told us that joint contracts are used infrequently but can be an effective method of coordinating with other utilities when services run alongside water pipes. Laying pipes for different services alongside old pipes no longer used can result in complex repair works (Figure 7). The Corporation told us that it used such arrangements perhaps once a year on average.

Source: Water Corporation

Figure 7: Side-by-side underground pipes can make for complex and challenging repair work

The Corporation's stakeholder engagement has improved but it is not always possible to give advance notice of works

Stakeholders we spoke to told us that consultation from the Corporation on major works involving trunk and distribution pipes has improved in recent years during the Pipes for Perth project. Around 72% of repairs and maintenance of trunk and distribution pipes is planned, allowing the Corporation to notify affected customers and other stakeholders. However, around 97% of repairs and maintenance on the reticulation network is in response to leaks and bursts and therefore unplanned, allowing little opportunity to coordinate works with others or provide advance notification to customers. This means that repairs and maintenance of up to 75% of all leaks and bursts across the whole pipe network are carried out without advance notice to affected residences or businesses.

The Corporation has increased its investment in stakeholder management since our last audit. It advised that more time and money have been put into community liaison and communication since the need was highlighted during major works in Subiaco in 2016-17. For example, the Corporation confirmed that it had invested $624,000 in its engagement strategy for Pipes for Fremantle out of around $10 million for the project. The engagement strategy included hiring a dedicated Community Engagement Advisor, media advertising, mailouts and renting a pop-up shop near the works where members of the public could drop in to discuss issues and ask questions.

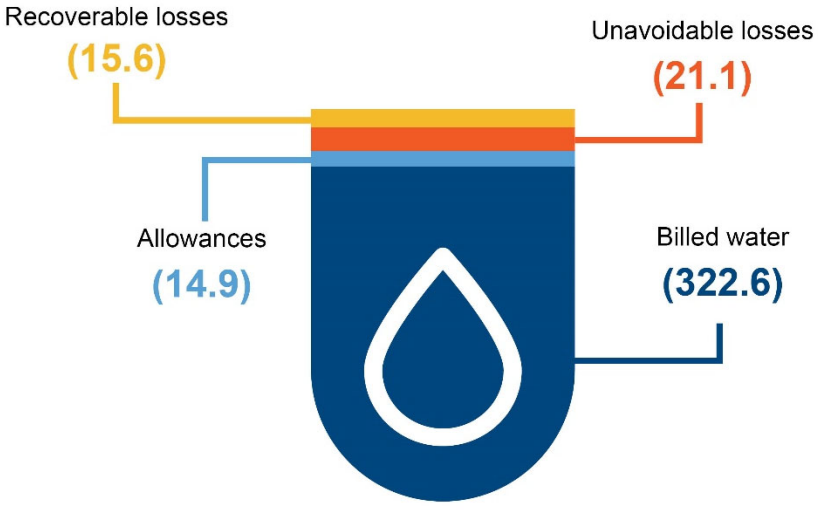
Both the City of Fremantle and the Fremantle Chamber of Commerce confirmed that the Corporation held regular meetings with residents and businesses during the project. These meetings included representatives of the gas provider carrying out works at the same time to minimise disruption. Feedback from these consultations informed planning of works. For example, the timing of works was changed to accommodate peak business periods during the year.

The Corporation liaises regularly with local government entities ahead of major works and is developing a Memorandum of Understanding with the City of Perth to facilitate future works. It has also provided 25 metropolitan local government entities with 5-year capital works program maps and a further 6 were in the process of being updated at the time of this audit. It meets with local government entities to discuss upcoming works during the 5 years of the capital works program and provides them with a guide explaining its processes.

