Green Star Performance

Potable Water Calculator Guide

November 2017

greenstar Developed by the Green Building Council of Australia

1. Change Log

Release	Date	Description of changes
Green Star – Performance Version 1 ***Release 1***	16/09/2015	Initial Release
Green Star – Performance Version 1 ***Version 1.1***	08/04/2016	Released for Green Star – Performance v1.1, minor changes to improve clarity
Green Star – Performance Version 1 ***Version 1.2***	29/11/17	Released for Green Star – Performance v1.2; Calculator guide applicable for New Zealand projects

2. Table of contents

3. Intent of this guide

This guide has been developed to inform building owners, managers and operators how to target and achieve credit points for Potable Water when seeking a Green Star - Performance rating. The guide contains:

- Information on the various compliance paths that project teams may take to demonstrate that their building complies with the credit
- The data requirements for each compliance path
- Information to help guide project teams through the entire submission compilation process.

This guide is structured along the lines of the Potable Water credit. It begins with an overview of the credit then focuses on the specifics of each compliance pathway, followed by some detailed advice on data, calculations and other relevant issues. The guide is not made to be read end-to-end. It is recommended that, once familiar with the credit in general, the reader seeks information from the section of this guide relevant to the compliance pathway that they are seeking to use.

4. The Potable Water credit

Credit Aim

To encourage the reduction of potable water use associated with the operation buildings.

Scope of the credit

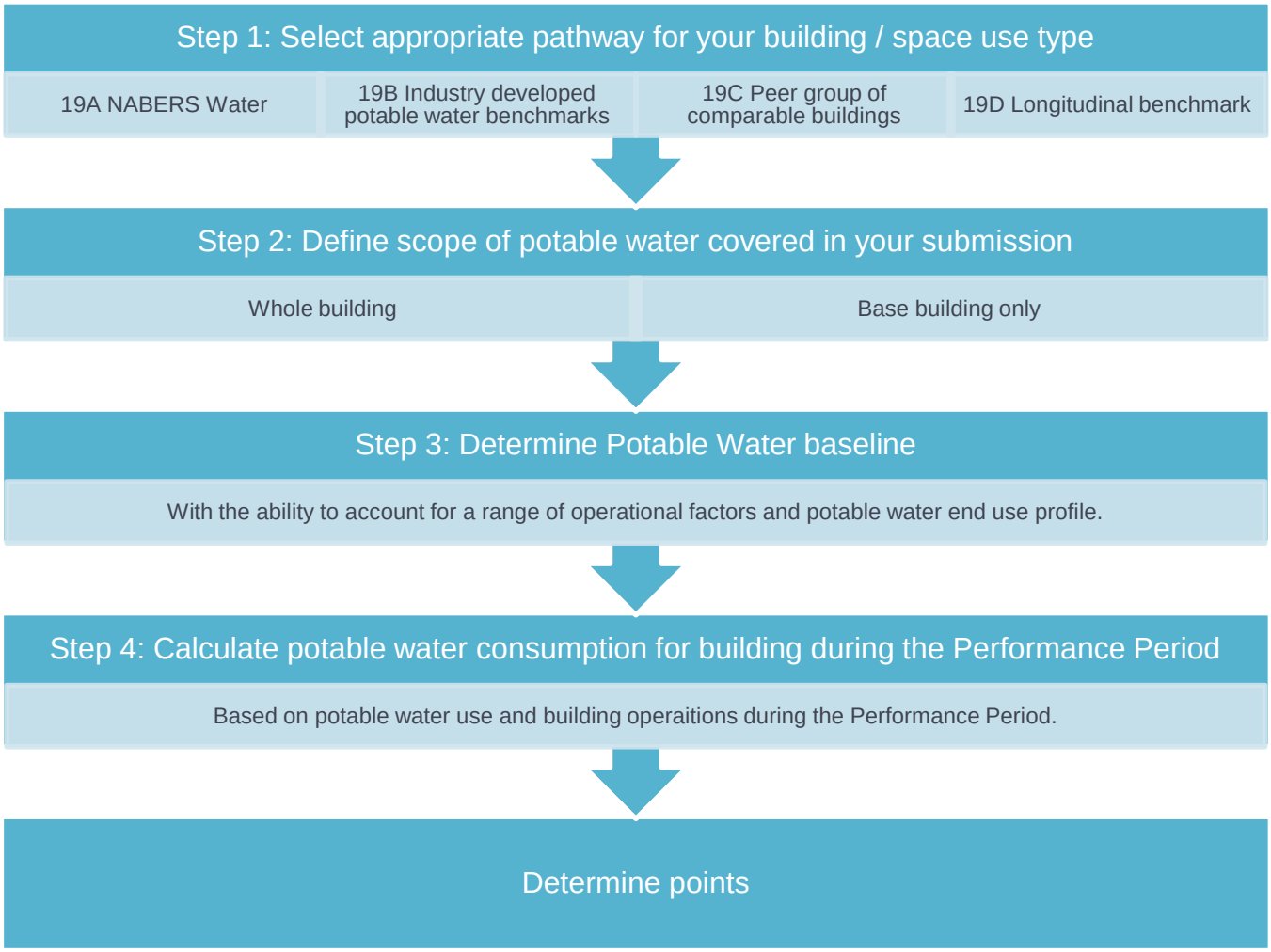
The Potable Water credit focuses on potable water consumption due to building operations during the Performance Period over which a building is assessed. For the purposes of the credit potable water is water that is drinkable i.e. safe for human consumption. Typically this will be water supplied from the town mains water supply to a building. The credit allows the use of non-potable water to supplement or reduce potable water consumption. For the purposes of the credit non-potable water is recycled water or water collected on/off-site, such as rainwater or stormwater, or recycled/recovered from a previous use such as blackwater or greywater recovery. It does not include water from rivers, lakes or groundwater (bore water) unless the water has previously been used.

