Part 3

Alternative water sources

Part 3 of **Best practice guidelines for water conservation in commercial office buildings and shopping centres** provides advice on alternative water sources that may be used in commercial buildings.

Chapter 20

Rainwater

Using rainwater is an excellent way to reduce demand on mains drinking water. Rainwater collected from roofs generally has low levels of pollutants, especially if a first flush diverter is installed. This makes any required treatment relatively simple and inexpensive.

The bigger and cleaner your roof catchment area, the more likely it is that you will be able to implement an effective rainwater reuse scheme.

Using rainwater

Rainwater can be used to replace drinking water for a range of uses including water features, toilet flushing, water heating systems, garden irrigation and outdoor cleaning. Most rainwater has very low levels of dissolved solids that can make it well suited for cooling towers. Make sure you are aware of the properties of rainwater you collect from your site before you use it in cooling towers.

NSW Health does not recommend using rainwater for drinking and cooking when an alternative mains water source is available. Guidelines are available in the document *Rainwater Tanks where a Public Supply is Available* published by NSW Health.

To maximise the amount of water and money you save with a rainwater tank, it's important that you maximise your use of rainwater. This can be achieved by using rainwater where it will be used frequently such as toilet flushing or cooling tower makeup. Frequent use of rainwater also maintains better water quality.

How much rainwater can you catch?

Before implementing any large scale rainwater collection system, you need to be aware of the size of your catchment and the likely annual rainfall you will receive.

Photograph 10 – Rainwater captured in tanks at Investa's 73 Miller Street building in North Sydney, is used to irrigate gardens on the building's rooftop and balconies.

You can refer to the Australian Bureau of Meteorology's website at www.bom.gov.au for data about average annual rainfall and mean days of rain for many locations in Sydney.

You can calculate the theoretical maximum rainfall that can be captured by multiplying your roof catchment area (in metres) by the average annual rainfall in metres.

It is likely that the amount of rainfall you can capture in a given year will be up to 20 per cent less than the theoretical maximum because of losses from evaporation in small rainfall events, infiltration into roof materials, overflows from gutters and tanks during heavy storms and losses to first flush devices.

For a rough calculation of how much water you may be able to save with a tank of a given size, you can use online calculators at https://egrants.com.au/watertankmodel/index.asp

To more accurately model tank sizes, you need to use daily rainfall data, understand your average daily water use and incorporate variables such as temperature and seasonal variability.

Rainwater quality

The quality of rainwater collected will depend on the location in which rainfall occurs, as well as the surface it falls onto and the standard of storage tanks. Rainfall in an industrial area is more likely to collect airborne pollutants and roof catchment areas are more likely to be polluted with settled particulate matter.

Rainwater collected from paved areas including carparks and roads is typically referred to as stormwater and contains significantly higher levels of pollutants. The capture, treatment and reuse of stormwater is covered in Chapter 21 of these guidelines.

The roofs of commercial buildings may collect contaminants like dust, leaves, vegetation, bird faeces and occasionally dead animals. Keeping roofs clean with regular maintenance will improve the quality of collected rainwater, reduce the likelihood that gutters and collection systems get blocked and reduce the amount of treatment that will be required.

A 'first flush device' will also improve rainwater quality. The device sits between the roof downpipe and the rainwater storage tank and will dispose of the first rainfall runoff collected by your roof. Because the first flush contains a higher concentration of pollutants, a properly sized first flush diverter is very effective at improving the quality of collected rainwater.

Use mesh covers and strainers on the inlet and overflow of the tank to prevent mosquitoes and other insects from getting into the tank and breeding. This will improve water quality and prevent your tanks from causing a public health nuisance.

Plumbing requirements and approvals

If your tank is going to require top up from mains water, which is likely if tank water is likely to be used for needs such as toilet flushing or cooling tower operations, you will need to comply with backflow prevention containment requirements and install a backflow prevention device at the property meter to protect the mains supply.

Plumbers must complete all work in accordance with the NSW Code of Practice Plumbing and Drainage and follow the specific technical requirements for rainwater tank plumbing that are detailed in *Guidelines for the Installation of Rainwater Tanks on Residential Properties*, Part 1 Plumbing requirements.

For more information, contact Sydney Water's Plumbing Policy, Standards and Regulation Group at: plumbing@sydneywater.com.au

You should also contact your local council to discuss the regulations that apply to the installation of rainwater tanks, stormwater reuse systems and greywater or black water reuse systems.

In New South Wales, property owners can install tanks of up to 10,000 litres without development approval – providing conditions such as siting, installation of first flush diverters, noise mitigation and mosquito control are covered. Larger tanks or tanks that do not comply with these conditions usually require local council development approval.

Costs and benefits of rainwater tanks

Rainwater harvesting is a popular way to conserve drinking water, although it is usually less cost effective than other measures for reducing water consumption, such as leak reduction and improved efficiency. However, rainwater tanks are easy to install and a strong visual symbol for water conservation.

Rainwater is not governed by water restrictions and can be freely harvested to irrigate parks and gardens. Rainwater harvesting also reduces stormwater discharges from commercial sites, which reduces stormwater flows into the local environment and reduces stormwater volumes during rainfall. It can also be a visible and low risk measure when compared to reuse options.

Equipment and cleaning

Keep your roof catchment clean, install an adequately sized first flush diverter and remove sludge from tanks every two to three years. Your tank water should remain quite clean and you will not need complex treatment systems.

To use tankwater, you usually need to install good quality pumps to ensure adequate operating pressure. You also need a reliable device to switch between rainwater and mains water supply. It is common for poor quality and badly maintained pumps to fail and this can jeopardise the success of your rainwater harvesting operations.

Your plumbing contractor or hydraulic engineer can advise on the costs and installation of this equipment.

You will need to clean your tank regularly to remove accumulated sediments. The technique used will depend on the type of tank you have installed. Advice on how to clean tanks is provided in 'Useful documents' section of this chapter.

Converting onsite detention tanks

Many commercial buildings have been constructed with large on-site detention (OSD) tanks for stormwater. These tanks are designed to capture rainwater and stormwater after heavy rain, and slowly release it to the main council stormwater system so these systems do not become overloaded.

There is increasing interest in converting these tanks to storage tanks. You should consider:

- using your OSD tanks may make design easy because rainwater collection has been centralised, i.e. there is little need to consolidate downpipes that drain different parts of the roof
- OSD tanks will often also take stormwater from paved common areas (like shopping centre forecourts), footpaths, carparks and internal roads. This is likely to increase pollutants including oils and greases in the captured water, which may reduce the uses of this water, or necessitate additional treatment
- it might be necessary to treat stormwater from some areas before it is diverted to your storage tanks. If you have more than one OSD tank, it might be possible to separate your stormwater and rainwater collection so that you can use each water source for purposes appropriate for their different quality.