The Corporation does not have a clear plan to limit long term water loss in metropolitan Perth to its 10% target and reduce regional losses

In 2020-21, 13.8% (51.6 billion litres) of total water supplied statewide was lost to unbilled usage such as firefighting, inaccurate meters, theft and leaks and bursts. The result for metropolitan Perth of 11.8% (30 billion litres) of total water supplied is well above the Corporation's long-term target of 10% by 2030. There is no equivalent target for water loss in the regions. While 2020-21 data shows a reduction in unbilled water for metropolitan Perth to 11.8% from 12.9% the previous year, this was offset by increases in other regions. High levels of water loss result in financial loss and a reputational risk to the Corporation after years of campaigning for customers to be conscious of their consumption, but it does not yet have a clear plan to address it.

The Corporation cannot quantify what happens to all unbilled water so it uses industry standards to estimate 'allowances' for it. Based on these, almost 30% of unbilled water is made up of under-metering by inaccurate meters, theft, and authorised uses such as firefighting. Just over 70% (36.7 billion litres) of unbilled water statewide is lost from leaks and bursts. Of these losses, 21.1 billion litres are considered unavoidable based on industry standards for a pipe network of this size. That leaves 15.6 billion litres that are potentially recoverable (Figure 8).



Source: OAG using Water Corporation data

Figure 8: Total water supplied in 2021 in billions of litres, made up of billed water, allowances, unavoidable losses from leakage and recoverable losses from leakage

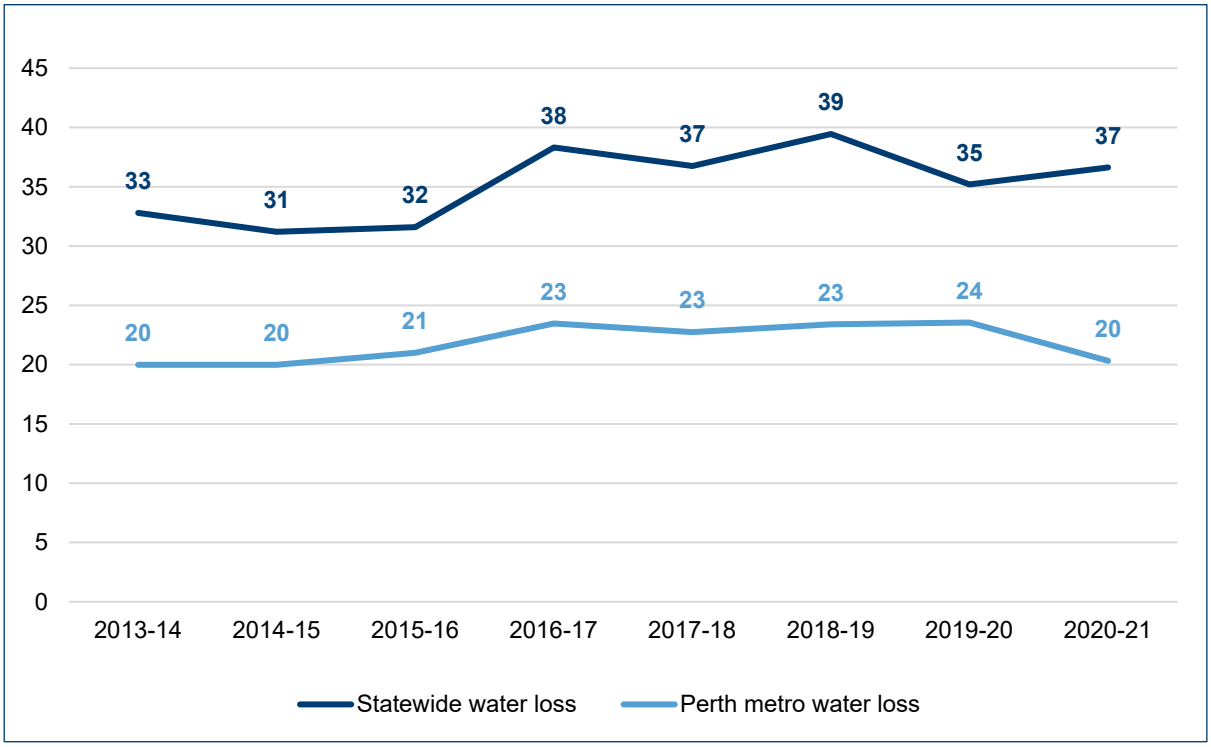
For a more detailed breakdown, see Appendix 2.