Credit Methodology Overview

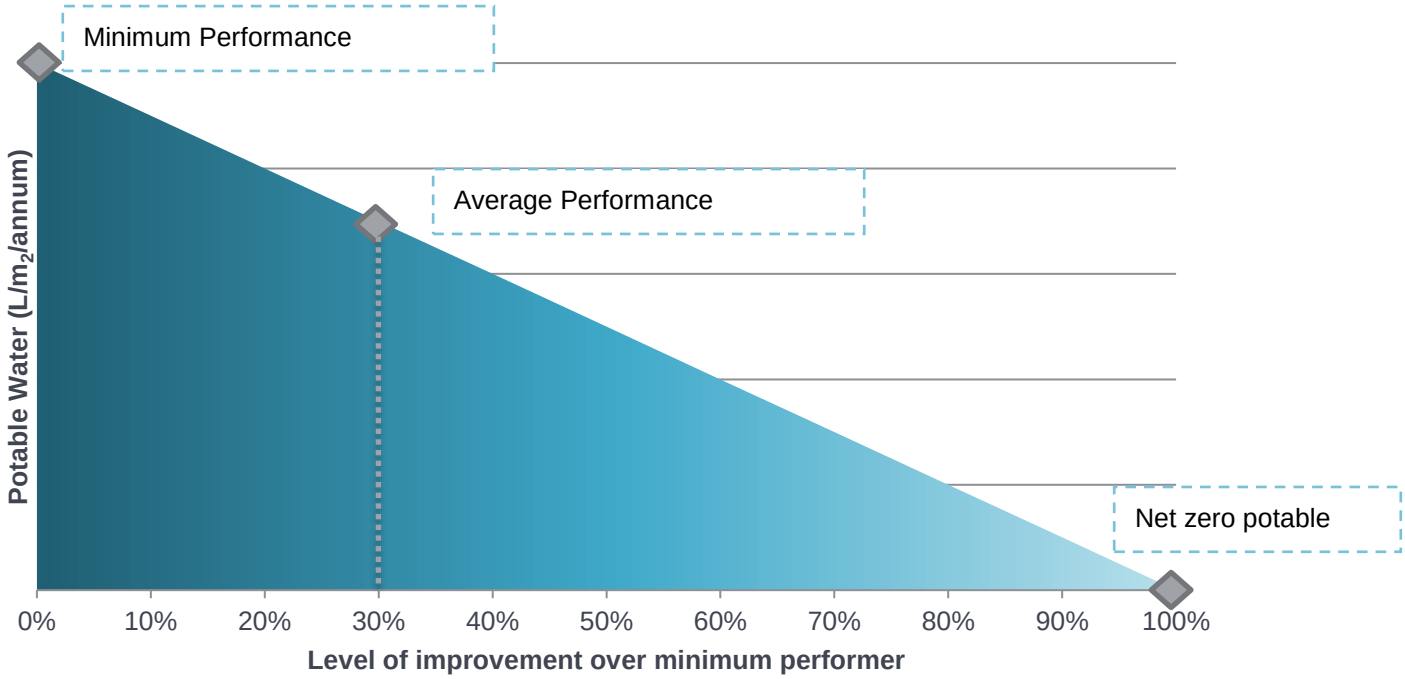
The Potable Water credit sits within the Water category and focuses on potable water consumption that result from building operations. The credit is structured to allow flexibility and applicability to the many different building types that are eligible to be certified under the Green Star – Performance v1.1. This flexibility is achieved by offering a number of different pathways for compliance. Selecting an appropriate pathway is the first step (Step 1 in the below graphic) in compiling a submission for Potable water consumption. The four compliance pathways are:

- 19A NABERS Water
- 19B Industry developed potable water benchmarks
- 19C Peer group of comparable buildings
- 19D Longitudinal benchmarking

Each pathway is based on a different method for establishing a baseline which may be appropriate to a building seeking certification. The sections that follow in this guide will provide further details on each pathway, the basis upon which it may be selected and details on the calculations.



Once a pathway is selected and performance benchmarks are established, potable water consumption performance for a project is assessed against these benchmarks. Points are awarded on an incremental basis for improvement on a nominal minimum performance benchmark. Up to 10 points are awarded for potable water performance (there are 100 points for environmental performance within the entire rating tool). (as shown below).



The average and minimum performance baselines, the project's potable water consumption, and points achieved are calculated within the appropriate Green Star - Performance Potable Water Calculator.

For each of the four pathways, a separate calculator has been provided. Data quality and requirements are stipulated within this guide. Points are awarded based on Table 19.0.3 below.

Table 19.0.3: Potable Water points available

Percentage better than 'minimum performer'	Points
0% - Nominal Minimum Baseline	0
5%	0.5
10%	1
15%	1.5
20%	2
25%	2.5
30% - Average Performer	3
35%	3.5
40%	4
45%	4.5
50%	5
55%	5.5
60%	6
65%	6.5
70%	7
75%	7.5
80%	8
85%	8.5
90%	9
95%	9.5
100% - Net Zero Potable Water	10

5. Pathway 19A: NABERS

Selecting this pathway

This option enables buildings which are eligible for a valid NABERS Water Certificate to determine potable water consumption performance using a certified NABERS Water rating. A 'potable water baseline' already exists for premises eligible for a NABERS Water Certificate. Green Star – Performance draws on NABERS benchmarks to determine a baseline upon which projects demonstrate improvements through their certified NABERS rating.

Data requirements

Applicants must have a NABERS Water Certificate valid during the Performance Period, obtain in line with rules set by the NABERS program, as determined by the National Administrators, the Office of Environment and Heritage NSW. The NABERS Water certificate used does not have to be valid throughout the whole Performance Period:

- Its expiry date must fall within Performance Period. Or;
- Its expiry date must fall within the 90 days between the end of the Performance Period and Round 1 submission for the project. Or;
- If it is a newly obtained NABERS certificate, it must have been obtained in the 90 days between the end of the Performance Period and the projects Round 1 submission (which would mean the rating is based on data from the Performance Period).

The documentation requirements of the credit will require the provision of both the NABERS Water Certificate and accompanying NABERS water report. For more detail please refer to 11. Data and validation requirements.

Establishing a baseline

Using this pathway there is no need to develop an average performance baseline. Baselines are already established within the Potable Water Calculator based on the following NABERS Water Star ratings:

- The Average Performer is predetermined as 3 Star NABERS Water.
- The Nominal Minimum Performer Baseline is determined to be 1 Star NABERS Water rating.

Points Allocation

There are two options that may be taken in determining points using a certified NABERS Water rating:

- Simple approach using the below table 19A.3 Simplified NABERS Water points allocation.
- Compare potable water consumption to those of a nominal 1 Star NABERS Water building.

Simple approach

The simplified approach can be carried out exceptionally quickly, however it is not as granular as the more detailed comparative approach.