Useful documents

NSW Health Private Water Supply Guidelines 2007, NSW Health, www.health.nsw.gov.au/public-health/ehb/water/private_supplies.html

Guidance on the Use of Rainwater Tanks 2004, Environmental Health Monograph, enHealth Council, http://enhealth.nphp.gov.au/council/pubs/documents/rainwater_tanks.pdf

Use of Rainwater Tanks Where a Public Water Supply is Available, June 2007, GL2008–09, NSW Health, www.health.nsw.gov.au/policies/gl/2007/GL2007_009.html

Case Study
Lend Lease Retail

Lend Lease Retail operates Macarthur Square Shopping Centre in Campbelltown, in the south west of Sydney. Lend Lease is collecting rainwater from the centre's roof, storing it in a 250 kilolitre underground tank and using it for toilet flushing and garden irrigation.

Photograph 13 – Part of the extensive roof top area at Lend Leases' Macarthur Square in Campbelltown. This roof top is a catchment for 250 kilolitres of rainwater storage.

Case study
Blackmores

Blackmores is one of the leading Australian manufacturers of natural health supplements. It is constructing a new head office building and distribution centre in Warriewood on Sydney's northern beaches. Through development and project managers, Ray White Projects, it is constructing a new building designed by Watermark Architecture & Interiors.

Blackmores is harvesting rainwater for drinking, cooling towers, irrigation and to fill the staff swimming pool. The design of the building was strongly influenced by the company's desire to reduce reliance on mains water as much as possible.

Captured rainwater and stormwater is used to fill water features near the building entrance.

This waterbody reduces ambient air temperature around the building at the point of air intake, further reducing demand on its cooling systems.

Cooling tower blowdown is also captured, treated and reused.

Stormwater overflow is captured by wetlands that have been reconstructed on the site.

The office building can operate independently of mains water for 97 per cent of the year. The manufacturing and distribution centre has higher demand for water because it has a higher cooling load – but the entire site is designed to be independent of mains water for 80 per cent of the year.

Photograph 14 – Blackmores' new head office at Warriewood on Sydney's northern beaches uses a waterbody to pre-cool air before it enters the building's air intakes. The site has been designed by Watermark Architecture & Interiors to operate independently of mains water for 80 per cent of the year.

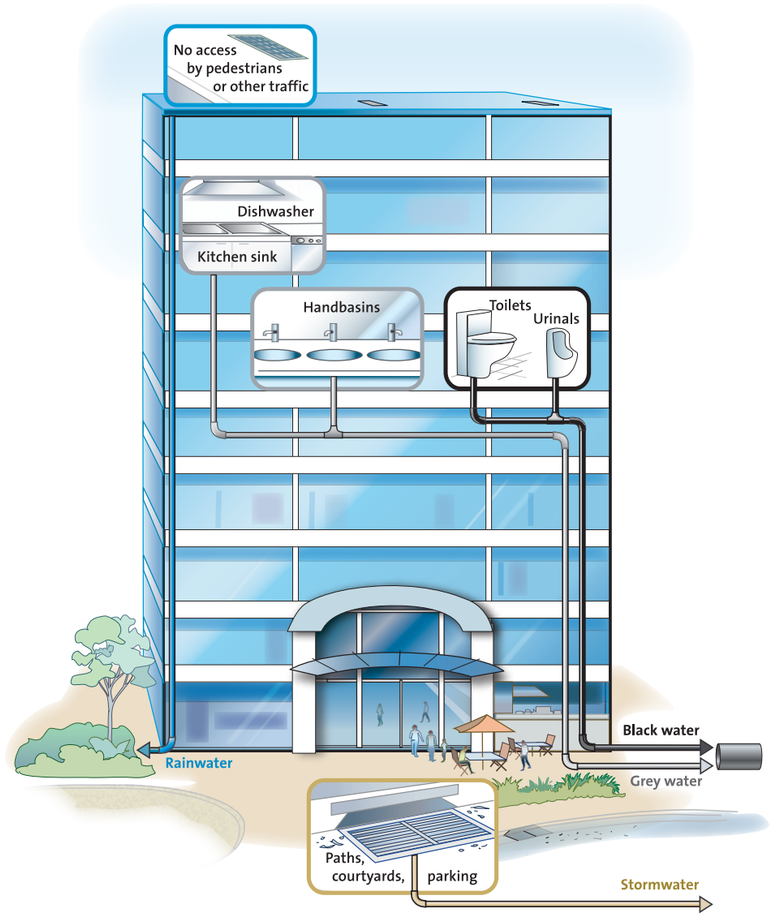


Figure 18 – Rainwater, stormwater, greywater and black water are classified according to the water's source.

Chapter 21

Stormwater reuse

Rainwater that has been collected from outside areas such as paving, footpaths, roads and car parks is generally called stormwater. Harvested stormwater can be used to flush toilets, clean down carparking areas and irrigate garden areas.

As well as reducing your use of mains drinking water, using stormwater will reduce the amount of stormwater discharged from your site and reduce your site's impact on the surrounding environment.

The type of technology used to harvest, store and treat stormwater will depend on specific site conditions including the size of your site, expected local rainfall, the level of likely stormwater pollution, the type of soils on-site and the sensitivity of downstream environments.

Using stormwater

Captured and treated stormwater is often used for irrigation of gardens and parks, water features, vehicle and outside area washing. In some areas where groundwater is extracted, captured stormwater can be used to recharge aquifers.

If you want to use stormwater for uses that have a higher chance of human contact you will need to take more precautions to keep your stormwater catchment clean and treat stored water properly. It is important to understand the quality of your source water and design a treatment and management system that will produce water suitable for your end use.

In some developments, irrigation is used as a method of stormwater treatment because plants and soil will remove nutrients and some suspended solids. Once water is recollected from irrigated areas it can be used for more sensitive uses.

How much stormwater can you capture?

The amount of stormwater that can be captured depends on annual rainfall and catchment size. Precise calculations on how much you can capture will depend on the type of ground surfaces in your stormwater catchments, the aspect and slope of your site and the amount of rain that falls in each rain event.

Campus style buildings and suburban shopping centres have large sites and are more likely to be able to capture and reuse stormwater than high rise commercial buildings on relatively small sites.

Refer to the Department of Environment and Climate Change NSW website at www.environment.nsw.gov.au for information on how much stormwater you can capture and reuse in urban areas in New South Wales under harvestable rights orders.

Stormwater quality

In many commercial buildings, stormwater catchments will be heavily used by people, pets and vehicles.

Stormwater can be contaminated by oils and grease, litter and harmful pathogens. As the quality of stormwater depends on the catchment it is sourced from, it can be easier to reuse stormwater if heavily polluted catchment areas – such as car parks – are excluded.

Keeping catchment areas clean can improve stormwater quality. Installing trash racks or gross pollutant traps can be expensive but will reduce pollutant loads. Regular street sweeping or litter patrols can also remove pollutants. Making sure that operations on your site, such as garbage storage and collection and building and excavation works are well managed, will reduce the chances of harmful stormwater contamination.