Water loss is reported nationally as an indicator of a water utility's performance to the Bureau of Meteorology and is publicly available in the Bureau's National Performance Reports. For

WA, loss is reported for schemes in 6 key population centres.[1] However, the Corporation does not publish indicators of water loss in its Annual Reports or on its website, even though it has this information readily available for national reporting purposes.

Losses from leaks and bursts have declined recently in Perth but not in regional areas

Water lost statewide through leaks and bursts alone is now 10% of water supplied at around 36.7 billion litres, up from 32.8 billion litres at the time of our last audit in 2014. Over that period, these losses peaked at 39.5 billion litres or 11% of water supplied in 2018-19. There has been some improvement in losses through leaks and bursts in metropolitan Perth since 2017 where they are now roughly the same volume at 20.3 billion litres as they were in 2013-14 at 20 billion litres (Figure 9). They are also the same percentage of water supplied at around 8%. However, in all non-metropolitan regions other than the Great Southern, these losses have increased, offsetting the improvements in Perth.

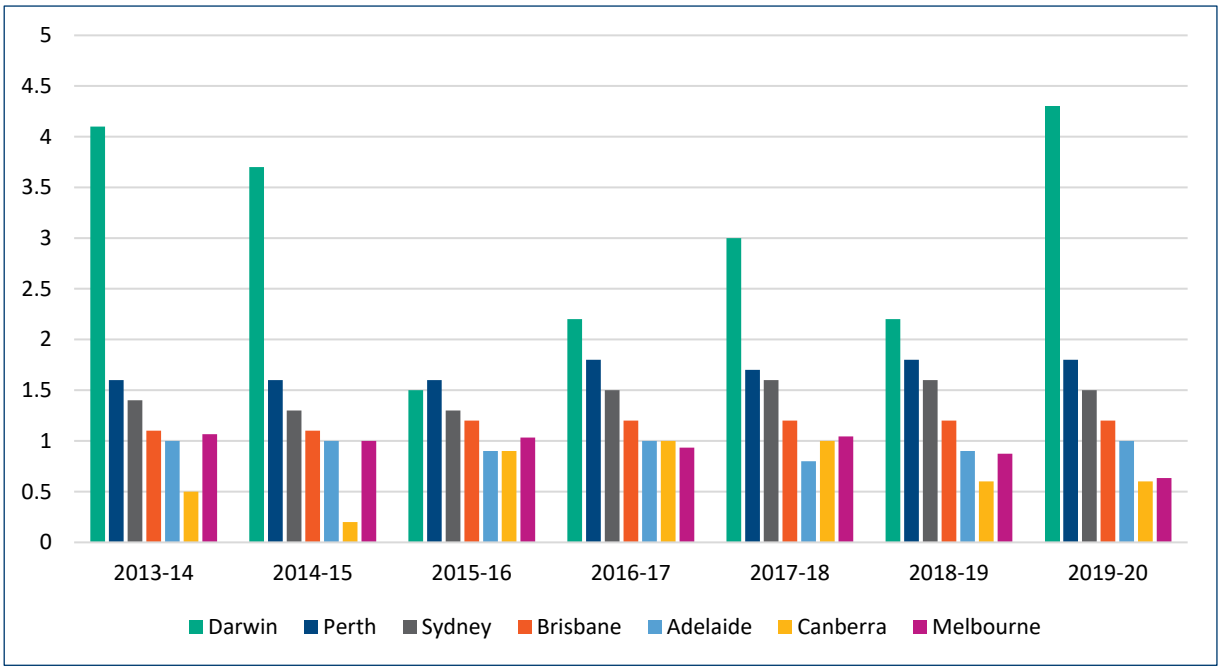


Source: OAG using Water Corporation data

Figure 9: Statewide vs Perth metropolitan water loss from leakage (GL)