Table 19A.3 Simplified NABERS points allocation

NABERS Water Star Rating	Points
1.0 Minimum Baseline	0
1.5	0.5
2.0	1
2.5	2
3.0 Nominal average performer	3
3.5	4
4.0	5
4.5	6
5.0	7
5.5	8
6.0	9
Net Zero Potable Water	10

Comparative approach

The comparative approach requires the applicant to determine a potable water benchmark using the relevant NABERS water reverse calculator. Figures entered into the reverse calculator must assume the same location and operational factors as those used in the certified NABERS Water rating. The applicant must determine and extract the potable water consumption for a 1 Star NABERS Water outcome (aligned with the nominal minimum baseline).

Figures from the reverse calculator must be entered into the Green Star – Performance Potable Water calculator alongside those from the certified NABERS Water Certificate and accompanying report for the building seeking certification. Based on this information entered that Potable Water calculator will determine the percentage reduction and overall points able to be targeted in line with Table 19.0.3.

6. Pathway 19B: Industry developed potable water benchmarks

Selecting this pathway

This option incorporates published potable water consumption benchmark data for a number of building types and regions across Australia. Applicants must select an appropriate benchmark (where available) from a recognised industry benchmark. Benchmarks currently recognised within the credit are:

- The National Business Water Efficiency Benchmarking (NBWeb) project.

In addition to the above, the GBCA are committed to partnering with stakeholders to release benchmarks for new building types as a statistically significant datasets are sourced and benchmarks developed.

This pathway may be selected where an appropriate water intensity figure is available for the space use types and given regional location for building seeking certification. Where data from the study is unavailable for building space use or type, and region, then this pathway cannot be used.

The National Business Water Efficiency Benchmarking project came out of ongoing collaborative programs between water suppliers and businesses. The project includes a partnership between 13 water authorities and government agencies across Australia. For more information on the NBWeb project and benchmarks please visit www.nbweb.com.au

Applicants must investigate the suitability of benchmarks for the building seeking Green Star certification when selecting this option. Applicants must note that the benchmarks represented in this pathway more may not be comparable to the building seeking Green Star certification due to differences in a range of operational factors. Applicants are encouraged to interrogate the NBWeb website and if required seek further advice before selecting a benchmark from the above.

Data requirements

Applicants must have access to the following data on the building seeking certification as a minimum to be able to compile a submission using this option:

- Building Specific Details as listed in Data and Validation Requirements; and
- Primary Operational Variables as listed Data and Validation Requirements

Mixed use building guidance

There is not currently an allowance for mixed use buildings within this option. Please submit a credit interpretation request proposing a methodology should you wish to pursue this pathway for a mixed use building.

Operational factors and normalisation

All relevant operational factors for the building seeking Green Star certification should be entered in the NBWeb online tool as well as the ‘Building Details’ tab of the 19B calculator. An operational factor is relevant if it is a variable that has a significant bearing on water use within the building. Where applicable the NBWeb tool calls for operational factors that have been found to influence potable water benchmarks within a particular building type or industry. Where this option is not available within the NBWeb platform, there is no additional normalisation capability within the 19B calculator.

7. Pathway 19C: Peer group of comparable buildings

Selecting this pathway

This pathway enables the applicant to establish a benchmark using in operation data from a group of comparable buildings to the building seeking Green Star certification. This option requires the applicant to source information to develop a relevant baseline and hence will likely require more time and effort than 19A or 19B, it is thus recommended that 19A or 19B are considered before selection the 19C pathway.

Data requirements

When using this option it is the responsibility of the applicant and project team to source all relevant information on the peer group of buildings to establish a baseline for comparison with the building seeking Green Star certification. Benchmarks within this approach are established based on at least three concurrent years of operational data for a peer group of at least three buildings.

As a stepwise process this will include:

- Selecting a peer group of at least three comparable buildings. For more detail please refer to Peer Group Selection.
- Sourcing all relevant building specific details as listed in Data and Validation Requirements for the peer group of buildings as well as the building seeking Green Star certification. Three years of operational data is required for the peer group of buildings.
- Sourcing Primary Operational Variables as listed in Data and Validation Requirements.
- Sourcing relevant secondary operational variables and water end-use breakup for the peer group of buildings as well as the building seeking Green Star certification. These will be required to ensure that benchmarks established by the peer group of buildings are able to be adjusted and normalised for relevance to the building seeking Green Star certification. For more detail please refer to Benchmark Adjustment and Normalisation.

Operational factors and normalisation

More than any other pathway 19C requires detailed operational information to ensure that benchmarks established are relevant to the building seeking Green Star certification. For more information please refer to information within Peer Group Selection followed by Benchmark Adjustment and Normalisation.

Alternative compliance

Benchmarks within this approach are established based on at least three years of operational data for a peer group of at least three buildings. The GBCA is open to alternate peer group benchmarks based on for example a larger peer group of buildings. In this instance it may be acceptable to formulate a baseline based on fewer years' worth of data for a significantly larger peer group. All proposals for alternative approaches should be submitted through a credit interpretation request.

8. Pathway 19D: Longitudinal benchmarking

Selecting this pathway

This pathway allows the applicant to establish a benchmark based on a longitudinal study of potable water performance based on previous year's operations. It is a pathway most suitable when a project is not eligible for pathways 19A, 19B, or 19C.

Data requirements

Project teams must establish a potable water Average Performance Baseline based on five concurrent years of historical water consumption data sourced from within the ten years of operation prior to the beginning of the performance period.

Applicants must have access to the following data on the building seeking certification as a minimum to be able to compile a submission using this option:

- Building Specific Details as listed in Data and Validation Requirements; and
- Primary Operational Variables as listed Data and Validation Requirements

If the applicant wishes the benchmarks to account for changes to the building or extended or abnormal operating hours year on year, or other building and operational factors in the potable water benchmarks, water end use breakup will also be required as specified in Data and Validation Requirements.

Operational factors and normalisation

Because 19D is a self comparison, it is unlikely that any operational factor or end use adjustments will have to take place, unless there have been material changes to the building or its use. If a material change has occurred to the building, then normalisation and end-use adjustment functionality is included in the 19D calculator in the same way that adjustments are made in the 19C Peer Group of Comparable buildings pathway. Examples of material changes to the building may include:

- Changes to floor area as a result of a building upgrade or extension.
- Changes to space use that have a material impact on water consumption which may include changes to occupant amenity that have a material impact on water consumption.

For a full and detailed explanation of benchmark adjustments please refer to Benchmark Adjustment and Normalisation.