Plumbing requirements

If you use stormwater for purposes that may require top up from mains water you need to comply with backflow prevention containment requirements. You should install a backflow prevention device at the property meter to protect the mains supply.

Plumbers should complete all work in accordance with the *NSW Code of Practice Plumbing and Drainage*.

Please refer to Sydney Water's Plumbing Policy, Standards and Regulation Group for more information.

Consult your local council about regulations that apply to the installation of stormwater storage dams or tanks, treatment equipment and alterations to onsite detention systems.

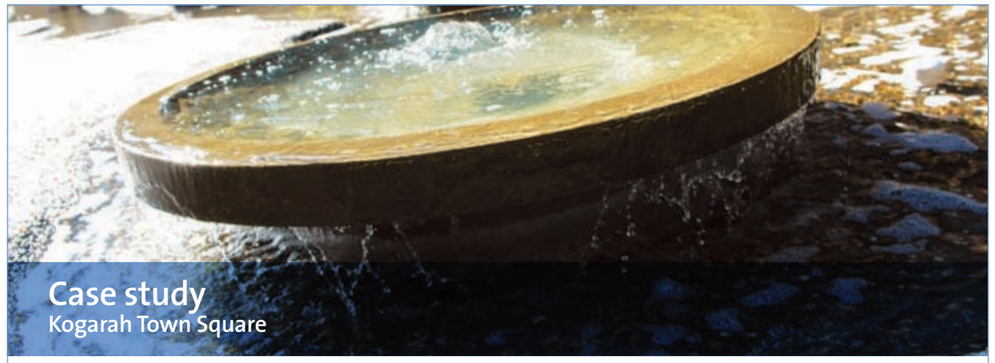
Costs and advantages

Costs of stormwater capture include pre treatment, piping, collection, treatment and the reticulation of treated water. Because stormwater catchments and stormwater quality vary so much, cost calculations need to be made for each project.

Reusing stormwater can reduce other development and maintenance costs, such as:

- reduce the required volume of stormwater discharge pipes
- reduce or eliminate the need for onsite detention systems
- reduce the need to install and maintain 'end of pipe' treatment systems, such as gross pollutant traps.

Case studies of stormwater capture in different types of developments are described below.



Case study
Kogarah Town Square

The Kogarah Town Square development comprises 193 residential apartments, 4,628 square metres of commercial and retail outlets and a town square with underground parking. The water management system in Kogarah Town Square was designed in a holistic water cycle management approach, focusing on water reuse and efficiency.

The three main principles under which the Kogarah Town Square project was developed as a best practice example of urban water collection, treatment and reuse are:

1. capturing stormwater from impervious areas
2. collecting rainwater from the roofs
3. reducing the demand of potable water through water conservation.

Eighty per cent of all water that falls on the site in a year (7,854 kilolitres) is reused.

From the impervious areas, stormwater passes through a gross pollutant trap that filters out the litter and large pollutants. The water is then collected in a storage tank and pumped to irrigate landscape areas. This saves up to 2,130 kilolitres of potable water a year. In addition, the landscape area acts as a filter for the water, removing the excess nutrients and fine particles. The filtered water is collected and stored in a separate tank and used as a primary top up supply for the other tanks.

From the roofs, rainwater is collected in a storage tank under the public car park. The water passes through a screen filter and is pumped for toilet flushing, car washing and into the water feature in the Town Square. This gives a savings of approximately 5,789 kilolitres of potable water a year.

Residential and commercial properties are fitted with water efficient devices such as flow restricted taps, 3 star rated showers, dual flush toilets, efficient urinals and dishwashers.

Photograph 15 – Water features at Kogarah Town Square are supplied with water from the site's rainwater and stormwater collection system.

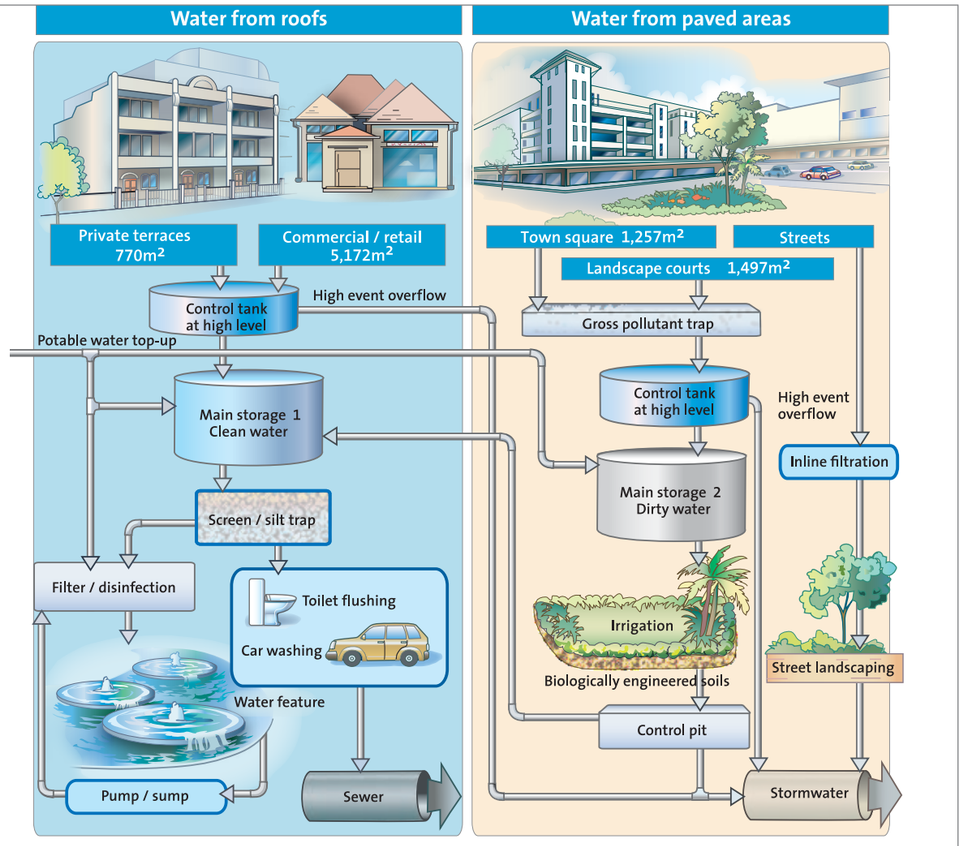


Figure 19 – The water reuse system at Kogarah Town Square

Useful documents

Managing urban stormwater harvesting and reuse 2006, Department of Environment and Climate Change NSW outlines some regulatory issues associated with stormwater harvesting and provides advice on how to plan a stormwater harvesting project.

Reference

Yuldeson, J, 2006, **Developing Green Case Studies**, National Association of Industrial and Office Properties, Herndon, USA.

Chapter 22

Groundwater

In some cases groundwater, sometimes known as bore water, may be a feasible alternative water source.

