Green Star Water Calculator
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Potable Water Calculator Guide

Green Star Design & As-built: Wat-1

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Green Star Design & As-built: Wat-1

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1.0 Introduction

The Green Building Council of Australia (GBCA) has developed a Potable Water Calculator (the Calculator) used in Green Star - Design & As-built to estimate potable water consumption associated with buildings. The Calculator returns the number of points awarded for the Green Star credit Wat-1 ‘Potable Water’ under the modelled water balance approach . This guide should be used in conjunction with the Potable Water Calculator in the Green Star - Design & As-built rating tool.

The Calculator determines the points awarded based on the usage of potable water in:

- Sanitation
- Whitegoods
- HVAC system heat rejection
- Landscape irrigation
- Fire protection sprinkler system testing
- Swimming pools
- Process cooling

The water demand associated with the above uses, which are applicable to the project, are calculated monthly and prorated daily.

$$V_{Total} = V_{sanitation} + V_{whitegoods} + V_{HVAC} + V_{irrigation} + V_{fire} + V_{pool} + V_{process}$$

Where:

$V_{Total} =$ daily water demand

$V_{sanitation} =$ daily sanitation water demand

$V_{whitegoods} =$ daily whitegoods water demand

$V_{HVAC} =$ daily HVAC system heat rejection water demand

$V_{irrigation} =$ daily landscape irrigation water demand

$V_{fire} =$ daily fire protection sprinkler system testing water demand

$V_{pool} =$ daily swimming pool water demand

$V_{process} =$ daily process cooling water demand

The available non-potable water is subtracted from the daily consumption figure to calculate a daily potable water demand.

$$V_{pot,total} = V_{Total} + V_{non-pot,total}$$

Where

$V_{pot,total} =$ daily potable water demand

$V_{Total} =$ daily water demand

$V_{non-pot,total}$
$=$ daily supply of nonpotable water (rainwater, greywater, blackwater, stormwater and off site supply)

A daily calculation time step has been implemented to provide sensitivity to the calculator’s rain water reuse calculation in relation to tank overflow. Other seasonally dependent uses such as HVAC system heat rejection and landscape irrigation are calculated on a monthly basis but prorated daily. The daily timestep has been applied to any water recycling and reuse systems included in the project.

It should be noted that the GBCA assumes that thorough calculations and dimensioning of all components in water reuse system have been undertaken in addition to the Green Star submission. The GBCA will not accept any responsibility for the dimensioning and functionality of the water recycling and re-use designs that are being assessed under Green Star - Design & As Built.

2.0 The Water Category

2.1 How points are awarded in Wat-1 'potable water

Up to ten points are awarded for reductions in potable water usage compared to the water usage in a building with standard practice water usage, as per the percentage improvements in Table 1 . Points are awarded for improvements on standard practice performance.

The standard practice benchmark represents water usage for a building designed to the level of standard practice; descriptions of how standard practice is defined are included in each section of this guide.

Points awarded	Percentage reduction compared to standard practice benchmark
0	0%
1	5%
2	15%
3	25%
4	35%
5	45%
6	55%
7	65%
8	75%
9	85%
10	95%

Table 1 Points Allocation for the Green Star credit Wat-1

It should be noted that, as percentage reductions are rewarded with Green Star points, the absolute water consumption for the benchmark varies depending on the building's characteristics.

An additional two points are awarded for the following uses (one point each):

1) compliance with fire protection system test water requirements

2) compliance with process cooling water requirements.

Where either of these two uses is not applicable to the project, the weighting of the percentage reduction points available in Table 1 will be increased so that the Calculator will always award a score out of 12.

3.0 Building Occupancy, Areas and Operation

An estimation of how many people are occupying the building and how much time they spend in the building is done to determine how often the fixtures and fittings in the building are used and how much greywater and blackwater is available for re-use. These parameters are estimated based on the building's design.

Where a building's purpose is to cater for sporting activities where the users will need, and use, shower facilities (e.g. swimming pool), the project team are required to provide an estimation of the number of users per day and the number of days per year the building operates in this capacity.

3.1 Calculation methodology

To calculate the water demands from fixtures and fittings, it is necessary to estimate how many people are occupying the building, as well as how much time they spend in the building. The concept of person-hours is used in this calculation methodology. A person-hour means that one person has spent one hour in the space. The number of person-hours per month for each space is calculated as follows:

$$Hours_{person} = \frac{A_{space}}{Occupancy_{design}} \times Hours_{Equivalent}$$

Where:

$Hours_{person} = \text{Person hours per month}$

$A_{space} = area\ of\ space$

$Occupancy_{design} = maximum\ design\ occupancy\ of\ A_{space}$

$Hours_{Equivalent} = Equivalent\ hours\ at\ max\ occupancy\ in\ month$

And:

$$Hours_{Equivalent} = \left(Hours_{Equivalent,peak} \times Days_{peak}\right) + \left(Hours_{Equivalent,offpeak} \times Days_{offpeak}\right)$$

Where:

$Hours_{Equivalent,peak} = Equivalent\ hours\ at\ maximum\ occupancy\ in\ a\ peak\ day\ (hours)$

$Days_{peak} = Number\ of\ peak\ days\ per\ month$

$Hours_{Equivalent,offpeak} = Equivalent\ hours\ at\ maximum\ occupancy\ in\ an\ offpeak\ day\ (hours)$

$Days_{offpeak} = Number\ of\ offpeak\ days\ per\ month$

The equivalent hours at maximum occupancy in a peak or off-peak day is calculated by summing the percentages in the relevant occupancy profile. This figure represents the equivalent number of hours that the space is occupied at maximum design occupancy. For example, the first occupancy profile shown in Table 2 (the NCC Table 2b 'peak day' profile) describes a space that is occupied from 7am until 9pm. The occupancy in this space varies from 15% at 7am, up to 100% at 9am down to 5% at 8pm. By summing the percentages we calculate that the equivalent hours at maximum occupancy is 9.5 hours on a 'peak' day for this space type.

The number of staff present at peak and off-peak times during the day is needed to estimate the water demand from staff showers. The following calculation is for a peak day, the same is undertaken in the spreadsheet for off-peak days:

$$Staff_{peak} = \frac{A_{space}}{Occupancy_{design}} \times \%_{occupancy} \times \%_{Staff}$$

Where:

$Staff_{peak} = Number\ of\ staff\ present\ on\ a\ peak\ day$

$A_{space} = area\ of\ space$

$Occupancy_{design} = maximum\ design\ occupancy\ of\ A_{space}$

$\%_{occupancy} = Maximum\ percentage\ of\ design\ occupancy\ present\ during\ peak\ day$

$\%_{Staff} = Percentage\ of\ occupants\ who\ are\ staff\ (that\ use\ the\ space\ as\ their\ primary\ place\ of\ work)$

The exception to the above is the showers installed for sports facilities, where the water demand is more closely related to patronage engaging in sporting activities. The daily patronage of occupants engaging in sports activities is multiplied with the number of days the facility operates, in order to estimate the annual water consumption associated with shower amenities installed for sports participants. The monthly water consumption is then determined by dividing the annual water consumption by the number of days in a year and multiplying the result by the number of days for each month.

3.2 Data entry requirement

The building should be divided into space types with different occupancy levels and patterns. For more information on how to do this, refer to Appendix XXXX of the Green Star – Design & As-built Greenhouse Gas Emissions Calculator Guide. The following data must be entered for all occupied[1] space types:

1) Area, entered in m^2

2) Number of 'peak' days of operation per week - the number of days per typical week the space is occupied as described in the relevant 'peak' occupancy profile. The remaining days are assumed to follow the off-peak profile.

3) Occupancy profiles – the way the space is occupied must be entered by either:

   a) Selecting one of the four sets of default occupancy profiles (the default occupancy profiles are based on those included in Section J of the NCC 2013, see Table 2 ; or

   b) Entering peak and off-peak profiles into the spreadsheet manually. This options should be used where none of the existing profiles are suitable for the space type (see Figure 1)

The profiles used in this Calculator must correlate with those used in the Greenhouse Gas Emissions Calculator.

4) Maximum design occupancy – the maximum design occupancy must be entered by either:

   a) Selecting one of the default values as per table D1.13 of the NCC; or.

   b) Entering the maximum design occupancy manually.

5) Percentage of occupants who are staff, and use the space as their primary place of work – for example, in an office, 100% of occupants can be assumed to be staff that uses the space as their primary place of work, whereas in an exhibition space, perhaps only 5% of occupants would be staff. This figure needs to be determined by the design team. It is used to estimate the number of staff in the building, a parameter required to calculate the water demand from staff showers (it is assumed that only staff will use the staff shower facilities). Only the staff that uses the space as primary places of work must be included in the percentage entered; this is so that staff are not double-counted as they move around the building.

[1] Occupied spaces include all spaces in the building except for those with no or low/transient occupancy such as stairwells, corridors and storage rooms.

Time period	NCC Table 2b (Class 5 building, Class 8 laboratory or Class 9a clinic, Day surgery or procedure unit)		NCC Table 2c (Class 6 shop or shopping centre)		NCC Table 2d (Class 6 restaurant or cafe)		NCC Table 2f (Class 9b theatre or cinema)	
	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak	Peak	Off-peak
12:00am to 1:00am	0%	0%	0%	0%	0%	0%	0%	0%
1:00am to 2:00am	0%	0%	0%	0%	0%	0%	0%	0%
2:00am to 3:00am	0%	0%	0%	0%	0%	0%	0%	0%
3:00am to 4:00am	0%	0%	0%	0%	0%	0%	0%	0%
4:00am to 5:00am	0%	0%	0%	0%	0%	0%	0%	0%
5:00am to 6:00am	0%	0%	0%	0%	0%	0%	0%	0%
6:00am to 7:00am	0%	0%	0%	0%	5%	0%	0%	0%
7:00am to 8:00am	15%	0%	10%	0%	5%	0%	0%	0%
8:00am to 9:00am	60%	0%	20%	0%	5%	0%	20%	0%
9:00am to 10:00am	100%	0%	20%	0%	5%	0%	80%	0%
10:00am to 11:00am	100%	0%	15%	0%	20%	0%	80%	0%
11:00am to 12:00pm	100%	0%	25%	0%	50%	0%	80%	0%
12:00pm to 1:00pm	100%	0%	25%	0%	80%	0%	20%	20%
1:00pm to 2:00pm	100%	0%	15%	0%	70%	0%	80%	80%
2:00pm to 3:00pm	100%	0%	15%	0%	40%	0%	80%	80%
3:00pm to 4:00pm	100%	0%	15%	0%	20%	0%	80%	80%
4:00pm to 5:00pm	100%	0%	15%	0%	25%	0%	80%	80%
5:00pm to 6:00pm	50%	0%	5%	0%	50%	0%	20%	20%
6:00pm to 7:00pm	15%	0%	5%	0%	80%	0%	20%	20%
7:00pm to 8:00pm	5%	0%	0%	0%	80%	0%	80%	80%
8:00pm to 9:00pm	5%	0%	0%	0%	80%	0%	80%	80%
9:00pm to 10:00pm	0%	0%	0%	0%	50%	0%	80%	80%
10:00pm to 11:00pm	0%	0%	0%	0%	35%	0%	80%	80%
11:00pm to 12:00am	0%	0%	0%	0%	20%	0%	10%	10%
Equivalent hours at maximum occupancy	**9.5**	**0**	**1.85**	**0**	**7.2**	**0**	**9.7**	**7.1**

