



# Water Efficiency Audit

Office Block



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## EXECUTIVE SUMMARY

The Office Block site is primarily an office with a mixed gender workforce. The site also uses water for irrigation. The main water uses at the are irrigation (69%) and the showers (13%).

This water efficiency audit consisted of a thorough site inspection and the measurement of water flows and volumes. The audit also relies on interviews with site staff and relevant contractors. The audit has identified some water savings and a cost benefit analysis for these has been conducted. The audit also makes recommendations for other facets of water management at the site including self measurement of water use, and staff involvement in water management.

The audit has identified potential water savings of 888 kL per year of the current modelled annual water use of 1,514 kL. This is a water saving of 59%. The full water efficiency audit will cost \$11,972 to implement, providing annual financial savings of \$1,969 with a payback period of 6.1 years and an annual rate of return on the investment of 14%.

## Recommended Actions

### Action 1

It is **recommended** that the complete water efficiency retrofit be implemented using either water efficient urinal cisterns or waterless urinals. All of the components of the retrofit for the site are shown below.

- Adjust the irrigation system to operate no more than the 2 days allowed under the Water Corporation's permanent water efficiency measures for summer, and no irrigation for winter.
- the installation of a 4 Star WELS Rated (or better) 7.5 litres/minute flow control valve in the aerator housing of all sinks on site.

This entails the installation of 1 flow control valve in sink aerators.

The installation of flow control valves is **not recommended** in areas which have an instantaneous hot water system. Restricting flow from these units can cause them to malfunction.

- the installation of a 6 Star WELS Rated (or better) 4.5 litres/minute flow control valve in the aerator housing of all basins on site.

This entails the installation of 7 flow control valve in basin aerators.

- the installation of 3 Star WELS Rated water efficient showerheads in the shower facilities in the site.

There are 3 of these showerheads to be installed.

- The replacement of all single flush toilets, with 3 Star WELS Rated toilet suites.

This entails the installation of 7 dual flush toilets.

Some water users have reported minor waste removal problems with 4 Star Models (4.5 litre/3 litre). 3 Star models have a higher full flush volume and are a proven technology.

WELS Rated appliances and devices will carry this label.



Additional Information on WELS Rated products can be found at [www.waterrating.gov.au](http://www.waterrating.gov.au) and at **Appendix 2** of this report.

The prices used in this report have been supplied in good faith and after considering potential local price variables such as freight and so forth but prices may vary with individual site characteristics. Individual quotes for all water efficiency options in this report should be obtained before proceeding.

## Action 2

The following no cost water efficiency, or water management measures are considered to be appropriate for this site.

It is strongly **recommended** that a staff member should make weekly meter reads and record these. This will allow management to monitor any unexpected changes in water use which may be caused by leaks, vandalism or the unauthorised rescheduling of irrigation controllers. Water meter data sheets have been attached as Appendices to this report and electronically with an MS Excel worksheet also included to allow for the easy analysis of the meter data.

It is also **recommended** that a member of the staff be appointed responsible for future inspection of plumbing fixtures and fittings for leaks and organising their repair where necessary. All staff should be made aware of attempts to manage water use in and around the site and be invited to report leaks or make recommendations to the appointed staff member. Pro forma inspection sheets have been attached as Appendices to this report.

This water audit **recommends** that where applicable <sup>1</sup>, management specify WELS accredited appliances and devices for any future plumbing work at the site.

This water audit also **recommends** that management adopt an asset replacement policy which stipulates that all water using devices are replaced by a WELS rated device when those appliances reach the end of their working life. This will ensure continuous improvement in the level of water efficiency at the site.

The following table shows the appropriate Ratings

Item	WELS Star Rating	Water Use
Shower	3	No greater than 9 litres/minute
Sink Taps	4	No greater than 7.5 litres/minute
Basin Taps	6	No greater than 4.5 litres/minute
Toilets	3	6 litre/3 litre dual flush
Urinals	3	No more than 2 litres/stall or 2 l/600 mm of continuous wall urinal

### Action 3

Irrigation accounts for a significant proportion of total water use. For this reason it would be prudent for site managers to closely monitor irrigation water use, and constantly seek to improve water efficiency in this area.