Accessing and managing groundwater

The Department of Water and Energy (DWE) regulates access to groundwater in New South Wales. Before you sink a bore you must first obtain a licence or an approval for the works from DWE. All bores must be constructed by a licensed driller.

The main reason for bore licensing is to ensure that this limited resource is equitably and sustainably shared among competing interests. It allows ready contact with licence holders incase significant resource management issues arise, such as water shortages or contamination.

There are groundwater embargoes in place for commercial use of groundwater around Sydney. In particular, these include the Botany Sands aquifer in the Eastern Suburbs of Sydney and around Botany Bay, as well as the Hawkesbury sandstone aquifer in the Blue Mountains area and parts of the Southern Highlands. These embargoes prohibit DWE from accepting new water licences.

Details of the embargo and water transfers can be obtained by contacting DWE.

In addition, there are areas of Botany Sands to the north of Botany Bay that have had groundwater extraction restrictions imposed as a precaution because of the likelihood that the groundwater may be contaminated. Domestic use in these areas is banned and industries are required to test their licensed groundwater extraction and demonstrate to DWE that the water quality remains of suitable quality for use.

Using groundwater

One of the most common uses for groundwater in commercial buildings is for cooling towers. Bore water generally has higher levels of dissolved solids than mains drinking water and may need to be treated before it can be used in cooling towers.

Groundwater is also commonly used for irrigation. This may only be cost effective if your shopping centre or commercial building

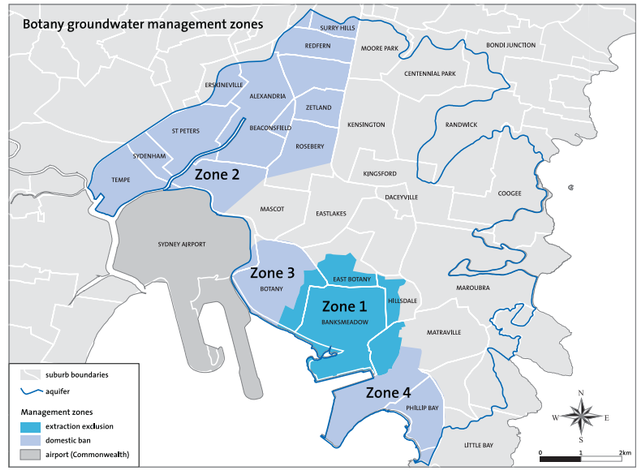


Figure 20 – Groundwater management zones for the Botany Aquifer, located south of Sydney.

has extensive landscaped areas. It is also important to consider the effect groundwater will have on soil quality, as it may contains high levels of dissolved salts.

Groundwater can be used to flush toilets and urinals. The University of New South Wales uses groundwater in some of its amenities and has trialled the use of groundwater in cooling towers.

Before using groundwater, you need to consider:

- what quantity of groundwater you need
- if the groundwater can deliver a sustainable yield
- what treatment the groundwater may need to undergo
- other land uses in the groundwater catchment and potential for contamination
- what approvals you need before drilling a bore and using groundwater.

Groundwater quality

Groundwater has higher levels of dissolved solids than mains drinking water. Some of the common contaminants in groundwater include dissolved iron, manganese and hydrogen sulphate. You should investigate the pH of groundwater and consider its likelihood to cause corrosion or scaling if it is not treated before use.

The amount of treatment groundwater needs will depend on its particular properties and the sensitivity of your end uses.

References

Frew, W, 2007, What a catch: the cricket oval that saves water in the Sydney Morning Herald, 22 January 2007, John Fairfax Publishers, Sydney. Also available online: http://www.smh.com.au/news/national/what-a-catch-the-cricket-oval-that-saves-water/2007/01/21/1169330767465.html

Case study
University of New South Wales aquifer recharge

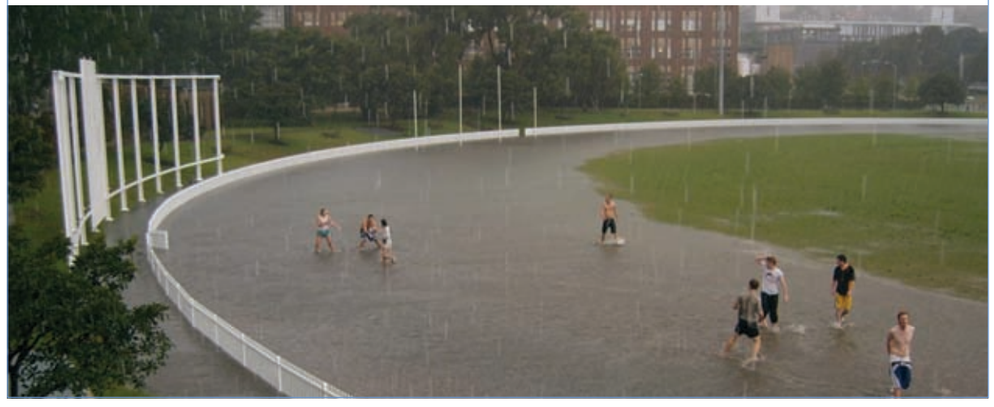
The University of New South Wales (UNSW) uses water from the Botany Aquifer to irrigate its lawns and ovals and meet other non-drinking water demands such as toilet flushing and laboratory process water. UNSW is also using stormwater captured in the lower part of its campus to help recharge the aquifer.

UNSW has built a 10 metre wide percolation chamber under its cricket oval to collect stormwater from 70 per cent of the main campus. This water is allowed to seep back into the sands of the Botany Aquifer.

If the chamber fills up, it overflows into local stormwater drains that drain to Botany Bay.

UNSW expects to return 160 megalitres of stormwater to the aquifer, which is about 80 per cent of its current extraction. (Frew, 2007)

Photographs 16 and 17 – The University of New South Wales aquifer recharge system contributes to the Botany Aquifer - shown during construction (above) and the completed system (below) during a period of heavy rainfall.



Chapter 23

Wastewater reuse

Wastewater can be a valuable and reliable source of alternative water, however it requires proper management and treatment before it can be reused because it has been polluted with a range of contaminants.

Wastewater can be classified three ways:

Greywater includes wastewater from baths, showers, basins, laundries and kitchens. Greywater can be contaminated by human faeces especially if cloth nappies are being washed. Kitchen wastewater may also be regarded as greywater, but treatment and reuse is more complex because it may be alkaline and can contain large amounts of grease, fat, food waste and detergents.

Black water (domestic sewage) is wastewater from toilets and bidets that is heavily and directly contaminated with human wastes and contains contaminated solid material, such as toilet paper. Black water is likely to have high levels of bacterial contamination and can be highly infectious.

Sewage is a combination of black water and greywater, as well as trade waste from commercial and industrial activities.