Table 2 Default occupancy profiles included in the calculator

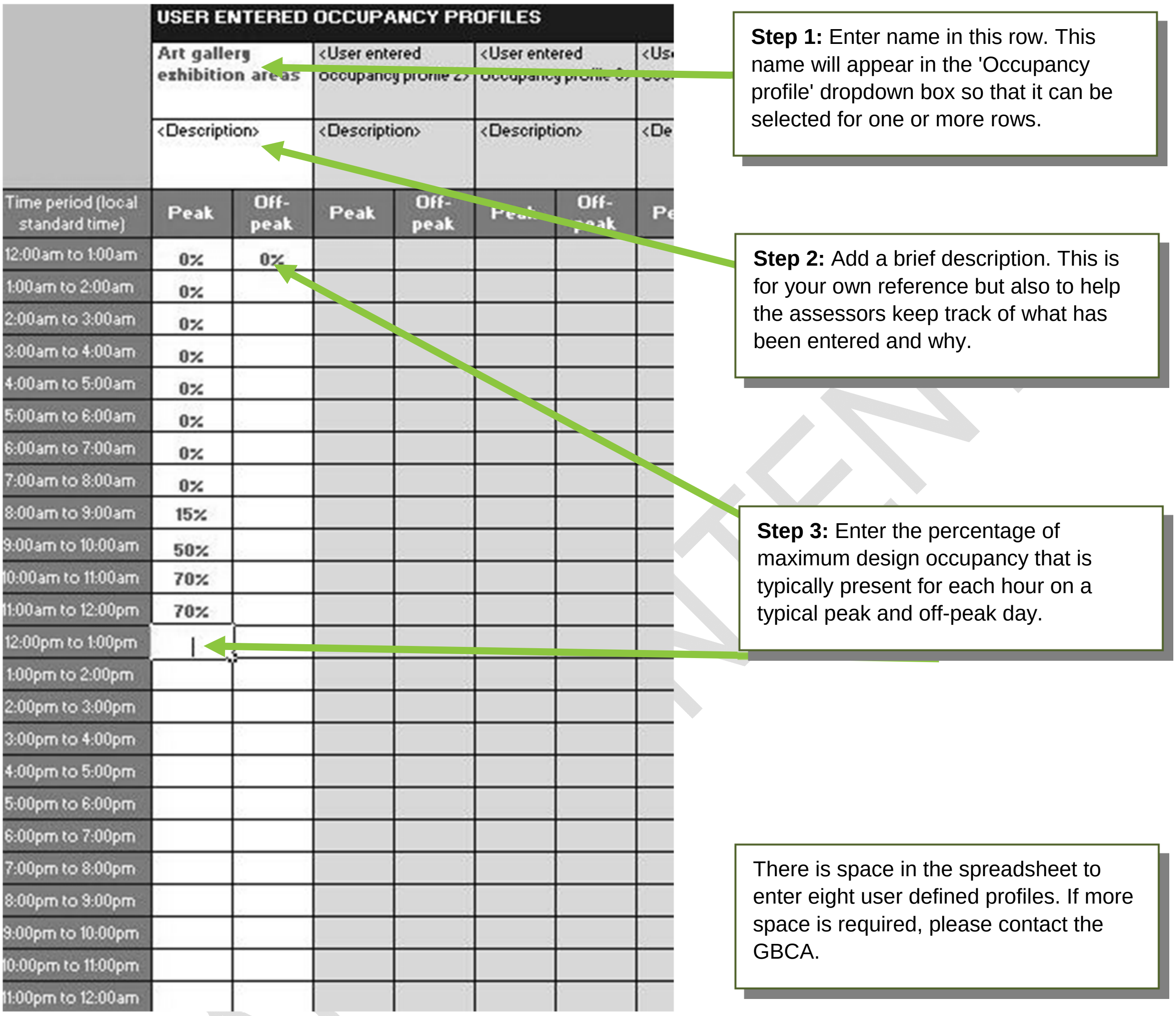

Figure 1 **How to enter profiles manually into the spreadsheet**

4.0 Building Checklist

The building checklist asks a series of yes/no questions in order to determine the inputs required throughout the remainder of the Calculator. This information is also used to help determine the boundaries of the Standard Practice Building's water consumption. All questions must be answered. The table below briefly elaborates on the questions asked within the Calculator.

Building Checklist Question	Comments
1. Sanitation	
- Are fixtures and fittings provided for building occupant sanitation?	Select 'yes' where the project includes any toilets, urinals, taps or showers.
- Does the project provide for sports activities?	Select 'yes' where the project includes a sporting facility as a part of the rated project. For example, the project might include a swimming pool, a gym, or a basketball court.
- Have showers been installed for post/pre activity use?	Select 'yes' where additional shower and change room facilities have been installed to support the installation of the sports facility.
2. White Goods	
- Does the project include any dishwashers or clothes washing machines?	Select 'yes' where the project will include the specification and installation of dishwashers or clothes washing machines. This includes both domestic and commercial applications of these two items.
3. HVAC	
- Does the project utilise water based heat rejection (building cooling)?	Select 'yes' where the project is utilising water-based heat rejection equipment. This includes conventional cooling towers, in addition to hybrid air/water cooled equipment. Select 'no' if the project will utilise an air-based heat rejection system.
- Does the project have cooling towers?	Select 'yes' where the project is utilising conventional water-based cooling towers.
- Does the project contain any other water cooled systems that are not conventional cooling towers?	Select 'yes' where the project is utilising other hybrid air/water cooled equipment for heat rejection. The Calculator permits project teams to enter a combination of these system types for the Proposed Building.
4. Irrigation	
- Are there any landscaped areas within the project?	Select 'yes' where landscaped areas have been included in the project. All landscape areas should be considered here whether irrigated or not. This includes xeriscape gardens.
- Are any irrigation systems included in the project?	Select 'yes' where irrigation systems are included within the project.
5. Swimming Pools	
- Are there any swimming pools within the project?	Select 'yes' where any swimming pools or spas are included within the project.
6. Fire Protection System Water	
- Does the project include a fire protection system?	Select 'yes' where the project includes a water-based fire protection system, even where this is just a partial water-based solution.
7. Process Cooling	
- Does the project include any water based process cooling?	Select 'yes' where the project includes equipment that requires water for process cooling.
8. Water Reclamation	
- Does any water collection, reclamation and/or reuse occur on the project site?	Select 'yes' where any form of reclaimed water capture is present on the project.
- Does the project include rainwater	Select 'yes' where the project includes a rainwater tank for the capture

Building Checklist Question	Comments
capture and reuse systems?	and reuse of rainwater on site.
- Does the project include greywater capture, treatment and reuse systems?	Select 'yes' where the project includes greywater collection and treatment for reuse on site.
- Does the project include blackwater capture, treatment and reuse systems?	Select 'yes' where the project includes blackwater collection and treatment for reuse on site.
- Does the project include other stormwater reuse or an off-site supply of non-potable water?	Select 'yes' where either stormwater is captured for reuse, or a recycled water supply is available for use within the project.

5.0 Fixtures and Fittings

5.1 Calculation methodology

The total water demand from fixtures and fittings is calculated as follows:

5.1.1 Monthly water demand from toilets, urinals and taps

The following calculations are for toilets, the same calculations are done for urinals and taps. The monthly results described by the following methodology are prorated daily as discussed in section 1.0.

$$\dot{V}_{fixture\ or\ fitting,month} = Uses_{fixture\ or\ fitting,month} \times Efficiency_{fixture\ or\ fitting}$$

Where:

$\dot{V}_{fixture\ or\ fitting\ ,month}$ = Monthly water demand from fixture or fitting (l/month)

$Uses_{fixture\ or\ fitting,month}$ = Number of fixture or fitting uses per month

$Efficiency_{fixture\ or\ fitting}$ = Average water efficiency of fixture or fitting (L/use, L/min, etc)

And:

$$Uses_{fixture\ or\ fitting,month} = Hours_{person} \times Usage_{fixture\ or\ fitting}$$

Where:

$Hours_{person}$ = Number of person hours per month

$Usage_{fixture\ or\ fitting}$ = Usage rate (as per Table 3)

and:

$$Efficiency_{fixture\ or\ fitting} = (\%_A \times \dot{V}_A) + (\%_B \times \dot{V}_B) + \ldots$$

Where:

$\%_x$ = Percentage (fixture or fitting x)

$\dot{V}_x$ = Water consumption (fixture or fitting x)

Fixture/Fitting	Number of uses per person per day (based on data for 9.5 hour work day)	Uses per person-hour
Toilet - no urinals	2.3	0.24
Toilet with urinals	1.3	0.14
Urinal	2	0.21
Taps	2.5	0.26

Table 3 Assumed usage rates of toilets, urinals and taps

5.1.2 Monthly water demand from staff showers

$$\dot{V}_{staff\ shower,month} = Uses_{staff\ shower,month} \times Efficiency_{staff\ shower} \times Length_{staff\ shower}$$

Where:

$\dot{V}_{staff\ shower,month} = Monthly\ water\ demand\ from\ staff\ showers\ (L/month)$

$Uses_{staff\ shower,month}$ = Number of staff shower uses per month

[2] This is the equivalent hours at maximum occupancy for an office space as defined in NCC Table 2b Occupancy and operational profiles of a Class 5 building, Class 8 laboratory or Class 9a clinic, Day surgery or procedure unit.

$Efficiency_{staff\ shower}$ = Average $staff\ shower$ water efficiency (L/minute)

$Length_{staff\ shower} = Average\ length\ of\ staff\ shower (minutes)$

And:

$$Uses_{staff\ shower,month} = Staff_{peak} \times \%_{staff,shower} \times Days_{peak} + Staff_{off\ peak} \times \%_{staff,shower} \times Days_{off\ peak}$$

Where:

$Staff_{peak}$ = Number of uses on peak or off peak days per month

$\%_{staff,shower}$ = Percentage of staff who shower (as per Table 4)

$Days_{peak}$ = Number of peak or offpeak days per month

And:

$$Efficiency_{staff\ shower} = (\%_a \times \dot{V}_a) + (\%_b \times \dot{V}_b) + \ldots$$

$\%_x$ = Percentage ($staff\ shower$x)

$\dot{V}_x$ = Water consumption ($staff\ shower$x)

And:

$$Length_{staff\ shower} = 5min$$

Description	Percentage of staff that use showers
No showers installed	0%
No significant gym or cyclist facilities	5%
1 point achieved in Tra-3 'Cyclist Facilities' (or gym provided)	10%
2 points achieved in Tra-3 'Cyclist Facilities'	15%

Table 4 Assumed percentage of staff that use showers

5.1.3 Monthly water demand from sports showers

$$\dot{V}_{sport\ shower,month} = Uses_{sport\ shower,month} \times Efficiency_{sport\ shower} \times Length_{sport\ shower}$$

Where:

$\dot{V}_{sport\ shower,month} = Monthly\ water\ demand\ from\ sport\ showers\ (L/month)$

$Uses_{sport\ shower,month}$ = Number of sport shower uses per month

$Efficiency_{sport\ shower}$ = Average $sport\ shower$ water efficiency (L/minute)

$Length_{sport\ shower} = Average\ length\ of\ sport\ shower (minutes)$

Where:

$$Uses_{sport\ shower,month} = \frac{Days_{open}}{365} \times Days_{month} \times Patronage_{average}$$

Where:

$Days_{open}$ = Number of days sporting facilities used per year

$Days_{month}$ = Number of days per month

$Patronage_{average}$ = Average daily patronage by sport participants

$$Efficiency_{sport\ shower} = (\%_a \times \dot{V}_a) + (\%_b \times \dot{V}_b) + \ldots$$

$\%_x$ = Percentage (*sport shower*x)

$\dot{V}_x$ = Water consumption (*sport shower*x)

And:

$$Length_{sport\ shower} = 5min$$

5.1.4 Total monthly water consumption

Total monthly water consumption = Monthly water consumption (Toilets) + Monthly water consumption (Urinals) + Monthly water consumption (Taps) + Monthly water consumption (Staff Showers) + Monthly water consumption (Sports Showers).