Irrigation catch cups can be placed on lawns and gardens watered by sprinklers to determine the relationship between your irrigation run time and the depth of water it delivers. By using these catch cups, you can adjust the irrigation station run times to ensure that water is being used as efficiently as possible.

It is strongly **recommended** that these catch cups be used to establish the run time per station to deliver the “standard drink” for your area.

### Action 4

The average water use over past years has varied significantly and an average is difficult to calculate. It is **recommended** that managers record the water use in kL over the next 12 months and use this as a benchmark against which future water use is measured. It is **recommended** that any significant increase in water use (more than +/-15%) be cause for investigation by site managers.

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<sup>1</sup> WELS covers water use in toilets, urinals, taps, showers, washing machines, dishwashers.

## 1.0 INTRODUCTION

This report contains the results of a water efficiency audit of the Office Block. The audit was conducted by Geoff Diver as part of a water efficiency investigation initiated by facility managers for the Office Block.

The audit involved a thorough inspection of the site, the measurement of instantaneous water flow rates, checks for leaks and general observations on the use of all water outlets.

Wherever possible, assumptions relating to water use are based on interviews with staff. Other technical details have been taken from sources such as manufacturers specifications.

Outdoor water use was observed and measured to arrive at a water balance for the site (matching calculated and historical water use). Some observations and recommendations concerning irrigation have been made where appropriate.

## 2.0 SITE DESCRIPTION

The Office Block site is primarily an office with a mixed gender workforce. The site also uses water for irrigation. The main water uses at the are irrigation (69%) and the showers (13%).

## 3.0 HISTORICAL WATER USE

Figure 2 shows the metered water use at the Office Block. Water meter data has been converted back to average daily water use.

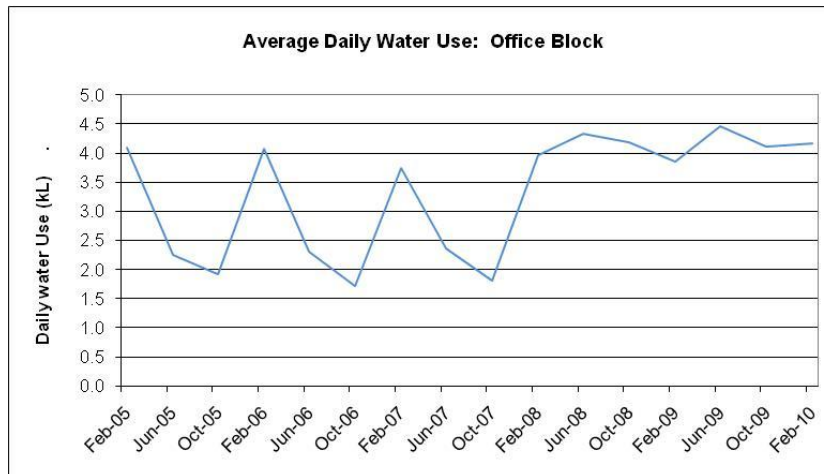


FIGURE 1: Average Daily Water Use, Office Block.

As Figure 1 shows, there is a cyclical pattern with summer peaks in water use, and winter troughs. This pattern of water use is usually driven by climate dependent uses such as irrigation and/or evaporative air conditioners. The pattern has been disrupted in recent years and the audit revealed that the appropriate winter settings for the irrigation system have not been applied in recent years.

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#### 4.0 WATER USE BY CATEGORY

As part of the water efficiency assessment, the potable water use in each category has been calculated for the site. The results of this are shown below.

Water use	Demand (kL/a)	Percentage
Irrigation	1,008	69
Shower	188	13
Toilet	93	6
Sink	65	4
Urinal	43	3
Leaks	35	2
Basin	22	1
<b>TOTAL</b>	<b>1,454</b>	<b>100</b>

TABLE 1: Modeled annual water use by category, Office Block.

This is also shown below.