Using greywater

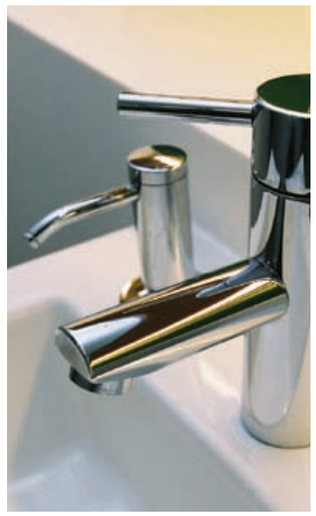
Greywater with low levels of pathogen contamination, oils and greases can be used for sub surface irrigation with little treatment. Greywater with higher levels of treatment can be used for above surface irrigation and indoor uses such as toilet flushing.

Before planning to reuse greywater, you need to:

- calculate how much greywater you generate and how much you can reuse
- identify the contaminants that your greywater contains
- decide on intended uses for the greywater, i.e. irrigation, toilet flushing
- determine how much contact people will have with reused greywater
- identify if there will be any environmental risks associated with greywater reuse
- decide on the treatment processes you will use
- determine if these treatment processes will remove contaminants and make water safe for users and the environment.

Preventing hazardous contaminants going into a greywater system is the best way of ensuring greywater quality. To do this you can:

- exclude kitchen waste because of high levels of oil, grease and bacterial contamination from food wastes



- exclude laundry water when items soiled with faeces or other excrements are washed because of high levels of bacterial contamination
- ensure cleaning and garden chemicals are not disposed of in the greywater system
- choose the right household cleaning products.

It is very important to communicate with building users and cleaners so that they understand what they can and cannot put down the drain and when water must be diverted to sewer.

If you plan to use greywater for irrigation, you must ensure that the volume of water will not be more than the holding capacity of the receiving soils.

There are two devices commonly available to reuse greywater:

Greywater diversion device

If you are confident that your greywater system excludes kitchen wastewater and does not have heavy pathogen loads, you can use a greywater diversion device to divert greywater to sub surface irrigation.

Sub surface greywater irrigation systems must be installed at least 10 centimetres underground to reduce human exposure to any potential pathogens.

Diversion devices are not allowed to store greywater because harmful pathogens can grow in storage tanks and unpleasant odours can develop. Any greywater that is not used for irrigation must be disposed of to sewer. To avoid waterlogging your soil, don't apply greywater after rain. Diversion devices must have a screen to remove any large pollutants, such as lint or twigs that could clog spray systems or pumps.

Greywater must be diverted to sewer if there is a known source of faecal contamination in the system or an outbreak of infectious disease amongst users of the buildings.

Diversion devices can be operated by gravity or pump. Pump devices have a surge tank that controls the amount of greywater sent to irrigation. The surge tank should not be used as a storage tank.

Greywater treatment system

A greywater treatment system must be used if greywater contains kitchen wastewater, or if you want to use greywater for toilet flushing, washing machines or unrestricted garden irrigation.

A complete greywater treatment system may include components such as wetlands, intermittent sand filters, soil filters, greywater septic tanks and aerated wastewater treatment systems. These processes remove pollutants including solids but will not remove harmful bacteria.

Disinfection is required where there will be human contact with reused greywater. When secondary treated greywater is disinfected using an active disinfection process such as chlorine, bromine, ozone or ultra violet light, it will reduce the levels of harmful bacteria and make greywater safe for more human contact.

Sewer mining and black water reuse

The amount of greywater generated onsite can sometimes be insufficient to meet your demand for recycled water and it may be more efficient to use blackwater or sewage. While these wastewater streams are more heavily contaminated and require more treatment, having a larger volume of wastewater to treat might be more cost effective.

Building owners can either use the sewage generated on-site, or access nearby sewer mains. Accessing wastewater in nearby mains is known as sewer mining. Approval is required from the relevant local council and Sydney Water.

Organisations who want to sewer mine should discuss their plans with Sydney Water to make sure the project is possible and the existing sewer infrastructure can cope with the proposed project. If the project is feasible, Sydney Water will provide initial development approval and construction approval.

Approvals and plumbing regulations

In New South Wales, local government approval is required to install and operate systems of sewage management that service more than one household. This requirement applies to greywater reuse systems.

Approval must be in accordance with the Local Government Act 1993 and Regulations.

In New South Wales, the Department of Water and Energy (DWE) and NSW Health can advise local councils when they are processing the applications.

Local government approval is not required where, under the Protection of the Environment Operations Act 1997, an environment protection licence is in force for a sewerage management scheme.

It is strongly recommended that recycled water schemes comply with the NSW Government guideline for the Management of Private Recycled Water Schemes.

To manage the risks of a recycled water system and gain approval to install and operate, you should:

1. conduct a risk assessment on the sources of wastewater and its intended uses
2. ensure the treatment system has multiple barriers
3. ensure disinfection is included as a treatment process
4. identify the system's critical control points
5. understand how the system of wastewater collection, treatment and reuse works
6. develop a system management manual
7. test and validate the system's performance for 12 weeks after approval to install the system is received
8. conduct a further four weeks of testing after approval to operate the system is received
9. undertake continuous online monitoring and regular manual monitoring when the system is operating and divert the system to sewer if critical control points are breached
10. ensure a person or organisation has responsibility for managing the system

11. think about additional ways you can manage recycled water in the building, ie signs, education, coloured plumbing pipes and fixtures and regular plumbing compliance checks to detect cross connections

12. ensure the system complies with plumbing requirements of the local authority

If your wastewater reuse system will be operated in Sydney, notify Sydney Water's Plumbing and Policy of any changes to your plumbing. Plumbing requirements for recycled water installation are outlined in the most recent edition of the **New South Wales Code of Practice: Plumbing and Drainage**.

Sydney Water will review your system to make sure there are no potential health threats, such as cross-connections between your drinking water supply and your greywater system.

You should also talk to your Sydney Water trade waste representative to make sure that changes to the quantity or quality of wastewater you intend to dispose of to sewer will not affect your Trade Waste Agreement.

Useful documents

- **Australian Guidelines for Water Recycling: Managing Health and Environmental Risks. National Resource Management Ministerial Council (NRMMC)**, Environment Protection and Heritage Council (EPHC) and Australian Health Ministers Conference (AHMC), 2006. This document outlines how to approach a risk-based approach to recycled water systems.

- **Advisory Note 4: Sewage Management Facility Accreditation Criteria Based on the Final Application of Treated Effluent and Risk of Disease Transmission**, NSW Health, 2006.

- **Management of Private Decentralised Recycled Water Systems** (draft), NSW Department of Energy, Utilities and Sustainability.

Costs and advantages

Wastewater can provide a regular source of alternative water and well run systems can significantly reduce demand on drinking water supplies.

Greywater treatment systems and costs may be simpler than black water and sewage reuse projects, but as most commercial buildings have more access to black water or sewage than greywater, it may be more feasible to reuse this waste stream.

In commercial buildings, the costs of designing systems to comply with regulatory and health requirements, then testing, maintaining and monitoring them may be high.