9. Peer group selection

Overview

For pathways 19B and 19C the need exists to select an appropriate peer group that will be used for determining a potable water consumption baseline. Under pathway 19B, the potable water consumption baseline can be directly determined from tables published in the credit based on the building's functional use. Further work is required under Pathway 19B for mixed use facilities.

For Pathway 19C, building owners and managers can nominate their own peer group comprising 3 or more comparable buildings. Relevant data is then to collected and analysed to determine a potable water consumption baseline from which the rating building's performance is assessed.

In the absence of average building performance benchmark data, the peer group comparison provides a suitable method of determining an emissions baseline of which building emissions performance can be compared to.

Note that buildings eligible for a NABERS Water Certificate (19A) are not required to select a peer group as a potable water consumption baseline is already determined using this approach. Similarly, the selection of a peer group is not required under 19D as this method involves a comparison against a longitudinal baseline from the building itself.

The selection of an appropriate peer group is essential to achieving an accurate and fair rating comparison. A number of comparable eligibility requirements must be met when selecting the peer group; these are presented in the following sections.

The peer group comparison option is open to significant variability between building specific characteristics and operational characteristics of different buildings and building types; therefore, a detailed normalisation procedure is required to limit this variability from considerably influencing the rating.

Peer Group Comparison Methodology

The following sections provide guidance in selecting an appropriate peer group of comparable buildings.

Primary Use Definition

The 'Primary Use' of a building is defined as the primary activity that covers at least 80% of the building's operations, inclusive of 'primary use – support areas'.

'Primary use – support areas' are any miscellaneous areas which support the primary building operations and activities. These include administrative offices, storerooms, toilets and common/public areas.

Comparable Eligibility Requirements

For buildings to be deemed comparable, they must satisfy a number of eligibility criteria:

1. Buildings must exhibit the same 'primary use' type to be eligible. Where a building is deemed 'mixed use', it must satisfy the requirements outlined in Options for treating mixed use premises.

2. The difference in total gross building area must be less than ±50% of the rated building's area, unless agreed.

3. The weekly hours of operation of the comparable buildings must be within ±10% (prior to normalisation), unless agreed through a credit interpretation request (CIR).

4. Building applicants must provide evidence to support the 'primary use' or 'mixed use' percentages claimed herein, by providing marked up floor plans that clearly identify the various functional spaces that the building consists of.

5. Building owners and managers must compare the end-uses of each comparable building with that of the rated building, to ensure that they feature similar water use systems.

6. Determine availability of data for each building in comparable peer group. Only buildings that exhibit comprehensive potable water data and end-use break up data are eligible.

Options for treating mixed use premises

For a building to be classified as a 'primary use', at least 80% of the building's gross area must be used for the same primary activity, inclusive of supporting administration areas. However, it is estimated that many buildings will exhibit 'mixed use' spaces; and the determination of a building's 'primary use' (hence the ability to directly compare this to a set of peer group buildings) will therefore be a non-trivial task.

Mixed-use buildings can be rated under the Green Star methodology; however, careful attention must be paid to selecting an appropriate peer group. Mixed-use buildings will most likely include various functional spaces, each with its own type of operating variables. As such, the rated building cannot simply be measured against other mixed-use buildings without reviewing the similarities and/or differences in use within each major functional space.

Two options exist for 'mixed use' building owners and operators to determine a peer group potable water baseline:

1. **Weighted averages approach:** Pro-rata gross building area into various functional spaces (uses) and construct an area-weighted average performer, based on single primary use peer group buildings (e.g. a university building that exhibits 30% laboratory, 20% lecture theatres and 50% classroom/administration can be compared to three separate peer group buildings, each exhibiting at least 80% primary use in each of laboratory, classroom and lecture theatre functional uses). This may be the preferred approach for building owners and managers seeking to use Option 1(a);

2. **Comparable functional spaces approach:** Demonstrate through a CIR (with appropriate supporting documentation) that 'mixed use' peer group buildings are comparable to the rated building, due to:

    a) a large number of mixed functional spaces (e.g. consider a case where such a large number of functional use spaces exist (in both peer group and rated buildings) that they can be deemed comparable); or,

    b) a similar functional use breakup between the comparable buildings;

The comparability may be a combination of qualitative and quantitative analysis. This approach may be preferred by building owners and managers seeking to use Option 1(a). An example of this approach is illustrated in Appendix A.

Should the applicant be unable to identify suitable buildings for use as a peer group, an alternative approach is to use 19D, which involves self-comparison.

Selection of peer group

The selection of the peer group is performed by the building applicant and is subject to GBCA third party peer review. The applicant may make use of any sources of data they have available to them, whether this be from external parties or from the applicant's own internal portfolio. At least three buildings must be selected to constitute a valid peer group.

The applicant building must clearly specify all of the functional spaces within the building to determine whether the building is a 'primary use' or 'mixed use' building.

Procedure

The following procedure presents a generalised method for selection and determination of peer group comparability:

1. Determine whether the rated building is eligible for 'primary use' or 'mixed used' categories (i.e. 80% primary use coverage);

    a) If primary use, search for buildings with the same primary use for peer group

    b) If mixed use, determine the number and size of different functional spaces in rated building and select comparable peer group buildings based on either a 'weighted averages' or 'comparable functional spaces' approach as per Options for treating mixed use premises.

2. Evaluate the following building specific characteristics for both the rated building and the peer group buildings in order to determine whether the peer group satisfies the Comparable Eligibility Requirements:

    a) Building Area – appropriate to the building type (e.g. net lettable area, gross floor area, effective area, usable floor area, etc).

    b) Water end-uses within the building.

    c) Combined area of each functional use type.

    d) Locality and climate zone, based on Postcode.

    e) Weekly hours of operation.

Note that potable water consumption should not form part of the evaluation criteria.

3. Compare peer group buildings and determine if Comparable Eligibility Requirements have been satisfied.

4. Identify dissimilar end-uses between the chosen peer group building and the rated building. Where primary end-uses do not match exactly, adjustments must be made to the building's water baseline, such that the buildings are compared on a 'like for like' basis.