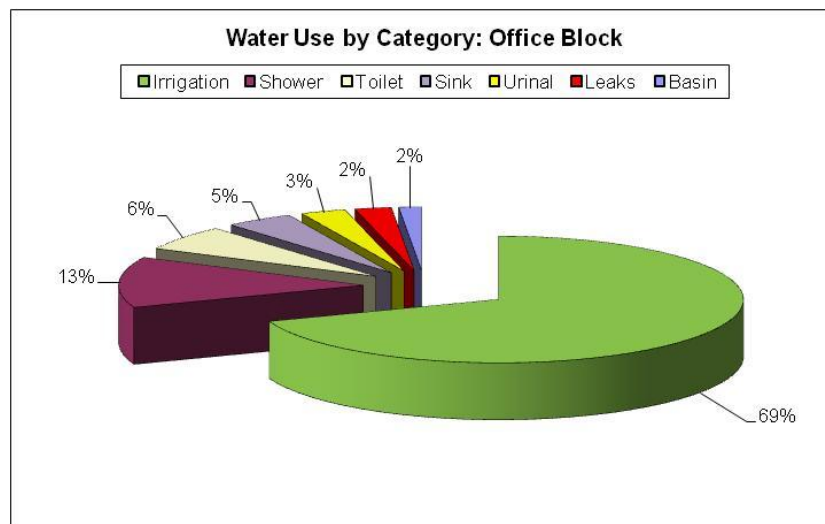


FIGURE 2: Modeled annual water use by category, Office Block.

The following sections contain observations on water use at a number of areas within the site and the potential water savings that could be made if the suggested water efficiency plan is fully implemented.

#### 5.0 WATER USE AND POTENTIAL WATER SAVINGS

##### 5.1 Ablutions

There is one main toilet block containing the male and female bathrooms as well as one unisex disabled bathroom. All the urinals are single flush models with a flush volume of approximately 9 to 11 litres. Toilets also had single flush volumes of approximately 9 to 11 litres.

The basins in the main toilet block all had aerators present and, on average, had a flow rate of 8 litres/minute.

The showerheads in the main toilet block are not water efficient and have a flow rate of about 14 litres/min.

Single flush toilets can be replaced with 3 Star WELS Rated suites or 4 Star WELS rated suites to give flush volumes of 6 litres/3 litres or 4.5 litres/3 litres<sup>2</sup> respectively. This will reduce average flush volumes significantly and reduce water use.

There are 4 main options for water savings in urinals. These are:

- Reduced cistern volumes
- Reduced cistern volumes and motion sensors
- Reduced cistern volumes and urine sensors
- Waterless urinals

Detailed information on these is shown at **Appendix 1** of the audit report.

All or any of the options listed in **Appendix 1** are suitable water efficiency measures. The exact choice will depend on the outcome sought by individual managers, and the characteristics (such as traffic flow) of the urinals in question.

The simplest and “safest” **recommendation** would be to retrofit urinals to have a 3 Star WELS rating of not more than 2 litres or less per stall per flush. In the case of stainless steel troughs, the rating is for 2 litres or less for every 600 mm of continuous trough.

It would be the **recommendation** of this report that only purpose built waterless urinals with either a mechanical or oil based seal be used if waterless urinals are to be considered.

Most waterless urinal systems also require ongoing expenditure for items such as oil cartridges, siphon units and the like. The cost benefit analysis on this report makes an allowance of \$130/unit/year for 10 years for these items.

**Waterless urinals have far higher concentrations of salts and chemicals in the waste flow than water models. These chemicals can be corrosive to old plumbing systems, and plumbing systems which use copper or copper alloy pipes.**

As a result, it is **very strongly recommended** that waterless urinals be connected to PVC plumbing systems and that old or copper based sewer systems to urinals be replaced with PVC when the units are being installed.

These costs have not been factored into the cost benefit analysis although half a day per unit of labour at \$75/hour has been included. Thus it is envisaged that the only additional costs which may have been overlooked are short runs of PVC piping. These are relatively inexpensive when compared to the cost of purchasing and installing the waterless urinals and the cost benefit analysis presented in this report is therefore more likely to be accurate.

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<sup>2</sup> Some water users have reported minor waste removal problems with 4 Star Models. 3 Star models have a higher full flush volume and are a proven technology.