5.2 Data entry requirement

Data about the fixtures and fittings included in the project should be entered into the 'Sanitation' section. The following information is required for each type of toilet, urinal, tap and shower being installed in the project:

1) The water efficiency of the fitting – this can be entered by either:

   a) Selecting the WELS Star Rating from the drop down menu. In this case, the corresponding water efficiency is automatically generated in the adjacent grey cell. A WELS star rating is awarded when the efficiency of a fixture is between a defined maximum and minimum water efficiency for that star rating; the efficiency with the highest water usage allowed for that particular WELS star rating is generated by the Calculator.

Or

   b) Manually entering the actual water efficiency, if known.

2) The percentage of fittings of this type that are to be installed with this water efficiency.

Additional information required for urinals

3) Are urinals to be installed? – Select yes or no from the drop down menu.

For urinals on autotimer, the following information is required (if no urinals on autotimer are being installed, leave these sections blank).

i) Average water efficiency (L/flush).

ii) Number of urinals on autotimer being installed.

iii) Percentage of all urinals in the building that are on autotimer.

Additional information required for staff showers:

4) Level of staff shower demand – Select from the drop down menu: No showers installed; no significant gym or cycling facilities, one credit achieved in Tra-3 or gym facilities provided; or two credits achieved in Tra-3.

Additional information required for sport showers:

5) Average expected patronage by sports participants.

6) Expected number of days per year that sporting facilities are open for use.

5.3 Standard Practice Benchmark Water Efficiency – Sanitation

The water efficiency of fixtures and fittings used to determine the total benchmark water consumption is presented in Table 5 .

Fixture/fitting	Water efficiency WELS rating and water consumption
Toilet	3 Star (4L/flush)
Urinals	3 Star (2L/flush)
Taps	4 Star (7.5L/min)
Showers	3 Star (9L/min)

Table 5 Standard Practice Benchmark water efficiency - Sanitation

5.4 Additional Guidance

The water efficiency of all fixtures and fittings sold in Australia is registered in the Water Efficiency Labelling and Standards (WELS) scheme. The WELS scheme awards each fixture or fitting with a star rating from one to six stars (with six representing the most efficient). The WELS ratings of all fittings and fixtures sold in Australia are publicly available from a database administrated by the federal government. The water consumption is displayed on the WELS label on the registered products.

For further information about the WELS rating scheme and the water efficiency thresholds for each star band, please refer to AS/NZS 6400:2005 Water Efficient Products – Rating and Labelling and www.waterrating.gov.au.

It should be noted that the maximum WELS rating for showerheads is 3 Stars. A showerhead is registered under a 3 star rating if the performance is between 9L/min and 7.5L/min. The calculator automatically assumes that a shower designated as 3 star WELS will perform at 9L/min. Project teams are advised to manually input the shower flow rate (if less than 9L/min) rather than the WELS star rating to ensure that the reduced flow rate is accounted for.

6.0 White Goods

The water consumption by white goods is split into two sections, the water consumption by washing machines and the water consumption by dishwashers

6.1 Calculation methodology

The total water demand for whitegoods is calculated annually and prorated daily as follows:

6.1.1 Daily water demand from washing machines

$$V_{WM,Daily} = \frac{V_{WM,annual}}{365}$$

Where:

$V_{WM,Daily}$ = Daily demand from washing machines (L)

$V_{WM,annual}$ = Annual demand from washing machines (L)

And:

$$V_{WM,annual} = Capacity_{WM,x} \times Efficiency_{WM,x} \times Cycles_{WM,x}$$

Where:

$Capacity_{WM,x}$ = Machine capacity (kg/Load)

$Efficiency_{WM,x}$ = Machine efficiency (L/kg)

$Cycles_{WM,x}$ = Number of cycles per year

6.1.2 Daily water demand from dishwashers

$$V_{DW,Daily} = \frac{V_{DW,annual}}{365}$$

Where:

$V_{DW,Daily}$ = Daily demand from dishwashers (L)

$V_{DW,annual}$ = Annual demand from dishwashers

And:

$$V_{DW,annual} = Efficiency_{DW,x} \times Cycles_{DW,x}$$

Where:

$Efficiency_{DW,x}$ = Machine efficiency (L/cycle)

$Cycles_{DW,x}$ = Number of cycles per year

Total daily water consumption

Total daily water consumption = Combined daily water consumption (washing machines) + Combined daily water consumption (dishwashers).

6.2 Data entry requirement

Data about the whitegoods included in the project should be entered into the 'Whitegoods' section. The following information is required for each type of clothes washing machine and dishwasher being installed in the project:

1) The water efficiency of the whitegoods – this can be entered by either:

    a) Selecting the WELS Star Rating from the drop down menu. In this case, the corresponding water efficiency is automatically generated in the adjacent grey cell. A WELS star rating is awarded when the efficiency of a fixture is between a defined maximum and minimum water efficiency for that star rating; the efficiency with the highest water usage allowed for that particular WELS star rating is generated by the Calculator.

    Or

    b) Manually entering the actual water efficiency, if known.

2) The capacity of the whitegoods, in either the nominal kg/load capacity of the clothes washing machine or the number of place settings for the dishwasher.

3) The number of each type of whitegoods

6.3 Standard Practice Benchmark Water Efficiency – White goods

The water efficiency of whitegoods used to determine the total benchmark water consumption is presented in Table 5 . These values have been taken from a combination of the minimum allowable WELS ratings under AS 6400:2005 Water efficient products—Rating and labelling, and the GBCA's recommendations for the baseline performance of these appliances within the rating tool.

White Goods	Water efficiency WELS rating
Clothes washing machine	3 Star (5kg capacity or greater) 2.5 Star (capacity less than 5kg)
Dishwasher	3.5 Star

Table 6 Standard Practice Benchmark water efficiency – White goods

The baseline for both the clothes washing machine and dishwasher will scale based on the capacity of the machine entered by the project team. In the case of the clothes washing machine, this is related to the weight of clothing that can be accommodated per cycle. For dishwashers, the baseline is linked to the number of place settings that the machine can accommodate in one cycle.

6.4 Additional Guidance

The water efficiency of all whitegoods sold in Australia is registered in the Water Efficiency Labelling and Standards (WELS) scheme. The WELS scheme awards each whitegoods with a star rating from one to six stars (with six representing the most efficient). The WELS ratings of all fittings and fixtures sold in Australia are publicly available from a database administrated by the federal government. The water consumption is displayed on the WELS label on the registered products.

For further information about the WELS rating scheme and the water efficiency thresholds for each star band, please refer to AS/NZS 6400:2005 Water Efficient Products – Rating and Labelling and www.waterrating.gov.au.

7.0 Heat Rejection Water

This section of the Calculator quantifies the water demand in cooling towers. The calculation methodology used is based on:

- AIRAH Best Practice guidelines for water conservation in cooling towers
- AIRAH Manual 1997
- AS 3666.1:2011 Air-handling and water systems of buildings—Microbial control

7.1 Calculation methodology

The annual water demand is calculated by summing the water demand for heat rejection for each month during a year. The monthly total is then prorated daily to align with the calculator timestep.

Monthly water demand for heat rejection is calculated as follows:

$$\dot{V}_{make\ up} = \dot{V}_{evap} + \dot{V}_{drift} + \dot{V}_{bleed}$$

Where:

$\dot{V}_{make\ up} = volume\ of\ make\ up\ water$

$\dot{V}_{evap} = volume\ of\ evaporated\ water$

$\dot{V}_{drift} = volume\ of\ drift\ water$

$\dot{V}_{bleed} = volume\ of\ bleed\ water$

7.1.1 Evaporation is calculated as follows:

$$Evaporation = \dot{m}_{air}(\omega_{leaving} - \omega_{entering})$$

Where:

$\dot{m}_{air} = the\ mass\ of\ air\ entering\ the\ cooling\ tower$

$\omega_{leaving} = the\ moisture\ content\ of\ the\ air\ leaving\ the\ cooling\ tower$

$\omega_{entering} = the\ moisture\ content\ of\ the\ air\ entering\ the\ cooling\ tower$

7.1.2 Drift is calculated as follows

$$Drift = C_{Drift} \times \dot{V}_{condenser}$$

Where:

$C_{Drift} = \text{Drift Coefficient}$

$\dot{V}_{condenser} = Monthly\ \text{Total Condenser Water Flow (L)}$

And:

$$\dot{V}_{condenser} = \frac{Q_{cooling} \times 3600}{C_{p,water} \times \Delta T_{condenser}}$$

Where:

$Q_{cooling} = \text{Total cooling load (kWh)}$

$C_{p,water} = \text{Specific Heat of Water (4.18 kJ/(kg.°C))}$

$\Delta T_{condenser} = Condenser\ water\ temperature\ difference$

7.1.3 Bleed is calculated as follows:

$$Bleed = \frac{Evaporation}{COC - 1}$$

Where:

$Bleed = Bleed\ water\ (L)$

$COC = Number\ of\ cycles\ of\ concentration$

The following constants are used:

Constants	Value
Specific Heat of Water (kJ/(L.°C))	4.180
Density of water (kg/l)	0.997

Table 7 Heat rejection water constants

7.2 Data entry requirements

The data entered in this section

7.2.1 Conventional Water-based Heat Rejection

Where the building is using conventional cooling towers, the following data must be entered to complete the Heat Rejection Water section of the calculator:

1) **Project elevation above sea level (m)**
This is used to derive the local atmospheric pressure.

2) **Cooling tower air flow (L/s)**
The combined volumetric flow rate through the project's cooling towers

3) **The peak building cooling load (kW)**
The peak anticipated heat load to be rejected by the project's cooling towers

4) Standard practice building HVAC inputs

a) Select the building type from the drop down menu

b) Enter the cooling tower combined flow (L/s) and the peak building cooling load (kW) for the Standard Practice Benchmark Building (Reference Building) from the Ene-1 modelling undertaken. In some cases this will be the same as the Proposed Building. In cases where a Reference Building model has not been produced (such as for NABERS Energy modelling), then these values should be the same as the Proposed Building.

5) **Monthly cooling load (kWh/month)**
The Cooling Load for each month in the Proposed Building and the Standard Practice Benchmark Building (Reference Building) should be entered. The Cooling Load for each month must be determined by the modelling required as part of the Greenhouse Gas Emissions calculator for Green Star – Design & As Built.

6) **Average monthly temperature (°C)**
The monthly average dry-bulb temperature for the project location. This can be obtained from the Bureau of Meteorology's website (http://www.bom.gov.au/climate/data/index.shtml?bookmark=200). Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures. If 9AM and 3PM data is not available, it is sufficient to use the monthly mean maximum temperature.

7) **Average relative humidity (°C)**
The monthly average humidity for the project location. This can be obtained from the Bureau of Meteorology's website (http://www.bom.gov.au/climate/data/index.shtml?bookmark=200). Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures.

8) **Condenser water (ΔT in °C)**
A predicted average Condenser Water Temperature Difference ΔT should be entered in °C.