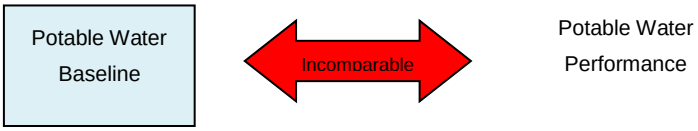
5. Proceed with performance period potable water calculation

10. Benchmark adjustment and normalisation

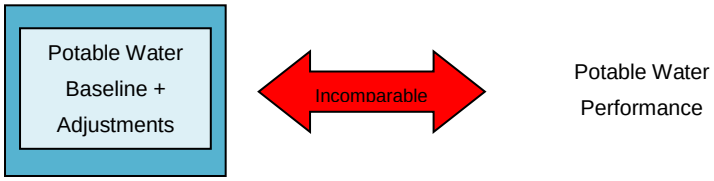
No two buildings are the same, and all buildings operate in a different manner. In order to make a direct comparison between baseline and performance period (to determine potable water performance), a building's potable water baseline must be 'normalised', such that the baseline and performance period can be directly compared on a 'like for like' basis.

As the potable water credit is available to a large variety of building types, it is therefore essential that the credit incorporates a structured normalisation procedure to ensure accuracy, consistency and fairness across all rateable building types. The below figure provides a high level overview of normalisation and why it is necessary.

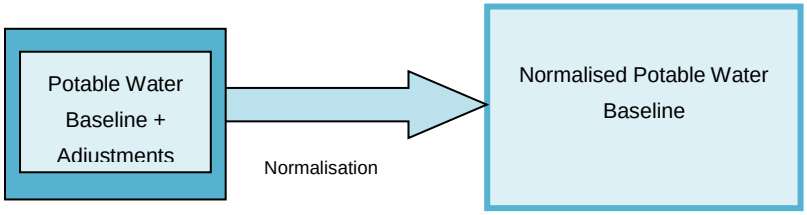
1. Comparison of potable water baseline period to performance period is inconsistent and unfair if carried out without normalisation. End-uses may dissimilar.



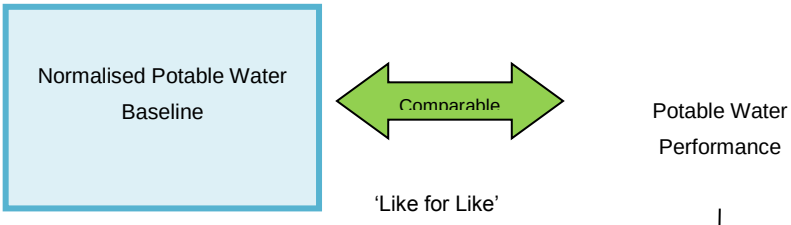
2. Adjustments are applied to the baseline to account for dissimilar end-uses, where applicable.



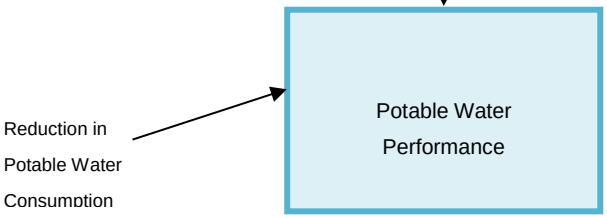
3. The potable water baseline is normalised using a combination of primary and secondary normalising variables; building water end-use breakup; end-use adjustments; and appropriate scaling factors.



4. The normalised baseline now enables a fair and more accurate comparison to the potable water performance.



5. The difference between the normalised baseline and potable water performance yields the reduction in potable water consumption.



Normalisation Overview

'Operating Variables' Definition

Potable water consumption associated with buildings is significantly influenced by a large number of operating variables. The magnitude of these operating variables, and the extent to which each will affect building potable water use, varies considerably between both building type and within similar building uses. Changes in any of these variables can have a significant effect on building potable water performance.

Operating variables that have an impact on potable water consumption in buildings include both building characteristics (e.g. building area, air-conditioning systems, building technology, location of building - to inform variance due to climate) and activity-based characteristics (e.g. operating hours, occupancy levels, transactions, meals produced, equipment manufactured etc).

Green Star attempts to normalise for variables that purely describe how a building operates, rather than the construction, technology and systems which describe why a building operates the way it does. These are defined as operating variables, and are described in more detail in Selection of relevant Operating Variables.

Normalisation Methodology

Depending on the building type being rated, and availability of peer group data to determine a potable water baseline, various normalisation options are available to building owners and managers. The available potable water baseline options are described in Credit Methodology Overview.

The Peer Group comparison approach has potential for significant variability between the potable water baseline and the potable water performance period. Therefore, for buildings eligible for 19C, a detailed normalisation procedure has been defined to ensure application of fairness and consistency throughout the rating tool. The normalisation procedure is presented in the following flow diagram:

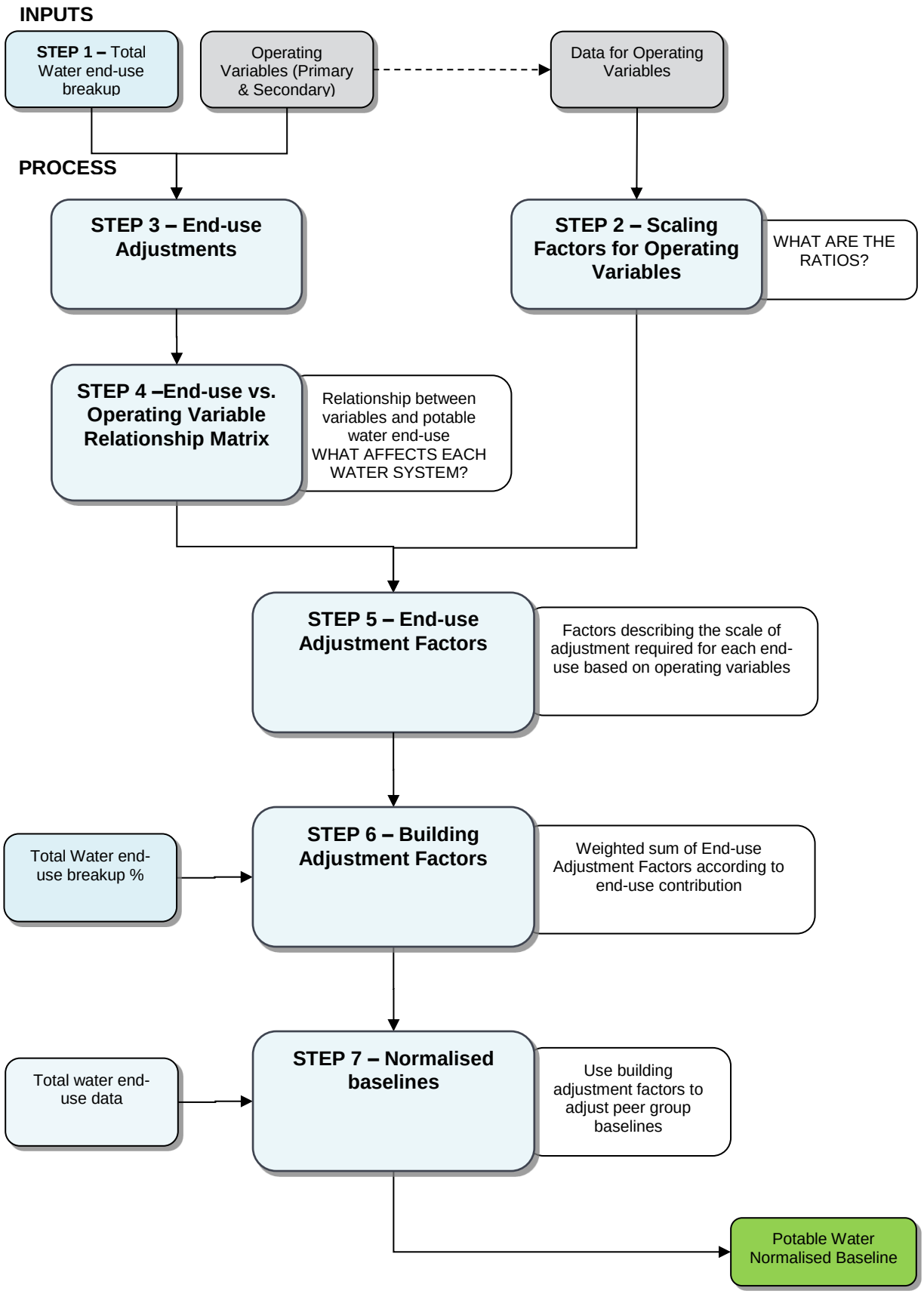


Figure 1 – Normalisation Procedure

The key steps of the normalisation process are described below. These steps occur once the peer group has been selected, the operating variables have been defined, and appropriate data has been collected. The other key input into this process is the collation of end-use break ups.

Step 1 – Peer Group Selection

Please refer to Selection of Peer Group Buildings for information on this step. Information required for these steps relates to:

- Building Characteristics
- A qualitative statement of building water end uses

Building Water End Use Services	Services in use?						
	Shopping Centre 1	Shopping Centre 2	Shopping Centre 3	Shopping Centre 4	Shopping Centre 5	Shopping Centre 6	Shopping Centre 7
Amenities	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shops	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Irrigation	Yes	Yes		Yes		Yes	
Cafeteria/Restaurants	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cooling Towers	Yes	Yes	Yes	Yes	Yes		Yes
Swimming Pool					Yes	Yes	
Cleaning	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data Availability		Yes	Yes	Yes	No - Gaps	Yes	Yes
Chosen for Peer Group		Yes		Yes		Yes	

Step 2 – Gather Water and Activity Data for Rated and Peer Group Buildings

Data for the rated building and peer group buildings must be collected in relation to:

- External Water Sources; and
- Operating Variables

Scaling factors are calculated for operating variables for each peer group building and annual baseline period. These factors represent the scaling required to 'resize' a particular operating variable (i) for annual period (j) from the peer group building (k) to the rated building. These factors will relate to a range of relevant variables including, cooling degree days, area and hours of operation for example.

Scaling factors are calculated using the following equation:

$$\text{Scaling Factor}_{i,j,k} = \frac{\text{Annual value for Operating Variable(i)for Building to be Rated}}{\text{Annual value for Operating Variable(i)for Annual Period (j) for Peer Group Building(k)}}$$

A sample calculation is shown in the example below. Suppose we are calculating the scaling required between two buildings for the operating variable Cooling Degree Days with the following data:

Operating Variable	Rated Building	Comparable Building
Cooling Degree Days	600	1752

The calculation of scaling factor for Cooling Degree Days will be:

$$\text{Scaling Factor}_{\text{Cooling Degree Days}} = \frac{600}{1752} = 0.34$$

Step 3 – Obtain a water end-use break up for each building

The first step is to obtain data relating to building water end-use (the proportion of total water used within each end-use system for each building).

Qualitative analysis is conducted in order to identify peer group buildings that exhibit similar water consuming end-uses (i.e. water use activities). With this in mind, it is assumed that the selected peer group will have similar water end-uses as the rated building. However, where an exact match between the rated and comparable building end-uses cannot be obtained, a series of adjustments must be made to the comparable building baselines to account for dissimilar end-uses. The adjustments are performed in Step 3.

Building owners and managers must source or develop an end-use breakup of the building's water consumption. Building owners are required to provide their own evidence of end-use breakup and how it was determined, which will be assessed by the GBCA assessors.

This will form a key component of the normalisation process. End-use breakups allow more accurate normalisation, as it facilitates the separate adjustment of each water end-use, based on its own set of operating variables.

Total Externally Supplied Water

End Use	End Use Breakup						
	Rated Building	Comparable Building 1		Comparable Building 2		Comparable Building 3	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Leakage	16%	14%	14%	12%	12%	13%	13%
Cooling Towers	22%	25%	25%	20%	20%	0%	0%
Shops	25%	20%	20%	20%	20%	22%	22%
Irrigation	10%	8%	8%	10%	10%	15%	15%
Amenities	22%	25%	25%	30%	30%	25%	25%
Swimming Pool	0%	0%	0%	0%	0%	15%	15%
Other	5%	8%	8%	8%	8%	10%	10%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Step 4 – Determine End-use adjustments

End-use adjustments are used to account for specific, known differences that will prevent a fair comparison between buildings. These may include additional or missing water end-uses, or special events that have caused non-routine consumption. Examples of dissimilar end-uses may include water-cooled vs. air-cooled HVAC systems, buildings that

may or may not have to fill a swimming pool, or periodic site shutdown of the rated building or one peer group building due to renovation or an extreme weather event.

Adjustments are determined in relation to particular end-uses. Adjustments are only applied to peer group buildings, and each adjustment must be accompanied by clear reasoning and documentation, which is subject to review by the assessment panel.

From the sum of all building and time based adjustments, new adjusted annual water use totals are then determined for each peer group building(k) and baseline year(j).

$$\text{Adjusted Annual Water Use}_{j,k} = \text{Annual Water Use}_{j,k} + \sum \text{Building Adjustments}_{j,k}$$

Finally, adjusted end-use breakups are calculated for each building and baseline year.