Given the costs of setting up a well running wastewater reuse system, it is important that you have an accurate idea of how much greywater you will be collecting and how much you will be using.

It is advisable to conduct an audit or an irrigation assessment before designing your system. Reuse projects will be most successful when all stakeholders are committed to operating a viable system that produces good quality water.

Case study
Wastewater reuse in Melbourne

Two commercial office buildings in Melbourne demonstrate the possibilities of wastewater treatment and reuse.

Urban Workshop at 50 Lonsdale Street and Southern Cross on the corner of Bourke and Exhibition Streets are both occupied by Victorian Government staff. Combined, the two buildings save 47 megalitres of drinking water a year by treating and reusing about 75 per cent of their sewage and greywater. After treatment, recycled water is returned to rooftop tanks for use in toilet flushing. However, the water is too salty to be used in cooling towers without additional treatment.

Both buildings use a three stage process to treat their wastewater. The primary treatment screens solids, the secondary treatment uses microbes to break down organic matter and membrane treatment to filter microscopic contaminants, and the tertiary treatment disinfects using ultraviolet radiation and chlorine.

Similar systems will be installed in three more multi-story office buildings in Melbourne in coming years. (City West Water, 2007).

Photograph 18 – Southern Cross on the corner of Bourke and Russell Streets (left) and the Urban Workshop at 50 Lonsdale Street (right) are two Melbourne buildings that demonstrate how wastewater can be treated and reused at a commercial location.

References

Turning waste into a resource, Liquid Assets, Issue 2, 2007 City West Water, Sunshine, Victoria.

Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006 National Resource Management Ministerial Council (NRMMC), Environment Protection and Heritage Council (EPHC) and Australian Health Ministers Conference (AHMC).

Sewage Management Facility Accreditation Criteria Based on the Final Application of Treated Effluent and Risk of Disease Transmission, NSW Health, Advisory Note 4 – May 2006, http://www.health.nsw.gov.au/public-health/ehb/general/wastewater/adnote4.pdf.

Part 4

Water saving checklist

Part 4 of **Best practice guidelines for water conservation in commercial office buildings and shopping centres** provides a practical Water Saving Checklist that shows you how well you manage water. The checklist will help you work your way through these guidelines and identify opportunities for water conservation in your commercial building or shopping centre.

Water saving checklist

Managing your water	Answer Yes / No	Recommended action
Do you monitor and record your water use?	Yes ☐ No ☐	If No, read your meter at least daily, or install a continuous monitoring system. Record meter reading information so you can identify changes in water use.
Do you benchmark your water consumption?	Yes ☐ No ☐	If No, calculate a L/m²/annum figure and compare it against other buildings in your portfolio and the benchmarks in Chapters 3 and 4.
Do you know where water is used in your office building or shopping centre?	Yes ☐ No ☐	If No, look at the average water balance graphs in Chapters 3 and 4 for guidance. Install sub meters according to the priorities in Chapter 9 to develop your own water balance.
Do you know where the best opportunities to save water are?	Yes ☐ No ☐	If No: - check for leaks - check cooling tower operations - install flow restrictors on taps - remove all cyclical flush urinals - develop a water balance for your building and see where you are using most water
Do you regularly review your company's water management?	Yes ☐ No ☐	If No, use the One-2-Five® Water or Water Achiever process offered through the EDC Business Program and concentrate on achieving identified critical actions. Use the template provided in the *NSW Water Saving Action Plan* guidelines. Compare your results to previous reviews and rate your achievement of critical actions.
Do you review your sub meters, or information from your continuous monitoring system regularly?	Yes ☐ No ☐	If No, establish work procedures so that a member of staff is responsible for water use information and knows what they need to do to if water use changes.
Do you know how much water, and all associated charges (energy, pumping, chemical, sewer discharge) are costing your business?	Yes ☐ No ☐	If No, refer to information about the true cost of water in Chapter 6. Calculate your own water costs and associated charges, as knowing how much your water costs will establish a business case for water conservation.
Have you developed a water savings plan?	Yes ☐ No ☐	If No, look at the findings of this checklist then develop a water balance and a basic savings plan.
Do you have signs, posters and stickers in your building to encourage water conservation and remind people to report leaks?	Yes ☐ No ☐	If No, business partners in the EDC Business Program can co-brand stickers, posters and shower hangers.

Amenities	Yes / No	Recommended action
Have you installed sub metes on supply lines to amenities and hot water supply?	Yes ☐ No ☐	If No, install meters on supply lines to amenities, as described in Chapter 9. Conduct routine inspections and program maintenance to detect problems before they become large leaks.
Does your building have any cyclic flushing urinals?	Yes ☐ No ☐	If Yes, replace urinals immediately with manually flushing urinals, automatic sensor units or ultra low flow or waterless urinals. Refer to Chapter 13.
Does your building have automatic on-demand urinal sensor flushing systems?	Yes ☐ No ☐	If Yes, regularly check that sensors are working properly and not detecting unrelated movement. Check that solenoids are operating correctly and replace them if they are faulty or worn.
Does your building have single flush toilets?	Yes ☐ No ☐	If Yes, replace single flush toilets in high use areas with 6/3 litre or 4.5/3 litre dual flush models. If toilets are in low use areas, restrict cistern volume and bring forward programmed replacement.
Does your building have dual-flush toilets?	Yes ☐ No ☐	If Yes, check the flush capacity. Older 11/5.5 litre and 9/4.5 litre dual flush toilets can be replaced with new 6/3 litre or 4.5/3 litre flush models.
Are cistern rubber seals on toilets replaced regularly?	Yes ☐ No ☐	If No, cistern rubber seals should be replaced every two years to prevent leaks.
Do you have a flusherette system?	Yes ☐ No ☐	If Yes, check the flow rate and flush timing. Over time, wear will cause excessive flush volumes. Insert flow control regulators into valve bodies to reduce flow.
Do you have flow regulators in all hand basins?	Yes ☐ No ☐	If No, install flow regulators so that flow is reduced to at least 6 litres per minute.
Do you have water efficient showers?	Yes ☐ No ☐	If No, install flow regulators so that flow is reduced to at least 9 litres per minute or install WELS 3 star rated showerheads.