9) **Drift coefficient (%)**
The predicted drift coefficient should be entered in %. A default value of 0.002% is given. This is based on the requirement in section 4.4 of AS/NZS3666.1 *Air-handling and water systems of buildings—Microbial control*. If a value different from the default value is to be used; the drift coefficient must be determined as per AS 4180.1 *Drift loss from cooling towers - Laboratory measurement*

10) **Cycles of concentration**
The proportion of Total Dissolved Solids (TDS) in the cooling tower water in proportion to the makeup water

7.2.2 Non-conventional Water-based Heat Rejection

Where the building is using air-cooled heat rejection or low water flow cooling towers, the following inputs are required by the Calculator:

1) Standard practice building HVAC inputs

a) Select the building type from the drop down menu

b) Enter the cooling tower combined flow (L/s) and the peak building cooling load (kW) for the Standard Practice Benchmark Building (Reference Building) from the Ene-1 modelling undertaken.

2) **Average monthly temperature (°C)**
The monthly average dry-bulb temperature for the project location. This can be obtained from the Bureau of Meteorology's website (http://www.bom.gov.au/climate/data/index.shtml?bookmark=200). Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures.

3) **Average relative humidity (°C)**
The monthly average humidity for the project location. This can be obtained from the Bureau of Meteorology's website (http://www.bom.gov.au/climate/data/index.shtml?bookmark=200). Where this is reported at 9AM and 3PM, the project team should take the average of the two reported figures.

4) **Monthly cooling load (kWh/month)**
The Cooling Load for each month in the Standard Practice Benchmark Building (Reference Building) should be entered. The Cooling Load for each month must be determined by the modelling required as part of the Greenhouse Gas Emissions calculator for Green Star – Design & As Built.

5) Monthly water demand (kL/month)

Enter the monthly water demand for non-conventional cooling towers.

Where more than one heat rejection system is used to meet the cooling demand; the cooling load as calculated in the Greenhouse Gas Emissions calculator for Green Star – Design & As-built should be apportioned to each of the systems. The method for apportioning could be based on the capacity of the system or the cooling demand of the spaces which the different systems are serving. The cooling demand in the Standard Practice Benchmark building is always assumed to be met by a water-based heat rejection system with the characteristics described in Section 7.3.

7.3 Standard Practice Benchmark Water Efficiency – Heat Rejection

The Standard Practice Benchmark is based on the following:

Monthly cooling load	**As per Standard Practice Benchmark building in Greenhouse Gas Calculator**
Condenser Water ΔT	5.5°C (as per the requirements in the GHG guide)
Drift coefficient (%)	0.002% as required in AS3666.1 clause 4.4

Monthly cooling load	**As per Standard Practice Benchmark building in Greenhouse Gas Calculator**
Cycles of concentration in cooling tower water	6 cycles of concentration in alignment with previous Green Star versions' compliance requirements

Table 8 Standard Practice Benchmarks – Heat rejection

7.4 Additional guidance

The evaporation calculation operates under the principles of energy-mass balance. The project team provide the average relative humidity and temperature data from which the calculator can determine the enthalpy of the air entering the cooling tower. As the project team know the heat rejection rate from the tower, the theoretical leaving air enthalpy can be determined. Assuming that the air leaving the tower is saturated (i.e. RH = 100%), the calculator looks up the leaving air enthalpy from the saturated vapour tables (ref. 1997 ASHRAE handbook) and determines the leaving air moisture content.

Using the ideal gas laws the calculator also determines the mass of air entering the tower and assuming the air flow to be incompressible at speeds well below Mach 0.8, the mass of air leaving the tower should be approximately equal to that entering the tower. On this basis the calculator can derive the quantity of moisture removed from the tower and the makeup water demand associated with this is determined.

8.0 Landscape Irrigation

This methodology uses site specific input parameters to determine the monthly and annual volume of water demand from irrigation. It simultaneously determines the performance of a standard practice benchmark building in the same location.

8.1 Calculation methodology

The irrigation requirement for the site is calculated for each month of the year, for each landscaped 'zone' in the site (a zone being a landscaped area that has the same soil type, irrigation system, microclimate, plant density and, as far as possible, types of plants). The irrigation requirement for each zone is calculated in three steps as described below:

Step 1: The irrigation requirement for each zone is calculated for each month of the year as follows:

$$Irrigation\ requirement = \frac{Demand_{plant} - Rainfall}{Efficiency_{irrigation}}$$

Where:

$Demand_{plant}$ = Plant water demand (mm)

$Rainfall$ = Rainfall available for plants (mm)

$Efficiency_{irrigation}$ = Application efficiency of the irrigation system (%)

And:

$$Demand_{plant} = Epan_{month} \times K_C$$

Where:

$Epan_{month}$ = Monthly point potential Evapotranspiration (mm)

K_C = Weighted average Crop Coefficient

And:

$$Rainfall = Rainfall_{month} \times Efficiency_{rain} \times (1 - \%_{Undercover})$$

Where:

$Rainfall_{month}$ = Monthly rainfall (mm)

$Efficiency_{rain}$ = Application efficiency of rainfall (%)

$\%_{Undercover}$ = Percentage of zone undercover (%)

A zone's monthly irrigation requirement is calculated by determining how much water the plants in the zone require, how much water will be provided naturally by rainfall and therefore how much water must be provided from an irrigation system, taking into account how efficient the particular irrigation system is at delivering water to the plants.

Step 2: The irrigation requirements for each month are then added together to calculate the total annual irrigation requirement (mm).

Step 3: The annual irrigation requirement, in mm, is then multiplied by the area of the zone, in m^2, to calculate the zone's annual irrigation requirement in litres.

Parameter	Description	Further information
Application efficiency of irrigation system (%)	The percentage of water applied via an irrigation system which is taken up by the plants.	Page 27
Application efficiency of rainfall (%)	The percentage of rainfall that is assumed to be taken up by the plants.	Page 27
Crop Coefficient	The crop coefficient is an agronomic multiplier used to determine the water usage requirement for a particular plant type.	Page 26
Monthly point potential Evapotranspiration (mm)	Point potential evapotranspiration data from the Bureau of Meteorology.	Page 25
Monthly rainfall (mm)	Rainfall data from the Bureau of Meteorology.	Page 25
Percentage of zone undercover (%)	This refers to the total percentage of the zone that will receive very little or no rainfall, as a result of being undercover.	Page 26

Table 9 Landscape irrigation definitions and further Information

8.2 Data entry requirements

All landscaped areas in the project that are to receive water via irrigation should be divided into zones; each zone should have the same soil type, irrigation system, microclimate, plant density and as far as possible, types of plants.

The following data is required to be entered for each zone:

1) Climate data (monthly rainfall data, monthly evapotranspiration data);

2) Zone name and description;

3) Area of zone (in m^2);

4) Percentage of zone undercover;

5) Weighted average Crop Coefficient in the zone. This reflects the water usage of the plant types in the zone. Crop Coefficients for various plant types are available in 0;

6) Application Efficiency of irrigation system.

8.2.1 Climate data

The monthly average rainfall and point potential evapotranspiration data must be obtained from the Australian Bureau of Meteorology (BoM). It should be noted that 'evapotranspiration' and 'evaporation' are not the same. 'Point potential' evapotranspiration data should be used. The highest resolution grid point extractions from base climatological data sets are required. For rainfall, the highest resolution currently available is based on a 2.5km grid. For point potential evapotranspiration, the highest resolution currently available is based on a 10km grid. The following data should be entered to the calculator:

1) Monthly 'point potential' evapotranspiration. This data is available from the BoM, and should be entered for each month for the specific location of the project;

2) Monthly Rainfall. This data is available from the BoM, and should be entered for each month for the specific location of the project.

Note that for the purposes of Green Star it is necessary to obtain data specific to the project site using the methodology outlined above. It is not acceptable to rely on the publically available data on the BoM web site, as this is not verifiable data, and does not have the resolution necessary to obtain accurate results from the calculator. The data sets purchased from the BoM must form part of the projects Green Star submission documentation.

An example of monthly rainfall and point potential evapotranspiration are given below. This data is for the grid coordinates -37.87 (Latitude) and 145.26 (Longitude).

Month	Grid-point average data for rainfall (mm)	Grid-point average data for point potential evapotranspiration (mm)
January	54	190
February	48	160
March	61	135
April	73	88
May	91	47
June	67	33
July	75	38
August	86	56
September	77	82
October	83	124
November	71	147
December	72	164
Annual	**873**	**1264**

Table 10 Sample rainfall and point potential evapotranspiration data from the BoM for grid coordinates -37.87 (Latitude), 145.26 (Longitude)

The climate data can be obtained from the BoM for a nominal fee. More information about this data can be obtained from the Climate Maps section of the BoM website. To purchase this data, please contact the BoM, National Climate Centre. Email: webclim@bom.gov.au Phone: (03) 9669 4082, FAX: (03) 9669 4515. To obtain the necessary data, the BoM will require the following:

- Latitude and longitude grid points (coordinates) of the project in decimal degrees. These coordinates can be obtained from good quality maps, or from web based maps/images including Google Earth;
- The type of grid (meteorological element) you require - rainfall and evapotranspiration (point potential);
- The period – average monthly data;
- The output format that you require – Excel.

8.2.2 Zone name and Description

Each zone should be named and described in enough detail for Green Star Certified Assessors to locate it on drawings.

8.2.3 Zone Area

The area of each zone should be entered in m^2.

8.2.4 Percentage of zone undercover.

This refers to the total percentage of each zone that will receive very little or no rainfall, as a result of being undercover. This applies to areas which are completely covered e.g. by roofs, significantly covered e.g. under awnings, or under dense vegetation such as trees with thick foliage.

8.2.5 Crop coefficient (K_c)

The crop coefficient is an agronomic multiplier used to determine the water usage requirement for a particular plant type. The **area weighted average** crop coefficient for the zone should be entered into the calculator. See

Crop coefficient (**Kc)** for the crop coefficients for common plant types. Crop Coefficients for various plant types are available in 0

8.2.6 Application Efficiency

Many factors impact the application efficiency of an irrigation method including uniformity, runoff, wind drift, and evapotranspiration. For example, sprays have fixed application of water and generally cover short distances, sprinklers have rotating streams and cover larger distances, and underground drip systems are less affected by wind than above ground systems. The average values in Table 11 reflect the differences between various irrigation system types. The system used in each zone should be selected from a drop-down menu in the calculator.

IrrigationMethod	Average Application Efficiency
Sprinklers – Day	65%
Sprinklers – Night	75%
Sprays – Day	65%
Sprays – Night	70%
Microsprays – Day	60%
Microsprays - Night	65%
Drip – Bare soil	80%
Drip – Under mulch	85%
Subsurface drip (SDI)	90%
Hand watering	50%

Table 11 Application efficiencies of common irrigation systems

Where the irrigation efficiency is different from any of the standard values, the available irrigation efficiency can be entered manually. Where a user determined application efficiency figure is used, additional compliance documentation is required to prove that such efficiency can be achieved. The application efficiency of rainfall is assumed to be 60%.

8.3 Standard Practice Benchmark Water Efficiency

The Standard Practice Benchmark is based on the following:

Monthly 'point potential' evapotranspiration	As Proposed Building
Monthly Rainfall	As Proposed Building
Total landscaped area of the zone	As Proposed Building
Percentage of zone undercover	As Proposed Building
Weighted average Crop Coefficient in the zone	0.6
Application Efficiency of irrigation system	75% (night time sprinklers)

Table 12 Water efficiency benchmarks

9.0 Swimming Pools

The water consumption by swimming pools is split into two sections, for indoor and outdoor applications.