Step 5 – Qualitatively map operational variables with water end uses

This involves qualitatively analysing the relationship between each operating variable and the water end-use systems within the group of buildings.

Essentially we are seeking to nominate the operating variables that we are confident would cause a change in the size or scale of its contribution to the overall water use of the building.

This is conducted by simply reviewing each water end-use in isolation and asking the following question for each operating variable:

Would changes in this operating variable result in changes in the resulting end-use?

Working through this process, we develop the relationship matrix for water end-use versus operating variables, which will be applied in the next step. Within the matrix, each variable is flagged (i.e. TRUE or FALSE) depending on whether that operating variable is a key influence on water consumption for each water end-use (i.e. variables that have a significant influence on water consumption for each end-use will be flagged to be included in the normalisation analysis).

The reason we go to this effort is to obtain a more accurate normalisation of each peer group building than would be achieved by simply scaling its entire annual water use by some factor (say area). Simply scaling doesn't adequately account for multidimensional changes that may affect each water use system differently.

For example, scaling by area doesn't account for changes in water use due to operating hours or climate zone and vice versa. More importantly, some variables affect all end-use systems, whilst others relate to specific end-use only.

Total Externally Supplied Water							
	End Use Adjustments						
End Use	Rated Building	Comparable Building 1		Comparable Building 2		Comparable Building 3	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Leakage							
Cooling Towers						15000.00	15000.00
Shops							
Irrigation							
Amenities							
Swimming Pool						-9726.44	-11060.48
Other							
TOTAL ADJUSTMENT (kL)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5273.56**	**3939.52**
ADJUSTED TOTAL (kL)	**94,191**	**26,620**	**25,059**	**19,731**	**19,312**	**70,116**	**77,676**
ADJUSTED TOTAL INTENSITY (kL/m2)	**1.62**	**1.18**	**1.11**	**0.73**	**0.72**	**1.18**	**1.31**

Total Externally Supplied Water							
	Adjusted End Use Breakup						
End Use	Rated Building	Comparable Building 1		Comparable Building 2		Comparable Building 3	
		Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Leakage	16%	14%	14%	12%	12%	12%	12%
Cooling Towers	22%	25%	25%	20%	20%	21%	19%
Shops	25%	20%	20%	20%	20%	20%	21%
Irrigation	10%	8%	8%	10%	10%	14%	14%
Amenities	22%	25%	25%	30%	30%	23%	24%
Swimming Pool	0%	0%	0%	0%	0%	0%	0%
Other	5%	8%	8%	8%	8%	9%	9%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Example operating variable relationship matrix

This matrix can be interpreted in the following way. The amount of water required for irrigation is influenced by ambient weather conditions (in the form of Cooling Degree Days) and the total irrigated area associated with the end-use. Similarly, cooling tower water consumption is influenced by ambient weather conditions (cooling degree days) and the size of the air-conditioning system (explained by total building area).

Guidance Tips

Given the synergies between peer group members, a simplified approach (using common data for water end-use and the relationship matrix) can be applied to all buildings. Alternatively, this approach can be applied separately for each peer group building, which would enable more accurate accounting for end-uses, source mix, minor differences in the mix of services delivered at each site, and onsite technologies, etc.

Some knowledge of building end-use systems may be required, as well as some background knowledge as to how these systems are implemented on-site.

In the approach above, if a water end-use (i.e. the table columns) is not linked to any particular operating variable, it won't be scaled in the next step. Essentially it is treated as a load with a fixed value – it still exists as it is represented in the end-use break up.

Building owners and managers are to identify (i.e. TRUE or FALSE) which operating variables are key drivers for water consumption for each water end-use (i.e. variables that have a significant influence on water consumption for each end-use will be flagged to be included in the normalisation analysis).

Step 6 – Calculate End-use Adjustment Factors

The next step is to combine the data for Scaling Factors with the Relationship Matrix to calculate End-use Adjustment Factors. The qualitative TRUE values in the relationship matrix are replaced with the scaling factors for the relevant operating variable. The End-use Adjustment Factor is then calculated by multiplying all applicable scaling factors that

apply to a single water end-use. This process is repeated for each building, annual period and water end-use. The example in Appendix A illustrates this process.

Step 7 – Calculate Building Adjustment Factors

Once all End-use Adjustment Factors have been determined, these are in turn aggregated as a weighted sum of building end-use, to form a Building Adjustment Factor. Building Adjustment Factors are calculated for each peer group building and annual period.

What does this mean?

In the preceding steps, we have used data relating to the operating variables, water end-use, and combined them in an informed way, to determine an adjustment factor or multiplier for each peer group building and annual period.

Step 8 – Calculate normalised potable water baseline for peer group

The final normalisation step involves simply applying the Building Adjustment Factors to the adjusted annual water use data for the peer group buildings, to rescale them into a like-for-like peer group. Finally, the potable water baseline (i.e. the Average Performer) is determined by taking the average of the potable water baseline for each building in the comparable peer group.

11. Data and validation requirements

Required Data

Building owners and managers will be required to source the following data:

Required building data for potable water performance

Data Type	Required Data
Building Specific Details	- Building Name - Contact Details - Building Address, Postcode and State or Territory - Building Type, description and industry type - Primary Building Use - Start Date for the annual performance period - Water billing data and/or verified interval data associated with the performance period, covering all water sources crossing the building boundary and consumed on-site. - Consumption data must completely cover both baseline and performance periods. - Where non-utility interval data is provided, requirements include: o Water account details including supplier, meter number, account number, and description of coverage. o Verification of Non-Utility Interval Meter Data as per Section 6.4.
Primary Operational Variables	- Building Area - Cooling Degree Days (informed by building postcode). This will be automated by a spreadsheet-based Potable water calculator, and it is explained here for transparency and clarity
Secondary Operational Variables	- Other operational variables which have specific relevance to that building type, and which have a significant impact on water consuming end-uses within the rated building. - The variable must apply to each comparable building when using Option 1(a) – Comparable Building Peer Group.

	- An end-use break up that covers all water consuming end-use systems within the building boundary.
End-use Breakup	- The end-use break up may be derived from various sources (including water audits, sub-metering, or from similar building types), and is subject to GBCA audit. - The end-use break up must be split into various water sources.