The Infrastructure Leakage Index (ILI) is the ratio of current annual losses from leakage to the estimated minimum or unavoidable annual losses from leakage (Appendix 2), so an ILI of 1.0 would indicate that losses are being minimised. The ILI for metropolitan Perth has been between 1.6 and 1.9 since our previous audit. The result for Perth is mid-range for Australian urban water utilities but higher than most capital cities, suggesting improvement should be possible (Figure 10).

[1] Perth, Albany, Australind/Eaton, Geraldton, Kalgoorlie-Boulder, Mandurah



Source: OAG, based on the 2019-20 National Performance Report data, Bureau of Meteorology

Figure 10: Infrastructure Leakage Index since our last audit

Notes: Melbourne is an average of the index for its 3 water retailers. TasWater had an ILI of 3.2 in 2019-20 but data before 2018-19 was not available.

The potential for improvement in country areas is more obvious. In 2019-20 the ILI results for Albany, Kalgoorlie-Boulder and Geraldton were higher (in the 2.0-4.0 range) and some small systems like those at Ledge Point, Marble Bar and Seaview report very high loss rates but on low absolute volumes. Programs such as the Non-Visible Leak Detection program aimed at reducing losses have included both metropolitan and regional areas. These programs are ongoing.

The Corporation has a strategic aim to improve efficiency by reducing unbilled water but does not have a clear plan to achieve it

For economic reasons, conserving water by minimising losses is a strategic aim for the Corporation but it is not by itself considered a threat to the water supply or a primary corporate risk. The Corporation has explored a range of measures to reduce unbilled water, including district metering to help pinpoint areas of water loss for further investigation and reduced water pressure in other areas to manage it. However, the Corporation has not yet adopted a plan incorporating these measures and has acknowledged a 'capability gap' that it will need to address to achieve its target.

Efficiency gains from reducing unbilled water would reduce costs that are passed on to customers and the WA Government. Costs are incurred sourcing extra water, for example from desalination, and from treating and distributing it. There is also a reduction in revenue from under-recording by worn meters.

Substantial investment in desalination and water recycling into aquifers has ensured reliable supply to at least 2035. While this leads to a relatively high cost per litre, ensuring a reliable supply is consistent with the Corporation's licence under the *Water Services Act 2012* which focuses on quality, pressure and flow. However, the higher cost of desalinated water compared with water from dams makes efficiencies elsewhere in the system more important.

Current approaches to reducing losses could achieve the Corporation's 2030 target

The Corporation calculates that it would be cost effective to recover around 6.5 billion litres of losses from leakage using approaches currently available to it. These approaches include reducing water pressure, detection and repair of non-visible leaks and replacing worn meters. The Corporation estimates that a project including some or all of these measures could produce a net financial benefit of $2.5 million a year in reduced operating costs by 2030. If this had been done in 2020-21, unbilled water in metropolitan Perth would have achieved the Corporation's target of 10% by 2030.

Beyond the Corporation's target for unbilled water of 10% of water supplied to metropolitan Perth by 2030, it has a 'stretch' target of 8%. Unbilled water has been above 10% since 2010-11. It was 11.6% with 29.4 billion litres when we tabled our last report, peaked at 13.3% in 2016-17 with 32.7 billion litres and was 11.8% with 30 billion litres in 2020-21. Reaching the target at the same time as the pipe network expands with population growth will require the Corporation to incorporate these or other effective measures into an effective implementation plan.