9.1 Calculation methodology

The total water demand for swimming pools is calculated using different methodologies dependent on whether the swimming pool is located indoors or outdoors. The daily water consumption is prorated from the seasonally dependent monthly water consumption to derive a daily demand for calculation of the annual potable water consumption.

The calculation methodology for outdoor and indoor swimming pools is derived from the following:

- ACT planning and land authority (ACTPLA) design and siting requirements for water efficiency;
- ASHRAE 1997 fundamentals handbook.

9.1.1 Daily water demand from outdoor swimming pools

$$Demand\ (outdoor\ pool) = Evaporation_{daily} + Backwash_{daily}$$

Where:

$Evaporation_{daily}$ = Daily evaporation consumption (L)

$Backwash_{daily} = Daily\ apportioned\ backwash\ (filter\ cleaning)(L)$

And:

$$Evaporation_{daily} = Evaporation_{daily,pool} - Rainfall_{daily}$$

Where:

$Evaporation_{daily,pool}$ = Average daily evaporative from swimming pool (mm)

$Rainfall_{daily}$ = Average daily rainfall (mm)

And:

$$Evaporation_{daily,pool} = Epan_{daily} \times K_{C,pool} \times Rain_{daily}$$

Where:

$Epan_{daily}$ = Average daily point potential evapotranspiration (mm)

$K_{C,pool}$ = Evaporation coefficient

$Rain_{daily}$ = Average daily rainfall (mm)

And:

$$Backwash_{daily} = \frac{Backwash_{annual}}{365}$$

Where:

$Backwash_{annual} = Annual\ backwash\ demand\ (L)$

And:

$$Backwash_{annual} = Demand_{filter} \times Frequency$$

Where:

$Demand_{filter}$ = Filter cleaning demand (L)

$Frequency$ = Frequency of filter cleaning operations (per year)

9.1.2 Daily water demand from indoor swimming pools

$$Demand\ (indoor\ pool) = Evaporation_{daily} + Backwash_{daily}$$

Where:

$Evaporation_{daily}$ = Daily evaporation consumption (L)

$Backwash_{daily} = Daily\ apportioned\ backwash\ (filter\ cleaning)(L)$

And:

$$Evaporation_{daily} = \dot{m}_{exhaust} \times \omega_{exhaust}$$

Where:

$\dot{m}_{exhaust}$ = Average mass of air exhausted from pool hall (kg/s)

$\omega_{exhaust} = Air\ moisture\ content\ at\ pool\ hall\ temperature\ \ (kg\ water/kg\ dry\ air)$

And:

$$Backwash_{daily} = \frac{Backwash_{annual}}{365}$$

Where:

$Backwash_{annual} = Annual\ backwash\ demand\ (L)$

And:

$$Backwash_{annual} = Demand_{filter} \times Frequency$$

Where:

$Demand_{filter}$ = Filter cleaning demand (L)

$Frequency$ = Frequency of filter cleaning operations (per year)

9.2 Data entry requirement

Data about the swimming pools included in the project should be entered into the ‘Swimming Pools’ section.

The following information is required for swimming pools being installed in the project:

For outdoor pools:

1) The volume of the swimming pool in cubic metres
2) The surface area of the swimming pool
3) Whether the pool has a cover
4) The monthly rainfall and evapotranspiration data for the project location
5) The amount of water used by backwash (filter cleaning) and the frequency that filter cleaning is undertaken each year

For indoor pools:

1) The project location elevation above sea level

2) The volume of the swimming pool in cubic metres

3) The surface area of the swimming pool

4) The **minimum** exhaust rate, required by AS 1668.2, from the pool hall

5) The proposed building exhaust rate from the pool hall

6) The average internal air dry-bulb temperature within the pool hall.

7) The amount of water used by backwash (filter cleaning) and the frequency that filter cleaning is undertaken each year

9.3 Standard Practice Benchmark Water Efficiency

The standard practice water efficiency for swimming pools has been taken from the ACTPLA water efficiency targets (http://www.actpla.act.gov.au/topics/design_build/siting/water_efficiency) which establish a calculation methodology for the reference case swimming pool water consumption. This methodology applies to outdoor pools and the ACTPLA requirements include:

- The use of a swimming pool cover (for outdoor pools)
- An annual backwash (filter cleaning) consumption based on 5 flushes per year at 250 litres per flush

For indoor pools the methodology regarding backwash has been retained, however as evaporation is driven by indoor climatic conditions, the methodology applied to calculate evaporation has been adapted from the cooling tower evaporation methodology to determine the water lost through the discharge of pool hall exhaust. In order to determine a benchmark water loss through evaporation of indoor swimming pools, the minimum exhaust requirements of AS 1668.2 are used to define a benchmark for discharge of moist air (which carries evaporated swimming pool water) from the pool hall.

9.4 Additional Guidance

For the purposes of calculating the evaporation losses from the indoor swimming pool, the assumption is made that the swimming pool hall is as close to 100% RH as practically possible. This assumption allows the calculation to based solely on the dry-bulb temperature of the pool hall air that is exhausted and combine this with the empirical moist air data (tabulated in the 1997 ASHRAE handbook, chapter 6, ‘Psychrometrics’) to determine the exhaust air moisture content.

10.0 Fire protection sprinkler testing

The fire protection sprinkler testing section assesses the following:

- The quantity of water discharged and capture for reuse during sprinkler system testing, and
- The daily demand attributable to the testing of such systems.

There is a standalone point available under this section that becomes N/A in the event that the project:

- Is not required to have a sprinkler system under part E of the NCC, or
- A sprinkler system is not provided by the project team, and
- Does not include a water-based fire protection system.

Where the point is not N/A the project team is required to demonstrate compliance with the credit requirements

10.1 Calculation methodology

The annual consumption is determined by the discharge from the fire protection system during testing and the amount that is captured for reuse. The indicated reuse component is then incorporated into the calculations to contribute to the project's water reuse

The annual fire system water demand is prorated daily such to be incorporated into the daily demand calculation.

Daily water demand from fire protection systems

$$Daily\ demand = \frac{V_{annual}}{365}$$

Where:

$V_{annual} = Annual\ fire\ system\ discharge\ (L)$

10.2 Data entry requirement

Data about the fire protection system should be entered in the 'Fire Protection System' section.

The following information is required for fire protection systems being installed in the project:

1) Confirmation as to whether a sprinkler system is required for part E compliance with the NCC
2) Whether the building discharges any water for fire protection system testing
3) The number of tests per year
4) The quantity of water discharged per test
5) Confirmation as to the quantity of discharged water that is captured for reuse.

10.3 Standard Practice Benchmark Water Efficiency

The standard practice water efficiency for fire protection sprinkler systems has been retained from previous Green Star rating tools. The credit requires that either water is not expelled during fire testing, or that 80% of fire test water is captured for reuse in order to obtain the additional point.

10.4 Additional Guidance

It is recognised that client requirements may require sprinkler systems to be installed as part of risk management or organisational policy. However, project teams for which this applies should recognise that their projects will be ineligible for the standalone point relating to the fire protection sprinkler system. Instead, the remaining points available for Wat-1 will be re-weighted.

11.0 Process Cooling

The process cooling section assesses the following:

- The nature of process cooling loops
- The daily demand attributable to these.

There is a standalone point available under this section that become N/A in the event that the project:

- Does not contain process cooling

Where the point is not N/A the project team is required to demonstrate compliance with the credit requirements

11.1 Calculation methodology

Where the system is closed loop, the calculator makes the assumption that annual water use will be minimal, hence if the project team indicates that process cooling is provided by closed loop systems, the annual water consumption will be assumed to be zero.

Where the project team identifies open loop process cooling systems in the project the following calculations are applied to determine the daily system demand

Daily water demand from open circuit process cooling systems:

$$Daily\ demand = (Evap + Discharge) \times \%_{potable}$$

Where:

$Evap = Evaporation\ losses\ (L)$

$Discharge = Water\ discharged\ to\ sewer\ (L)$

$\%_{potable} = Proportion\ of\ daily\ demand\ that\ is\ potable\ (\%)$

11.2 Data entry requirement

Data about the process cooling systems should be entered in the ‘Process Cooling’ section.

The following information is required for process cooling systems being installed in the project:

1) The proportion of the daily demand that is potable
2) The daily evaporation losses from the system
3) The daily discharge to sewer by the system

11.3 Standard Practice Benchmark Water Efficiency

The standard practice water efficiency for process cooling systems has been retained from previous Green Star rating tools. The credit requires that either all equipment requiring process cooling is served by a closed-loop system, or that open loop systems are supplied with greater than 95% non-potable water.

12.0 Reclaimed water use

Reclaimed water use refers to the use of on-site rainwater, greywater, blackwater, stormwater or the use of a reclaimed water supply.

The calculator uses three steps in determining the impact of any reclaimed water use on the reduction in potable water consumption.

- The first step in determining how much reclaimed water is used on site is to establish the water demand that could be met with reclaimed water. The methodology used to establish the demands is given in Section 12.1 *Demand for Reclaimed Water*.
- The second step is to calculate how much reclaimed water is available to be collected on-site, in the case of rainwater, greywater, and blackwater. For the off-site supply of recycled water, this involves defining the maximum volume of water available from this source.
- The third step looks at whether the available reclaimed water can be utilised by the daily demands on site. This involves looking at the water balance between the available sources and their competing demands. Where there is not enough reclaimed water to meet a demand, it is assumed that mains potable water will be used instead.

Additional information in regards to entering inputs for central shared resources is given in section 12.4.

12.1 Demand for reclaimed water

The demand for reclaimed water sets the **upper limit** to reclaimed water use; it is the maximum potential demand. The demand for 'mains water only' is also calculated. This defines the minimum quantity of mains water used. Therefore, regardless of how much reclaimed water is available, if the water uses are not connected to the reclaimed water system, reclaimed water will not be used.

The Water Calculator also allows the project team to enter any demands for non-potable water that have not already been included in the Calculator. The Calculator assumes that water demands from any 'Non-Wat-1' uses are met before the 'Wat-1' water uses.

The demands are established separately for each of the following water sources:

1) Rainwater systems;
2) Greywater systems
3) Blackwater systems
4) Stormwater and off-site reclaimed water systems; and
5) Mains water only.

Where water uese are supplied with water from more than one source, it is assumed that they are first supplied with water from any greywater and blackwater systems, followed by rainwater, stormwater and off-site reclaimed water systems. This is to ensure the maximum potential of and greywater and blackwater systems can be claimed within the Calculator.

12.1.1 Data entry requirements

To establish the Wat-1 reclaimed water demand:

1) Enter the percentage of each Wat-1 water use connected to an on-site rainwater system, greywater system, blackwater system, or off-site supply of recycled water;
2) Enter the percentage of each Wat-1 water use connected to mains water only.

Notes:

a) Where a water use has only a limited portion of fixtures connected to a reclaimed water system, it is possible to enter a percentage between 0% and 100% to account for this. For example, a refurbished building where only 80% of urinals were able to be plumbed into a recycled water system. The balance must be entered under the 'Mains Water Only' input column. This scenario is illustrated in Figure 2.

b) It is possible to enter more than one source of reclaimed water for each of the water uses. This is shown in the included example, where both toilets and urinals are served by rainwater and greywater sources.

Water use (assessed in Wat-1)	Percentage of fittings/systems connected to the following water sources				
	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Toilets	100%	100%			0%
Urinals	80%	80%			20%
Indoor Taps					100%

Figure 2 Percentage of water uses connected to reclaimed water sources

Following this methodology, where the demand from a particular water use can be met by water supplied from more than one source, the total reclaimed water demands can add up to more than 100% of the actual demand. This is not an error as the 'mains water only' demand is also calculated, which limits the reduction in potable water demand from reclaimed systems. Therefore, regardless of how much reclaimed water is available, if the water uses are not connected to the reclaimed water system, the reclaimed water will not be used.