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Flow rates in basins were found to be higher than necessary. WELS Rated flow control valves can be fitted to the taps in basins (4.5 litres/minute) to regulate the flow and avoid potential water waste. These can either be fitted directly into the tap body, in the plumbing line to the tap, or in the aerator housing of basin taps which are aerator equipped.

The installation of flow control valves is not needed in areas which have an instantaneous hot water system. Restricting the output from these can cause them to malfunction.

The showers in the site have flow rates higher than the recommended 9 litres per minute. It is recommended that these be replaced with 3 Star WELS Rated water efficient showerheads.

## **5.2 Kitchens/Food Preparation**

The site contains the normal staff tea/coffee/lunch facilities with a kitchen sink.

Flow rates in some sinks were also found to be higher than necessary. Once again, WELS Rated flow control valves can be fitted to the taps in sinks (7.5 litres per minute) to regulate the flow and avoid potential water waste.

## **5.3 Cooling Tower/Evaporative Air Conditioning**

A number of split system air conditioning units operate on the site, mainly in the office block. These do not use water.

## **5.4 Garden & Irrigation**

The irrigation system at the Office Block is fed directly from the main water supply. As a result, all garden and lawn irrigation is charged at the full water tariff.

The audit uncovered that the system operates all year round at 5 days per week. This is in contravention to the Water Corporation's permanent water efficiency measures. It is recommended that the system be adjusted to operate no more than 2 days per week in summer, and not to operate at all in winter.

As irrigation accounts for a significant proportion of total water use it would be prudent for site managers to closely monitor irrigation water use and constantly seek to improve water efficiency in this area.

Key areas of irrigation water use include:

- *Irrigation design.* ensure that all irrigated surfaces receive water at the same rate. This requires accurate sprinkler head spacing, and the use of similar sprinkler heads throughout the station.
- *System maintenance.* ensure that individual systems are checked regularly for missing or damaged sprinkler heads, sticking solenoids, or broken pipes. ***This is especially important for systems which run automatically through non-business hours when no-one is present to see faults.***
- *Run times.* commercial irrigation systems can have high flow rates. Extra minutes/day can add significantly to annual water use, and water bills.
- *Seasonal management.* adjust down the run times down in wetter months.
- *Episode management.* adjust down the run times down after rain events.

- *Hydro-zoning.* plant individual beds or sections of grounds with plants which have a similar water demand. Irrigate these groups of plants on single systems. Mixing plants of differing water demands means that all the plants in the beds need to be watered to the level of the most water intensive plant in the garden. This leads to excessive water use.

Irrigation catch cups which can be placed on lawns and gardens watered by sprinklers to determine the relationship between your irrigation run time and the depth of water it delivers. By using these catch cups, one can adjust the irrigation station run times to ensure water is being used as efficiently as possible.



FIGURE 3: Irrigation catch cups.

It is strongly **recommended** that these catch cups be used to establish the run time per station to deliver the “standard drink” for your local conditions.

### 5.5 Fire System

There is no fixed fire system service using water present on site.

### 5.6 Water Use Summary

The following diagram shows water sources, flows and sumps when all water sources at the site are considered.