Continued overleaf

Cooling tower operations	Yes / No	Recommended action
Does your building have cooling towers?	Yes ☐ No ☐	If Yes, continue with this section. If No, go to the next section.
Is there a water meter on the make up water pipe?	Yes ☐ No ☐	If No, install a sub meter and monitor the water consumption regularly.
When the pump is stopped, is there water flowing from the overflow drain pipe?	Yes ☐ No ☐	If Yes, check that the drain valve is correctly set and if there are any leaks. Check if the valve is closed and adequately sealed.
When the pump is stopped, does the water flow out of the overflow drain pipe whilst the water is coming in through the make up water line?	Yes ☐ No ☐	If Yes, this indicates that the ball float valve is incorrectly set. The ball float valve needs to be reset.
If you have a V shaped basin, when the pump stops does the cooling tower overflow?	Yes ☐ No ☐	If Yes, consider installing a break tank, or a more precise make up control.
If there is a significant length of condenser water pipe work running at high level, causing the tower overflow when the pump stops?	Yes ☐ No ☐	If Yes, consider reconfiguring the pipework.
If you have two or more cooling towers interconnected, when the pump stops does water flow from the drain pipe?	Yes ☐ No ☐	If Yes, check the ball float valve settings and the height of the tower basin. If one basin is higher than the other some modifications may be required.
Is the water overflowing the edge of the tower basin?	Yes ☐ No ☐	If Yes, check that the overflow pipe is set correctly or not blocked.
Is the area around the tower regularly or constantly wet?	Yes ☐ No ☐	If Yes, water is splashing out of the tower. Install or replace anti splash louvres.
Is any leakage present in the tower, casing, basin, or any intake or exhaust ducts or flexible connectors?	Yes ☐ No ☐	If Yes, joints need to be adjusted and sealed.
Does the cooling tower have drift eliminators, or old or ineffective eliminators?	Yes ☐ No ☐	If No, install a drift eliminator that limits drift loss to no more than 0.002 per cent.
Do any pumps have packed gland pump seals?	Yes ☐ No ☐	If Yes, ensure pumps are inspected monthly and seals tightened as needed. Also consider replacing the seals with mechanical seals.

Cooling tower operations	Yes / No	Recommended action
Does your water treatment contractor clean the conductivity sensor every month?	Yes ☐ No ☐	If No, make this part of their ongoing duties. Ensure it is recalibrated every month.
Is the water treatment system installed with a bleed blockout?	Yes ☐ No ☐	If No, install a bleed blockout to ensure that unnecessary bleed does not occur during chemical dosing.
Does the cooling water system have a side stream filter that uses water for back flushing purposes?	Yes ☐ No ☐	If Yes, consider capturing the bleed off in a backwash holding tank and then using it to backwash the side stream filter.
Have you contacted your water treatment contractor to discuss increasing the cycles of concentration in your cooling tower to reduce the bleed rate?	Yes ☐ No ☐	If No, ask your contractor to do so. Water supply in Sydney should be able to be cycled to about 9. If your contractor is unable to do this, discuss opportunities of changing to a treatment system that can function effectively at high cycles of concentrations.
Does your cooling tower water treatment contract require the contractor to report back on all water leaks after each service?	Yes ☐ No ☐	If No, amend contract to ensure this occurs.
Do you have a certificate stating that an effective process of disinfection is installed and operating?	Yes ☐ No ☐	If No, make sure your contractor can supply one. These certificates are mandatory in New South Wales.

Continued overleaf

Cooling systems and building design	Yes / No	Recommended action
Have you integrated economy cycle or fresh air venting into your air conditioning system?	Yes ☐ No ☐	If No, investigate if this can be done with your current HVAC equipment.
Have you reduced the heat load in your building as far as possible?	Yes ☐ No ☐	If No, install energy efficient lighting, building insulation, external shading, high performance insulation, sympathetic landscaping, and heat efficient natural lighting.
Is your cooling load under 500 kWR?	Yes ☐ No ☐	If Yes, you should investigate the possibility of air cooled systems. In smaller systems, air cooled systems can be appropriate because they do not consume water and have lower maintenance costs.
Have you looked at alternative water sources for your cooling system?	Yes ☐ No ☐	Lake water, groundwater, sea water, reclaimed water, recycled water, rainwater and condensate may all be used in cooling systems.
Have you considered other cooling systems?	Yes ☐ No ☐	If No, investigate options including evaporative pre-cooled air cooled condensers with pad or spray cooling, variable refrigerant volume systems, hybrid coolers or condensers, phase change materials or chilled beam technology. These are viable alternatives to traditionally cooling towers and should be investigated when building or renovating.
Kitchens and food courts	**Yes / No**	**Recommended action**
Are the water supply lines to kitchens sub metered?	Yes ☐ No ☐	If No, install sub meters on the supply lines to food businesses, especially high volume, water intensive kitchens.
Do you benchmark water use in each of the kitchens or your food court?	Yes ☐ No ☐	If No, use sub metering information to establish benchmarks so you can track kitchen water use over time. Common benchmarks are litres per cover, litres per meal served, or litres per patron.
Do you have flow regulators on kitchen sinks and basins?	Yes ☐ No ☐	If No, install 9 or 12 litres per minute flow restrictors on kitchen sinks and 6 litres per minute restrictors on hand basins.
Do you have waterless woks in your kitchen?	Yes ☐ No ☐	If No, consider installing a waterless wok. You may be able to get information and financial assistance from the Ethnic Communities Council of NSW. If you are accepting new tenancies into your food court, make the installation of waterless woks a lease condition.
Do you have a water efficient dishwasher?	Yes ☐ No ☐	If No, replace your existing model with a water efficient model. You will save money through water and energy savings.

Kitchens and food courts	Yes/No	Recommended action
Do staff in food courts and kitchens operate dishwashers and glass washers efficiently?	Yes ☐ No ☐	If No, ensure all staff receive information about water efficient dishwasher information. If you are accepting new tenancies, make installation of water efficient dishwashers and glass washers a lease condition.
Do staff in food courts and kitchens rinse plates before washing?	Yes ☐ No ☐	If Yes, install water efficient 6 litres per minute WELS rated pre-rinse spray valves. Sydney Water is offering a rebate system for their installation.
Do you check the condition of pre rinse spray valves?	Yes ☐ No ☐	If No, inspect pre rinse spray valves every two weeks to check for leaks and worn valves. Worn valves waste water and reduce cleaning efficiency.
Do staff in food courts and kitchens leave taps running while they are cooking and cleaning?	Yes ☐ No ☐	If Yes, install signs to remind staff to turn taps off. Consider installing sensor taps or foot operated taps. Waterless woks have hip controls and automatic turn off swivel taps.
Are kitchen floors and food court areas hosed down?	Yes ☐ No ☐	If Yes, consider using mops or squeegees instead of hoses. Microfibre mops are highly water efficient. If hoses must be used, ensure they are fitted with trigger nozzles.
Is food ever defrosted under running water?	Yes ☐ No ☐	If Yes, ensure all food is defrosted in a refrigerator, or in a microwave if it is to be cooked immediately.
Are water cooled steamers used?	Yes ☐ No ☐	If Yes, install more efficient steamer equipment. Efficient steamers can use up to 90 per cent less water and up to 60 per cent less energy than older models and have shorter cook times, higher production rates and reduced heat losses.
Do tenants pay for their own water consumption?	Yes ☐ No ☐	If No, you may be able to establish leases so that sub metering information can be used to charge tenants for their water consumption. This gives each tenant a financial incentive for water conservation.
Fitness centres	**Yes / No**	**Recommended action**
Does your building contain a fitness centre?	Yes ☐ No ☐	If Yes, continue with this section. If No, go to the next section of this checklist.
Are the showers water efficient?	Yes ☐ No ☐	If No, install 9 litres per minute flow restrictors or WELS 3 star rated showerheads on showers.
Do you have flow regulators in all hand basins?	Yes ☐ No ☐	If No, install flow regulators so that flow is reduced to 6 litres per minute or less.
Does the fitness centre contain a swimming pool?	Yes ☐ No ☐	Ensure you sub meter supply and refer to the Sydney Water fact sheet Swimming pools for benchmarking and water conservation information.