The daily demand for reclaimed water from Non-Wat-1 uses (such as water demands for wash down) is calculated in the same way as for Wat-1 uses. The total monthly water demands are however entered directly into the calculator rather than being determined in the Water Demand section of the Calculator. These are then prorated daily for inclusion in the calculations.

To establish the Non-Wat-1 reclaimed water demand:

1) Enter the monthly water demand (kL/month) for each non-Wat-1 water use (wash down, etc.) (this value will be prorated daily) as shown in Figure 3. The project team should also enter a description of the non-Wat-1 water use. This description will carry over to the following table where percentages of water sources are entered;

2) Enter the percentage of each non-Wat-1 water use connected to an on-site rainwater system, greywater system, blackwater system, or off-site supply of recycled water;

3) Enter the percentage of each non-Wat-1 water use connected to mains water only.

	Monthly water demand (kL/month)		
	Loading Dock Washdown	<Enter description of any other uses of rainwater or re-used water>	<Enter description of any other uses of rainwater or re-used water>
January	1.2		
February	1.2		
March	1.2		
April	1.2		
May	1.2		
June	1.2		
July	1.2		
August	1.2		
September	1.2		
October	1.2		
November	1.2		
December	1.2		

How are the water demands from the Non-Wat-1 water uses met?					
Water use (assessed in other credits)	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Loading Dock Washdown	100%				0%
<Enter description of any other uses of rainwater or re-used water>					
<Enter description of any other uses of rainwater or re-used water>					

Figure 3 Monthly demand and percentage of non-Wat-1 water uses connected to reclaimed water sources

12.1.2 Standard Practice Benchmark demand for reclaimed water

The Standard Practice Benchmark Building does not include any water re-use systems therefore any use of reclaimed water in the Proposed Building will be an improvement over standard practice.

12.2 Availability of Reclaimed Water

The quantity of reclaimed water available is established by requesting inputs from the project team on:

- Climate data;
- Rainfall collection areas;
- Storage tank sizes;
- Percentage of water uses that are collected on-site for recycling;
- Volume of water collected from any non-Wat-1 water uses;
- Water that is available from any off-site recycled water supply.

The following section looks at the inputs required for each reclaimed water source.

12.2.1 Data entry requirements – rainwater collection

The quantity of rainwater collected on site depends on the quantity of rainfall available for collection, the size of the rainwater storage tank and the collection area. The calculations for rainwater availability are done on a daily basis to account for daily variations in rainfall, the seasonal variation in demand for rainwater, for example where rainwater is used for cooling systems or irrigation, as well as the ability of the rainwater tank to store water where supply exceeds demand from one day to the next.

To establish the maximum amount of rainwater collected the following inputs are required:

1) **Rainfall collection area (m2)**
The area where rainwater is collected should be entered in square metres.

2) **Run-off coefficient**
The type of roof should be selected and then the associated run-off coefficient (see Table 13) will be displayed.

Run-off coefficient for different roof types:	
Pitched roof with profiled metal sheeting	0.9
Pitched roof with tiles	0.8
Flat roof without gravel	0.8
Flat roof with gravel	0.65
Green roof, intensive	0.5
Green roof, extensive	0.7

Run-off coefficient for different roof types:	
Permeable pavement – Granular media	0.7
Permeable pavement – Plastic crates	0.8

Table 13 Run-off coefficients. Source: BSI British Standards (2009), Rainwater Harvesting Systems – Code of Practice

3) **Storage capacity (kL)**
The size of the total storage capacity for rainwater should be entered in kilolitres.

4) **Rainfall data**
The project team is to paste daily average rainfall data for their location into the table provided in the Calculator. The project team may supply their own data, or may copy and paste the provided data that has been provided for selected locations, to the right side of the Calculator.

Where the project team is nominating to supply their own rainfall data, this should be an average across 10years of historical data to provide a daily rainfall quantity across 365 days in the year.

Rainwater collection:

Rainfall collection area (m2)		
Run-off co-efficient	Pitched roof with profiled metal sheeting	0.9
Storage capacity (kL)		
Rainwater tank reliability %		

Rainfall data:

Location	Melbourne
Date	10-Year Average (mm)
1-Jan	0.8
2-Jan	2.2
3-Jan	0.1
4-Jan	1.1
5-Jan	1.1
6-Jan	0.2
7-Jan	0.7
8-Jan	1.6
9-Jan	0.0
10-Jan	0.3
11-Jan	1.1

Figure 4 Rainwater collection and rainfall data inputs to determine availability

12.2.2 Data entry requirements – greywater and blackwater collection

The quantity of greywater and blackwater collected, treated and used on site is established by determining the percentage of water uses that are collected on-site for reuse, in addition to any non-Wat-1 uses that are collected. The calculations for both greywater and blackwater availability are performed on a daily basis taking into account the varying demand for this water seasonally.

To established the maximum amount of greywater and/or blackwater available daily, the following inputs are required:

1) The percentage of discharge from toilets, urinals, taps, showers, whitegoods, heat rejection bleed, swimming pool backwash, fire sprinkler test water and process cooling discharge that is collected and treated for reuse on site. A percentage between 0 and 100 should be entered for all uses.

2) The daily collection of greywater and/or blackwater from other sources such as chiller condensate, cooling tower wash down or sewer mining etc.

GREYWATER COLLECTION

	% discharge water collected for re-use
Toilets	
Urinals	
Indoor taps	
Showers - staff	
Showers - sport	
Washing machines	
Dishwashers	
Cooling tower bleed +other heat rejection	
Fire system test water	
Swimming pools filter cleaning	
Process Cooling	

Other sources e.g. Chiller condensate, cooling tower washdown or sewer mining etc...

	<Enter description of any other sources of greywater> (kL/month)	<Enter description of any other sources of greywater> (kL/month)	<Enter description of any other sources of greywater> (kL/month)	kL/month greywater collected for re-use from other sources
January				0.0
February				0.0
March				0.0
April				0.0
May				0.0
June				0.0
July				0.0
August				0.0
September				0.0
October				0.0
November				0.0
December				0.0

Figure 5 Percentage of water uses collected for greywater recycling

12.2.3 Data entry requirements – stormwater or off-site recycled water source

Using stormwater (collected either on or off-site) or an off-site recycled water source is an acceptable way to achieve reductions in potable water consumption in Green Star provided that it can be demonstrated that the relevant local authority has given approval for its use. Any reclaimed water system must be operational at the time of practical completion of the building.

Both stormwater and any off-site recycled water source should be entered in kilolitres for each month. For stormwater the calculation methodology in the Emi-5 ‘Stormwater’ credit should be followed. For any off-site water supply, the monthly volumes entered into the calculator require validation by the water supply authority.

STORMWATER AND OFFSITE

	Stormwater collected for re-use (kL/month)	Off-site reclaimed water supplied to site (kL/month)
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		

Figure 6 Monthly volume of stormwater or off-site reclaimed water source available

12.3 Utilisation of reclaimed water

The method for calculating the utilisation of reclaimed water has been linked between each of the water uses and reclaimed water sources. This is to allow the Calculator to account for water uses that might be utilising reclaimed water from more than one source, such as the example originally given in Figure 2, where toilets and urinals were served by a combination of rainwater and greywater.

The following section describes the Calculator's process for establishing the reclaimed water utilised on the project. The inputs entered for reclaimed water demand and availability are used in this section. No additional inputs are required.

12.3.1 Calculation methodology

The maximum potential demand for reclaimed water for a particular water use (be it from rainwater; greywater and blackwater; or stormwater and off-site reclaimed water systems) is calculated on a daily basis using the total daily water demands from each water use, and the percentages of the water uses connected to each type of reclaimed water system.

The calculation methodology follows a number of steps for each day of the year as follows:

Step 1 – Establish rainwater tank volume at day one;

Step 2 – Establish the total volume of reclaimed water demand (regardless of source) for the first water use;

Step 3 – Establish the volume of reclaimed water available from each reclaimed water source on day one, after subtracting the non-Wat-1 reclaimed water demands – rainwater (established at step 1 for day one), greywater, blackwater, off-site recycled water;

Step 4 – Establish the volume of reclaimed water required from each water source to meet the demands of the first water use;

Step 5 – Calculate the volume of reclaimed water utilised from each water source to meet the demands of the first water use

Step 6 – Repeat Steps 2 to 5 for each additional water use in Wat-1. The availability of a reclaimed water source will subtract any reclaimed water utilised by a previous water use in the sequence;

Step 7 – Establish the volume of the rainwater tank at the end of day one. It has been assumed that treated greywater and blackwater can only be held for 24 hours due to health requirements, therefore where the full volume is not used within a day it is rejected to sewer. This then becomes the volume of the rainwater tank at the beginning of day two after any additional rainfall has been added to the tank.

12.3.2 The calculation methodology in detail

Step 1 - Establish rainwater tank volume on day one

To ensure that a fair assessment of rainwater reuse is undertaken, the tank is first initialised by undertaking a full year of daily rainwater calculations to determine the volume of the rainwater tank on day one.

The quantity of rainwater available for use depends on the amount of rainwater that is already in the tank left over from previous days, the rain that can be collected in the day in question minus a certain volume of rainwater that must be diverted from the tank at each rain event to prevent contaminants polluting the tank (referred to as a 'first flush[3]'). The amount of rain that can be collected depends on the monthly rainfall and the size, pitch and absorbency of the collection area. The first flush is always assumed to be 0.5L/m^2 (HB 230-2008 Rainwater Tank Design and Installation Handbook). First flush reductions are only ever applied on days when rainfall events occur.

In the event that the maximum capacity of the tank is reached as a result of one or more heavy rain events, no further water will be added to the tank and at the end of the day the remaining volume will be equal to the tank capacity. This ensures that undersized tanks do not provide a false indication of rainwater reuse.

The equation used to determine the rainwater available is:

$$Rainwater_{available} = Rainwater_{prev} + Rainwater_{new} - Rainfall_{FF}$$

Where:

$Rainwater_{available}$ = Rainwater available for use on day (x) (L)

$Rainwater_{prev} = Rainwater\ already\ in\ tank\ from\ previous\ day's\ rainfall\ (L)$

$Rainwater_{new} = Rainfall\ on\ collection\ area\ on\ day\ (x)\ (L)$

$Rainfall_{FF}$ = Rainwater diverted as first flush (L)

And:

$$Rainwater_{prev} = 0\ \big(for\ day\ (x)\big) or, Result\ from\ step\ 7\ (previous\ day)$$

And:

$$Rainwater_{new} = Day_x \times A_{collection} \times C_{runoff}$$

Where:

$Day_x = 10\ year\ average\ daily\ data\ for\ each\ day\ (mm)$

$A_{collection}$ = Collection area (m^2)

C_{runoff} = Runoff coefficient (see Table 13)

And:

$$Rainfall_{FF} = 0.5 \times A_{collection}$$

Step 2 – Establish the total volume of reclaimed water demand for the first water use

Step 2 sets maximum reclaimed water demand for each water use. Starting with toilets on the 1st of January, the maximum demand for reclaimed water for toilets is calculated as follows:

$$Reclaimed\ Water\ Demand_{toilets\ max} = \big(Demand_{toilets} \times (1 - \%_{toilets})\big)$$

---

[3] **First Flush**: The first rainfall event may contain higher than average amounts of accumulated dust, industrial pollutants, bird and animal droppings, leaves and other debris. Rainwater collection systems typically divert this initial rainfall to drain to ensure the good quality of collected rainwater.