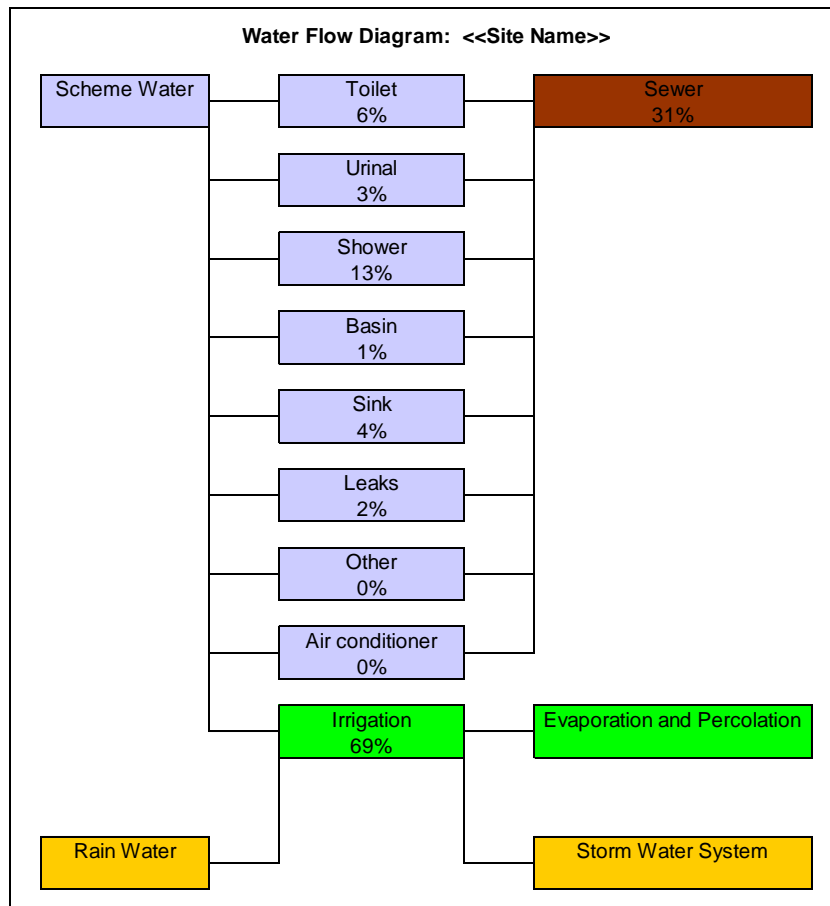


FIGURE 4: Flow diagram of current water use at Office Block.

### 5.7 Water Use Benchmark

The average water use over past years has varied significantly and an average is difficult to calculate. It is **recommended** that managers record the water use in kL over the next 12 months and use this as a benchmark against which future water use is measured. It is **recommended** that any significant increase in water use (more than +/-15%) be cause for investigation by site managers.

## 6.0 SUMMARY OF POTENTIAL WATER SAVINGS

This report has identified potential water savings of 888 kilolitres per annum (888,000 litres per annum). The water savings can be realised through the installation of water efficient hardware. As a consequence, the water savings would be “locked in”, and not dependent on the actions of water users at the site.

The estimated 888 kilolitres per annum in potential water savings contains hot water savings of 49 kilolitres per annum. Hot water savings have the added advantage of reducing energy consumption via avoided water heating.

## 7.0 OTHER AUDIT FINDINGS / INFORMATION

### 7.1 Record Keeping

One of the best water management tools at your disposal is your own Water Corporation water meter. These meters are very accurate and can detect even the smallest water use.

An MS Excel workbook is included to allow for the easy analysis of the meter data. The first page of the workbook contains instructions for its use. The workbook also contains an electronic copy of the meter read sheets to allow you to print off copies as required.

It is **recommended** that the main meter be read at approximately the same time each week. The date and the reading are then entered into the MS Excel spreadsheet which will automatically graph the water use for the period. Any anomalies will present as a spike in the graph. Appropriate investigations should be undertaken should this occur.

Details on how to read the your water meter are shown in **Appendix 3** of this report.

### 7.2 Leak Inspection

Site managers need to be vigilant to ensure that leaks do not go undetected. It is **recommended** that a member of the staff be appointed responsible for future inspection of plumbing fixtures and fittings for leaks and organising their repair where necessary. All staff should be made aware of attempts to manage water use in and around the site and be invited to report leaks or make recommendations to the appointed staff member.

Pro forma inspection sheets have been included as **Appendix 4** of this report.

### 7.3 Asset Replacement Policy

This water audit also **recommends** that management adopt an asset replacement policy which stipulates that all water using devices are replaced by a WELS rated device when those appliances reach the end of their working life. This will ensure continuous improvement in the level of water efficiency at the site. The appropriate Ratings are shown below.

Item	WELS Star Rating	Water Use
Shower	3	No greater than 9 litres/minute
Sink Taps	4	No greater than 7.5 litres/minute
Basin Taps	6	No greater than 4.5 litres/minute
Toilets	3	6 litre/3 litre dual flush
Urinals	3	No more than 2 litres/stall or 2 l/600 mm of continuous wall urinal

TABLE 2: WELS Ratings.