Continued overleaf

Outdoor areas and water features	Yes / No	Recommended action
Do you have a landscaped area or water features?	Yes ☐ No ☐	If Yes, continue with this section.
Do you sub meter your irrigation supply and water features?	Yes ☐ No ☐	If No, consider installing sub meters to determine your water use and identify leaks. This is especially important if you have large areas of irrigated areas or large water features.
Do you improve your soils?	Yes ☐ No ☐	Improving soil quality can improve plant growth and water retention. Add organic matter such as compost or composted animal manure.
Do you use an alternative water source to irrigate your garden?	Yes ☐ No ☐	If No, consider using rainwater, stormwater or treated wastewater for irrigation.
Cleaning	**Yes / No**	**Recommended action**
Do you communicate with cleaning staff regularly?	Yes ☐ No ☐	If No, cleaning staff will need information about water wise cleaning techniques and the correct way to clean specialized equipment such as waterless urinals. You can use Sydney Water EDC Business Program stickers, poster and fact sheets to communicate with staff.
Do cleaners hose down floors or carparks?	Yes ☐ No ☐	If Yes, remember that water restrictions prohibit the hosing of hard surfaces. Use brooms or mops to clean floors, or use rainwater or other water sources if you must use the hose. In most large carparks, commercial street / foothpath cleaning equipment can be used.

Appendix

Sydney Water benchmarks explained

Office building benchmarks

The water use efficiency benchmarks presented in Chapter 3 of these guidelines were developed with information gathered from 31 water efficiency audits conducted by the EDC Business Program. The buildings used in the sample were large and fitted with cooling towers.

Benchmark	Offices with cooling towers
Average practice and no leaks	1.01 kL/m²/year
Economic best practice (median of implementing water saving projects with two year paybacks)	0.84 kL/m²/year
Very well managed building	0.77 kL/m²/year

Office building benchmarks – without cooling towers

Benchmarks for buildings without cooling towers were developed by taking out the proportion of water use attributed to cooling towers. These adjusted benchmarks have not been verified against the population and should be interpreted as an indicative estimate.

Benchmark	Offices without cooling towers
Average practice and no leaks	0.64 kL/m²/year
Economic best practice (median of implementing water saving projects with two year paybacks)	0.47 kL/m²/year
Very well managed building	0.40 kL/m²/year

Office building benchmarks – with small retail areas

Benchmarks were also derived for office buildings that supply water to one or more retail tenants in the building. These benchmarks can be used if you are unable to separate the water consumed by retail tenancies within your office building.

Benchmark	Offices with small retail areas on common meters
Average practice and no leaks	1.08 kL/m²/year
Economic best practice (median of implementing two year paybacks)	0.90 kL/m²/year
Very well managed building	0.82 kL/m²/year

These adjusted benchmarks account for the additional water consumption used by retail activities within your building. They are derived based on the average impact of retail on office buildings within the sample sets – typically up to one level of retail in a multi level office tower.

The benchmarks should be interpreted in this context and may not be appropriate for large retail or food court installations. If you have large retail or food court areas in your building, install more sub meters to make sure you can keep track of water use.

Glossary

ABGR The Australian Building Greenhouse Rating System.

Backflow The unwanted reverse flow of water in the potable water system.

BASIX BASIX is a regulatory tool applied to new houses, home renovations and multi-unit dwellings in NSW

Bleed The water that is removed from a cooling tower to reduce the concentration of dissolved and suspended solids.

Cooling load The amount of heat which needs to be removed to keep an occupied building at a set temperature and the energy required to do this.

Cycles of concentration The number of times the concentration of dissolved and suspended solids in cooling tower water is increased because of evaporation. Four cycles of concentration means the concentration of solids has been increased by four.

Drift Water lost from a cooling tower as liquid droplets within the exhaust air. Drift does not include condensation.

GLA Gross Lettable Area is the floor space of a tenancy in a shopping centre.

HVAC Heating, ventilation and air conditioning.

Greenstar Greenstar is a building environmental rating system for buildings run by the Green Building Council of Australia.

LEED LEED is a USA standard for the design, construction and operation of high performance green buildings.

Legionella Bacteria that can cause a type of pneumonia is called Legionnaires Disease. Legionella bacteria can multiply rapidly in wet, warm conditions.

NABERS The National Australian Building Rating System, a voluntary building performance rating tool.

NLA Net Lettable Area, the floor space of a tenancy in a commercial office building.

One-2-Five® Water A management diagnostic process that analyses qualitative or non technical measures that all businesses must address to achieve sound water management. One-2-Five® is a patented process of Energetics Pty Ltd.

Phase change materials Materials that can store and release heat. Active phase change materials can change state, for example ice has a capacity to cool warmer, ambient air and absorb heat by melting.

Pre rinse spray valve A handheld nozzle used to remove food scraps from dishes before they washed.

Solenoid An electro mechanical device that activates a valve.

Splash In cooling towers, the water that can be lost because of falling water in the tower, or strong winds blowing through the tower.

SUDF Sewerage Usage Discharge Factor is a measure of the ratio of water going out of your business through the sewerage system compared to water coming in from Sydney Water mains.

Thermal Mass The amount of time building materials take to gain or release heat. A building with a high thermal mass will be more energy efficient because internal temperatures will not swing with outside air temperatures.

WELS Water Efficient Labelling Scheme. As part of the Water Efficient Labelling and Standards program, WELS gives products a star rating according to their water efficiency. An overview of water consumption required for WELS ratings is shown in Chapter 13 of these guidelines.

WaterMark™ WaterMark™ certification shows that water supply, sewerage, plumbing and drainage goods meet quality standards.

Wet bulb temperature The lowest temperature that can be obtained by evaporating water into the air at constant pressure. Wet bulb temperature will be lower than dry bulb temperature in the same conditions.

Index of illustrations

Part 1 Understanding your water use

Part 2 Technical water saving information

Part 2 Technical water saving information (continued)

Part 3 Alternative water sources

Every Drop Counts Business Program

Sydney Water's Every Drop Counts (EDC) Program helps large water using businesses, including commercial property owners and managers, save water by better management and cost effective technical measures.

Small to medium water using businesses can also use information provided by the EDC Business Program, such as fact sheets, best practice guidelines and marketing materials.

Contact us

For more information about the EDC Business Program, contact:

Email EDCBusiness@sydneywater.com.au

Phone 1800 661 161

Fax 02 9350 5942

Website www.sydneywater.com.au