Where:

$Reclaimed\ Water\ Demand_{toilets\ max}$ = Maximum potential demand for reclaimed water for toilets on 1st of January

$\%_{toilets}$ = Percentage of toilets served by mains potable water

$Demand_{toilets}$ = Water demand from toilets on 1st of January

Step 3 – Establish the volume of reclaimed water available from each reclaimed water source on day one

Step 3 calculates the reclaimed water available from each of the reclaimed water sources that could be used to meet the demand. The calculation of rainwater availability is covered under Step 1 and so will not be repeated here. Greywater and blackwater use a similar method to calculate the reclaimed water available for reuse. The greywater available on the 1st of January for use is calculated as follows:

$$Greywater\ available = \left(Demand_{toilets} \times \%_{grey\ toilet} + Demand_{urinals} \times \%_{grey\ urinals} + \cdots\right) - Greywater_{non\ Wat-1}$$

Where:

$Greywater\ available$ = Greywater available on 1st of January

$Demand_{toilets}$ = Water demand from toilets on 1st of January

$\%_{grey\ toilets}$ = Percentage of toilets from which greywater is collected for reuse

$Demand_{urinals}$ = Water demand from urinals on 1st of January

$\%_{grey\ toilets}$ = Percentage of urinals from which greywater is collected for reuse

$Greywater_{non\ Wat-1}$ = Greywater demand from other non Wat − 1 uses

Stormwater and off-site recycled water source availability is calculated differently as values are entered directly as a kL/month value. For these two inputs the monthly value is prorated to a daily kL/day available to meet demand.

Step 4 - Establish the volume of reclaimed water required from each water source to meet the demands

Step 4 looks at the demand requirements for each of the reclaimed water sources independently. Using this method, where the demand for a particular water use could be met by water supplied from more than one source, the total reclaimed water demands of each independent source can add up to more than 100% of the total reclaimed water demand calculated at Step 2. This is not an error, as the demand calculated at Step 2 then provides a limit for Step 5 of the calculation.

The calculation for each of the reclaimed water sources is similar to the example given below for rainwater. Starting with toilets on the 1st of January, the maximum demand for rainwater for toilets is calculated as follows:

$$Rainwater\ Demand_{toilets\ max} = (Demand_{toilets} \times \%_{toilet\ rain\ max})$$

Where:

$Rainwater\ Demand_{toilets\ max}$ = Maximum potential demand for rainwater for toilets on 1st of January

$Demand_{toilets}$ = Water demand from toilets on 1st of January

$\%_{toilets\ rain\ max}$ = Maximum percentage of toilets served by rainwater

Step 5 - Calculate the volume of reclaimed water utilised from each water source to meet the demands

The daily calculations are undertaken in a cascading manner, checking that for each water use the nominated reclaimed water source has capacity to service the demand before allowing potable water to be substituted with reclaimed water. Where a reclaimed water source has met the limit of its capacity and no other source is available, the remaining demand is assumed to be met by mains potable water.

Greywater water is the first reclaimed water source assessed, followed by blackwater, rainwater, and then off-site and stormwater sources. The logic flow representing this assessment is best demonstrated by the flow chart in Figure 7.

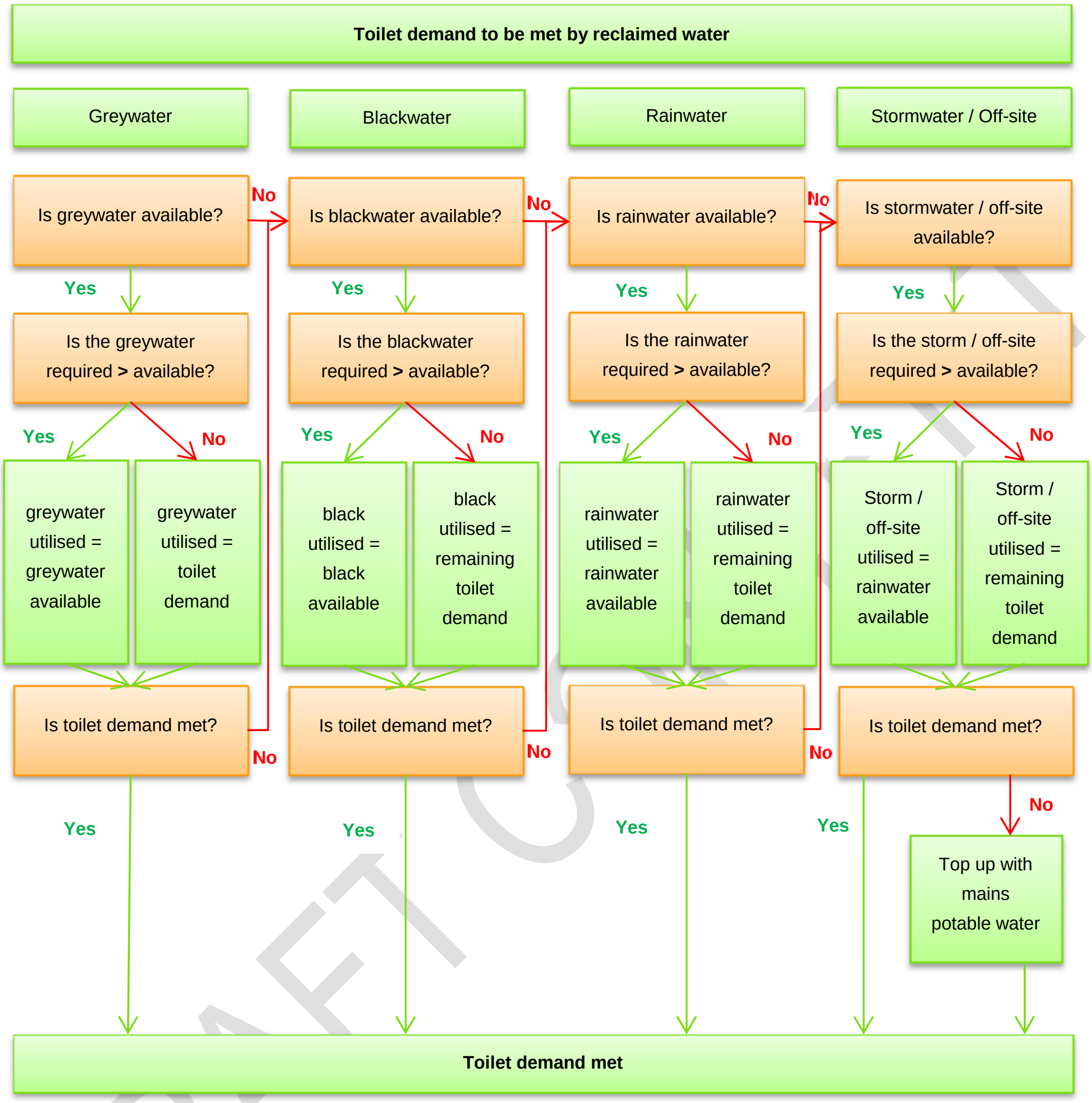

Figure 7 **Flowchart showing the reclaimed water utilisation methodology**

Step 6 - Repeat Steps 2 to 5 for each additional water use in Wat-1

The calculations described in Steps 2 to 5 describe how the Water Calculator establishes the reclaimed water utilised for the first water use, but does not address any of the other subsequent water uses such as urinals, irrigation, or heat rejection etc. The calculations are essentially the same for each ensuing water use, with the exception of Step 3 where the availability of each of the reclaimed water sources is reassessed.

For each of the following water uses, the reclaimed water available becomes the reclaimed water remaining:

$$Greywater\ remaining = Greywater\ available\ - Greywater\ utilised_{toilets+\cdots}$$

Where:

$Greywater\ remaining$ = Greywater available after subtracting greywater utilised by previous water uses

$Greywater\ available$ = Greywater available on 1st of January

$Greywater\ utilised_{toilets+\cdots}$ = Greywater utilised by previous water uses

Step 7 – Establish the volume of the rainwater tank at the end of the day

After repeating Steps 2 to 5 for all water uses, a summary of the reclaimed water sources utilised is calculated. The volumes must then reset again for the next day of the daily calculations. The following equation establishes the volume of the rainwater tank on the next day:

$$Rainwater_{available} = Rainwater_{prev} - Rainwater_{demand,x} + Rainfall_{new} - Rainfall_{FF} - Rainwater_{non\ Wat-1}$$

Where:

$Rainwater_{available}$ = Rainwater available for use on day (x) (kL)

$Rainwater_{prev} = Rainwater\ in\ tank\ at\ start\ of\ previous\ day\ (kL)$

$Rainwater_{demand,x} = Rainwater\ used\ on\ previous\ day\ (kL)$

$Rainfall_{new} = Rainfall\ on\ collection\ area\ on\ day\ (x)\ (kL)$

$Rainfall_{FF}$ = Rainwater diverted as first flush (kL)

$Rainwater_{non\ Wat-1}$ = Rainwater demand from other non Wat – 1 uses (kL)

In undertaking the above calculation, the Water Calculator also reviews whether the rainwater tank reaches its capacity with any new rainfall added to the tank.

$$Volume_{day\ start} = MAX\ [0\ AND\ MIN\ of\ [Cap_{tank}\ AND\ Rainwater_{available}]]$$

Where:

Cap_{tank} = Tank storage capacity (kL)

12.4 Multiple Buildings Single Rating Guidance

This credit is applicable to the entire site within the project scope. Points will be allocated using the Green Star – Design & As Built Potable Water Calculator.

There may be instances where a development includes multiple buildings and a single central reclaimed water source that serves these multiple buildings, but rated under separate Green Star ratings. Therefore one or more of these buildings and their water consumption may fall outside of the immediate rating's project scope.

Projects that have multiple buildings sharing a central reclaimed water source must follow this additional guidance in order to account for the benefit of shared central services within the Calculator.

12.4.1 Shared Rainwater Collection and Reuse

Projects that have multiple buildings sharing a central rainwater tank must follow the following procedure for calculating the amount of rainwater available for the rated project site:

- Enter the total rainfall collection area (m^2) for the central rainwater tank into the calculator.
- Enter the total storage capacity (kL) for the central rainwater tank into the calculator.

Rainfall collection area (m2)		3000
Run-off co-efficient	Pitched roof with profiled metal sheeting	0.9
Storage capacity (kL)		200
Rainwater tank reliability %		

- The project team are required to undertake separate calculations that cover all buildings served by the central rainwater system. These calculations are used to calculate the overall demand for rainwater based on the demand from all buildings and ancillary services (such as landscaping) being served, given the collection area and storage tank capacity.

- Leaving the inputs for collection area and storage capacity to reflect the full central rainwater tank, under part 8 of the Calculator 'Reclaimed Water – water demands not assessed in Wat-1', include the monthly rainwater demand (kL) from the other buildings that will utilise the central rainwater tank.

	Monthly water demand (kL/month)		
	Central rainwater tank - other building demands	<Enter description of any other uses of rainwater or re-used water>	<Enter description of any other uses of rainwater or re-used water>
January	50		
February	50		
March	50		
April	50		
May	50		
June	50		
July	50		
August	50		
September	50		
October	50		
November	50		
December	50		

- In the following table, indicate that 100% of the non-Wat-1 water will be met by rainwater. The Calculator will assume that these demands are met first before allocating remaining rainwater to the uses nominated within the rated project site.