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## 8.0 FINANCIAL ANALYSIS

### 8.1 Retrofit

This section shows the financial costs and benefits of the proposed water efficiency retrofit for the site. Costs include labour but will need to be confirmed by calling for quotations from a plumbing contractor. Benefits include water savings, savings in sewerage discharge tariffs, and energy savings which arise from avoided water heating.

Financial model inputs, along with information on various rates and charges levied by the Water Corporation, and notes on the calculation of the cost of hot water are shown in **Appendix 5** of this report.

Water saving action	Cost (\$)	Savings (\$/a)	Payback period (years)	Cumulative payback (years)
Irrigation savings	\$0	\$1,006	0.0	0.0
Sink retrofit	\$50	\$144	0.3	0.0
Shower retrofit	\$192	\$427	0.4	0.2
Basin retrofit	\$350	\$47	7.5	0.4
Urinal retrofit	\$5,440	\$167	32.7	3.4
Toilet retrofit	\$5,940	\$179	33.2	6.1
<b>TOTAL</b>	<b>\$11,972</b>	<b>\$1,969</b>	<b>6.1</b>	<b>6.1</b>

TABLE 3: Costs and benefits of proposed water efficiency audit, Office Block.

The proposed water efficiency retrofit for the building is cost effective with a payback period of approximately 3.6 years. Most of the individual components are cost effective in their own right with the least effective being the toilet and urinal modifications. By implementing all water saving actions at once, the Office Block can maximise potential water savings while retaining an attractive investment offer. The annual return on the investment for all components of the water efficiency retrofit are shown in Table 4.

Water saving action	Annual return on investment
Irrigation savings	N/A
Sink retrofit	288%
Shower retrofit	222%
Basin retrofit	10%
Urinal retrofit	-8%
Toilet retrofit	-9%
<b>TOTAL</b>	<b>14%</b>

TABLE 4: Annual return on investment of proposed water efficiency measures, Office Block.

## 8.2 Discharge To Sewer

With the exception of the irrigation, all of the water uses with potential for increased water efficiency have a 100% discharge to sewer. Implementation of the water efficiency measures at the Office Block would therefore result in a drop in sewer discharge of 888 kilolitres per annum.

This is important as the Water Corporation uses a system of charging for wastewater based on estimated sewer volumes. The estimate is the percentage of water coming onto the site through the meter which is judged to subsequently leave the site via the sewer.

The “discharge factor” has been calculated as part of the water use model used for this report. The discharge factor for Office Block before the water efficient retrofit is 29%, with a discharge factor of 42% if the work goes ahead.

Billing information shows that the site is currently assessed as having a discharge factor of 95%. Site managers can therefore apply to have the discharge factor varied citing this report as supporting evidence. This should result in a financial saving of \$2,722 p.a.

## 9.0 RECOMMENDATIONS

It is strongly **recommended** that catch cups be used to establish the run time per station to deliver the “standard drink” for your local conditions.

It is **recommended** that the main meter be read at approximately the same time each week. The date and the reading are then entered into the MS Excel spreadsheet which will automatically graph the water use for the period. Any anomalies will present as a spike in the graph. Appropriate investigations should be undertaken should this occur. Details on how to read the your water meter are shown in **Appendix 3** of this report.

It is **recommended** that a member of the staff be appointed responsible for future inspection of plumbing fixtures and fittings for leaks and organising their repair where necessary. Pro forma inspection sheets have been included as **Appendix 4** of this report.

This water audit **recommends** that management use WELS accredited appliances with a rating of at least three stars and devices for any water efficiency retrofit.

This water audit also **recommends** that management adopt an asset replacement policy which stipulates that all water using devices are replaced by a WELS rated device when they reach the end of their working life.

The average water use over past years has varied significantly and an average is difficult to calculate. It is **recommended** that managers record the water use in kL over the next 12 months and use this as a benchmark against which future water use is measured. It is **recommended** that any significant increase in water use (more than +/-15%) be cause for investigation by site managers.

In light of a projected 14% return on investment, it is recommended that the complete Water Saving Retrofit be implemented.