Appendix 1: Status of recommendations from our 2014 audit report

Report recommendations	Current Status
The Water Corporation should by late 2014:	
• include undetected leakage from pipes as a factor in its pipe replacement planning and investment decisions	
• take a risk-based approach to ensure pipe references to original construction drawings and survey field books are contained in its spatial information system	
• review how information on leaks and bursts and from its leak detection program could be better linked across its IT systems	
• make gathering information about the location of leaks and bursts mandatory and regularly check to see that it is being gathered	
• review how information and learning about larger incidents of leaks and bursts could be better captured and disseminated to ensure lessons are learnt and resulting actions are followed up	

 Implemented

 Partly implemented

 Not implemented

Appendix 2: Measures of water loss and the water balance

Total water supplied by the Corporation can be summarised by the water balance, described by the diagram below. Different categories of water make up all the water in a water supply system.

<table>
<tr><td rowspan="4">Water Supplied</td><td>Billed Water</td><td colspan="2">Billed Authorised Consumption
(Metered & Unmetered)</td><td>Includes:
Billed Metered Residential
Billed Metered Non-Residential
Billed Unmetered[1]</td></tr>
<tr><td rowspan="3">Unbilled Water

Target for metropolitan Perth = 10% of water supplied, by 2030</td><td colspan="2">Unbilled Authorised Consumption
(Metered & Unmetered)</td><td>Includes:
Hydrants & some fire services[2]
WTP process water[3]
Environmental flows[4]
Mains scouring (flushing)</td></tr>
<tr><td rowspan="2">Water Losses</td><td>Apparent Losses</td><td rowspan="2">Includes:
Unauthorised consumption
Customer meter errors
Unavoidable Losses (leakage)
Recoverable Losses (leakage)</td></tr>
<tr><td>Real Losses</td></tr>
</table>

Source: OAG based on Water Corporation information

Notes: [1.] Billed Unmetered water is water supplied to properties where there is no meter and an alternative basis is used for charging, such as average consumption. [2.] Fire services are increasingly being metered and billed. [3.] WTP process water is water used by water treatment plants. [4.] Environmental flows are releases of water from dams or weirs to maintain downstream river health.

Good management of the pipe network keeps unbilled water to a target level that ensures the State's water supply represents value for money. The Corporation expresses this target as a percentage of water supplied. The target for metropolitan Perth is 10% by 2030, with a stretch target of 8%. The Corporation has not set a statewide target.

The percentage of water supplied can be affected by factors other than the volume of unbilled water, also referred to by the Corporation as non-revenue water. For example, the same volume of unbilled water can result in a higher percentage if consumption falls during 'waterwise' campaigns. For this reason, the industry has begun to use other measures in addition to simple percentages, including the Infrastructure Leakage Index (ILI) and the Economic Level of Real Losses, also known as the Economic Level of Leakage (ELL).

The ILI is the ratio of current annual real losses to unavoidable annual real losses. Real losses are losses from leakage from the water pipe network. They exclude standard allowances for:

- unauthorised consumption at 0.1% of water supplied
- unbilled authorised consumption, for example, fire-fighting and operational use such as flushing pipes, at 0.5% of water supplied
- customer metering under-registration at 2% of revenue water.

The Corporation told us it allows 3.5% for customer metering under-registration based on its own testing rather than the standard 2%. These allowances simply come off total unbilled water to gain a better estimate of real losses caused by leakage from the system.

The ELL is the level of leakage at which it is no longer economical to invest more to further reduce leakage. The Corporation now tracks water loss using each of these measures but its targets are set using simple percentages of water supplied.

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Auditor General's 2021-22 reports

Number	Title	Date tabled
6	Roll-out of State COVID-19 Stimulus Initiatives: July 2020 – March 2021	20 October 2021
5	Local Government COVID-19 Financial Hardship Support	15 October 2021
4	Public Building Maintenance	24 August 2021
3	Staff Exit Controls	5 August 2021
2	SafeWA – Application Audit	2 August 2021
1	Opinion on Ministerial Notification – FPC Arbitration Outcome	29 July 2021

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