How are the water demands from the Non-Wat-1 water uses met?					
Water use (assessed in other credits)	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Central rainwater tank - other building demands	100%				0%
<Enter description of any other uses of rainwater or re-used water>					
<Enter description of any other uses of rainwater or re-used water>					

12.4.2 Shared Greywater or Blackwater Collection and Reuse

Projects that have multiple buildings sharing a central greywater or blackwater treatment plant must follow the following procedure for calculating the amount of greywater or blackwater available for the rated project site. as the procedures are essentially the same for both these water sources, the example focuses on greywater, but can also be used for blackwater:

- The project team are required to undertake separate calculations that cover all buildings served by the central greywater system. These calculations are used to calculate the overall demand for greywater based on the demand from all buildings and ancillary services (such as landscaping) being served, given the collection sources utilised.
- Where the central greywater treatment system collects from additional sources outside of the rated project site, the additional water collected can be entered under the greywater section of the calculator in monthly inputs (kL/month).

Other sources	e.g. Chiller condensate, cooling tower washdown or sewer mining etc...			
	Central greywater treatment - other building inputs	<Enter description of any other sources of greywater> (kL/month)	<Enter description of any other sources of greywater> (kL/month)	kL/month greywater collected for re-use from other sources
January	15			15.0
February	15			15.0
March	15			15.0
April	15			15.0
May	15			15.0
June	15			15.0
July	15			15.0
August	15			15.0
September	15			15.0
October	15			15.0
November	15			15.0
December	15			15.0

- Where the central greywater treatment system is used to meet additional demands outside of the rated project site, these demands should be entered under part 8 of the Calculator 'Reclaimed Water – water demands not assessed in Wat-1', include the monthly greywater demand (kL) from the other buildings that will utilise the central greywater treatment plant.

	Monthly water demand (kL/month)		
	Central greywater treatment - other building demands	<Enter description of any other uses of rainwater or re-used water>	<Enter description of any other uses of rainwater or re-used water>
January	50		
February	50		
March	50		
April	50		
May	50		
June	50		
July	50		
August	50		
September	50		
October	50		
November	50		
December	50		

- In the following table, indicate that 100% of the non-Wat-1 water will be met by greywater. The Calculator will assume that these demands are met first before allocating remaining greywater to the uses nominated within the rated project site.

How are the water demands from the Non-Wat-1 water uses met?					
Water use (assessed in other credits)	Rainwater	Greywater	Blackwater	Stormwater recycling or other off-site reclaimed water	Mains water only (this column must be completed - please enter a figure of between 0% and 100% for each water use)
Central greywater treatment - other building demands		100%			0%
<Enter description of any other uses of rainwater or re-used water>					
<Enter description of any other uses of rainwater or re-used water>					

13.0 Green Star - Design & As Built Sewerage Calculator

The Green Star - Design & As-built Sewerage Calculator does not require any data input from the user. All required data is entered to the Potable Water Calculator and then exported to the Sewerage Calculator. The Sewerage Calculator returns the number of awarded points (out of four available[4]) for the Green Star credit Emi-6 'Discharge to Sewer'.

Points are awarded based on the percentage reduction compared to a Standard Practice Building. Reduced flow to sewer can be achieved through water-efficient fixtures and fittings as well as the collection of greywater and blackwater. Descriptions of how standard practice is defined are included in each section of this guide.

[4] The Sewerage Calculator awards up to four points, there are however five points available in the Emi-6 'Discharge to Sewer' credit, for further details please refer to the Technical Manual.

14.0 Green Star - Design & As Built Greenhouse Gas Emissions Calculator

The Green Star - Design & As-built Greenhouse Gas Emissions Calculator is designed to assess reductions in greenhouse gas emissions compared to a Standard Practice Building. More information about the Greenhouse Gas Emissions Calculator is available at www.gbca.org.au.

The energy consumption associated with water heating for taps, showers dishwashers and washing machines in the building (domestic hot water) is a required input of the Greenhouse Gas Emissions Calculator. The methodology that must be used to determine the energy consumption associated with domestic hot water is included in the *Greenhouse Gas Emissions Calculator Guide*; it requires the demand for domestic hot water as an input. The methodology shows that reductions in greenhouse gas emissions can be achieved by installing more efficient fittings and fixtures as well as installing an efficient hot water system and/or a solar hot water system.

The domestic hot water demand figures that must be used are calculated and displayed in the Potable Water Calculator. The calculator assumes that 50% of the water used in taps and showers in the Proposed and Standard Practice Buildings is hot water. The proportion of hot water used in washing machines and dishwashers is defined in accordance with the usage of the whitegoods' "normal" or default cycle which the project team should support with manufacturer's documentation. The water efficiency of taps, showers dishwashers and washing machines in the Proposed Building are as entered by the project team in the Potable Water Calculator. The water efficiency of the fittings of the Standard Practice Building is based on the standard practice fittings described in 'Standard Practice Benchmark Water Efficiency – ' and for whitegoods in 'Standard Practice Benchmark Water Efficiency – White goods.' The hot water consumption figures are displayed in the Results Section of the Potable Water Calculator.

15.0 References

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APPENDIX A.

Crop coefficient (K_c)

The crop coefficient is an agronomic multiplier used to determine the water usage requirement for a particular plant type. The **area weighted average** crop coefficient for the zone should be entered into the calculator.

The table below provides crop coefficients based on the general plant type e.g. native trees, exotic trees, native shrubs etc. and the expected water use of that general plant type. Examples of specific plants that belong in the crop coefficient category are also provided. For plants that do not appear on the list, project teams should pick a plant category that most closely matches the plants in the zone, based on the examples provided. Where a crop coefficient cannot be determined, a Technical Clarification may be submitted to the GBCA.

1. Trees	Crop Coefficient
1.1 Native trees	
1.1.1 Very Low Water Use	0.1
Banksia (Silver) (Banksia marginata)	
Eucalypt (Yellow Gum) (Eucalyptus leucoxylon)	
Eucalyptus (Sugar Gum) (Eucalyptus cladocalyx)	
Eucalyptus (Red Iron Bark) (Eucalyptus tricarpa)	
She-Oak (Drooping) (Allocasurina verticillata)	
Wattle (Cootamundra) (Acacia baileyana)	
Willow leaf Hakea (Hakea salicifolia)	
1.1.2 Low Water Use	0.25
Bottlebrush (Weeping) (Callistemon viminalis)	
Melaleuca (Melaleuca stypheliodes)	
Oak (Silky) (Grevillea robusta)	
1.1.3 Moderate Water Use	0.5
Ash (Mountain) (Eucalyptus regnans)	
Fig (Moreton Bay) (Ficus macrophylla)	
Cabbage Tree Palm (Livistonia australis)	
Umbrella Tree (Schefflera actinophylla)	
Lilly Pilly (Acmena Smithii)	
White Peppermint (Eucalyptus pulchella)	
1.1.4 High Water Use	0.7
None	
1.2 Exotic trees	Crop Coefficient
1.2.1 Low Water Use	0.35
Pear (Ornamental) (Pyrus calleryana	
Chinese Elm (Ulmus parvifolia)	
Crab Apple (Malus “plena”)	

1. Trees	Crop Coefficient
Crepe Myrtle (Lagerstroemia indica)	
Monterey Pine (Pinus radiata)	
1.2.2 Moderate Water Use	0.6
Golden Ash (Fraxinus excelsior “Aurea”)	
Golden Poplar (Populus x canadensis “Serotina Aurea”)	
Pin Oak (Quercus palustris)	
Pencil Pine (Cypressus sempervirens)	
Magnolia (Magnolia grandiflora)	
Jacaranda (Jacaranda mimosifolia)	
1.2.3 High Water Use	0.85
Douglas Fir (Pseudotsuga menziesii)	
Paperbark Maple (Acer griseum)	
Maple (Japanese) (Acer palmatum)	
Rubber Plant (Ficus elastica)	
Silver birch (Betula pendula)	

Table 14 Tree crop coefficient

2. Shrubs	Crop Coefficient
2.1 Native shrubs	
2.1.1 Low Water Use	0.25
Banksia (Heath) (Banksia ericifolia)	
Bottlebrush (Splendens) (Callistemon citrinus “Splendens”)	
Saltbush (Rhagnodia spinescens)	
White Correa (Correa alba)	
2.1.2 Moderate Water Use	0.5
Banksia (Swamp) (Banksia robur)	
Boronia (Red) (Boronia heterophylla)	
Flame Pea (Chorizema cordatum)	
Snowy Daisy Bush (Olearia lirata)	
Native Heath (Epacris impressa)	
2.1.3 High Water Use	0.7
Creamy Candles (Stackhousia monogyna)	
Birds Nest Fern (Asplenium australasicum)	
Soft Tree Fern (Dicksonia australis)	
Weeping Fig (Ficus benjamina)	
2.2 Exotic shrubs	

2. Shrubs	Crop Coefficient
2.2.1 Low Water Use	0.35
Abelia (Abelia x grandiflora)	
Oleander (Nerium oleander)	
Euphorbia (Crown of Thorns) (Euphorbia milii)	
Lantana (Lantana camara)	
Sedum (Ice Plant) (Sedum spectabile)	
Yucca (Spannish Dagger) (Yucca gloriosa)	
Hebe	
2.2.2 Moderate Water Use	0.6
Camellia (Camellia sasanqua)	
Daphne (Winter) (Daphne odora)	
Japanese Honeysuckle (Lonicera japonica)	
Japanese Wisteria (Wisteria floribunda)	
Dogwood (Buddleia davidii))	
Pittosporum (Diamond leaf) (Pittosporum rhombifolium)	
Viburnum (Viburnum x burkerwoodii)	
Rose (Rosa spp)	
Azalea	
2.2.3 High Water Use	0.85
Hibiscus (Scarlet Rose-mallow) (Hibiscus coccineus)	
Hydrangea (Hydrangea x macrophylla)	
Rhododendron (Rhododendron hybrid)	
Gardenia	

Table 15 Shrub crop coefficient

3. Climbers	Crop Coefficient
3.1 Native climbers	
3.1.1 Very Low Water Use	0.1
Clematis (Small Leaved) (Clematis microphylla)	
Kennedia (Kennedia macrophylla)	
Native Sarsparilla (Hardenbergia violacea)	
3.1.2 Low Water Use	0.25
Pandorea (Bower of Beauty) (Pandorea jasminoides)	
3.1.3 Medium Water Use	0.5
3.2 Exotic climbers	**Crop Coefficient**
3.2.1 Very Low Water Use	0.25
Vine (Glory) (Vitis cultivar)	

3. Climbers	Crop Coefficient
3.2.2 Low Water Use	0.35
Ornamental grape (Vitus vinifera)	
Star Jasmine (Trachelospermum jasminoides)	
Wisteria (Chinese) (Wisteria sinensis)	
3.2.3 Medium Water Use	0.6
Banksia Rose (Rosa banksiae “Lutea”)	
Carolina Jasmine (Gelsemium sempervirens)	
Virginia Creeper (Parthenocissus quinquefolia)	
3.2.4 High Water Use	0.85
None	

Table 16 Climber crop coefficient

7. Turf	Strong growth, Good condition	Vigorous growth, Lush condition
7.1 Warm Season Grasses	0.6	0.85
couch		
kikuyu		
buffalo		
Zoysia		
7.2 Cool Season Grasses	**0.85**	**1**
Kentucky blue		
Ryegrass		
Tall Fescue		
Bentgrass		
8. Ornamentals	**0.8**	**0.95**

Table 17 Grasses and ornamentals crop coefficients