Water sources and building boundary

Water sources and coverage

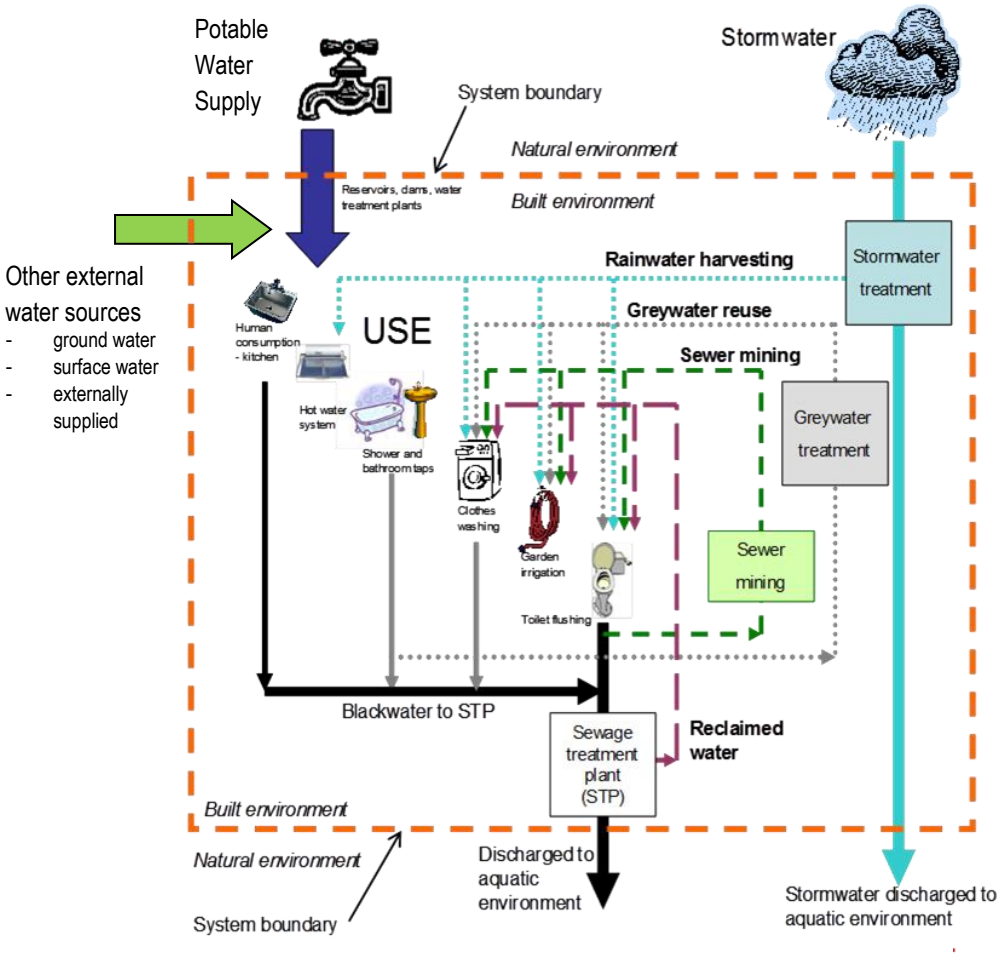
The rating must include all external water sources supplied to the rated building, and cover all water consuming end-use systems or activities within the building. External water sources include potable water, externally supplied recycled water, external ground and external surface water. All external sources of water are used to determine the total water consumption associated with each building. Total water consumption is then used to adjust, normalise and compare building performance throughout the rating tool.

Any on-site water catchment, recycling and water treatment processes (which occur inside the building boundary) will not need to be separately accounted for, as these water sources will effectively increase the potable water efficiency of the building by reducing the consumption of externally supplied water sources.

Export of on-site water capture and recycling is not covered under this credit.

Building Boundary

Since the credit methodology only analyses data associated with external water sources, a definition of the building boundary must be defined in order to discern between internal and external water sources. The below figure presents a typical building boundary diagram, demonstrating the various water sources and end-uses in a building. External water sources consist of potable water supply, external ground water, external surface water and externally supplied recycled water. Internal water sources include rainwater harvesting, greywater recycling, sewer mining (blackwater treatment) and reclaimed water.



Typical Building Water Source Boundary

In the diagram presented in the above figure, the orange dotted line represents the building boundary, separating the built environment from the surrounding natural environment. External water sources entering into the boundary consist of:

- Potable water supply
- Stormwater
- Other Sources
    - External Ground water
    - External Surface Water
    - Externally Recycled Water

Discharged water sources exiting from the building boundary into the natural aquatic environment consist of treated sewerage and stormwater.

Within the building boundary, there are potentially several internal systems that are used for collecting and recycling water. These systems may include rainwater harvesting, greywater recycling, blackwater treatment & recycling and reclaimed water systems. The potable water credit does not directly take into account any on-site capture or treatment systems. Potable water performance is evaluated purely on the total amount of water supplied to the building from external sources. The calculator accounts for externally provided potable water as well as externally provided recycled, non-potable water only.

Standards for acceptable data

Water Use Data

Standards for acceptable water source data are provided below, in order of preference:

1. **Utility bills (revenue data)**

    a. Utility bills from a verified utility, showing consumption figures for the performance period, including meter reading times/dates and meter identification.

2. **MDA utility meter data (revenue data)**

    a. Other electronic records including spreadsheets from verified MDA utility data, showing consumption figures for the performance period, including meter reading times/dates and meter identification.

3. **Non-utility metered interval data (non-revenue data)**

    a. Electronic records including spreadsheets that show consumption figures for the performance period, including reading times/dates and meter identification.

    b. Non-utility meters must be validated according to Non-utility meter validation.

    c. Non-utility meters must have an accuracy of at least Class 1 quality.

4. **If requirements of 1, 2 or 3 cannot be met,** building owners may apply for an alternative methodology to the GBCA through a Credit Interpretation Request (CIR).

Water End-use Breakups

When using the 19C pathway, building owners and managers are required to source a comprehensive water end-use breakup from an acceptable data source. Acceptable sources are listed as follows, in order of preference:

1. **Commissioning a current Water Audit report or use of previous existing Water Audit report**

    a. Audit reports should be no older than three years from the start date of the performance period.

2. **End-use sub-metering**

    a. Break ups from sub-metering should be such that they cover a full 12 months operation and be capable of separating water by end-use, not simply functional areas. The sub-metering should cover the entire building.

3. **Comparable Building End-use Breakup**

    a. A water end-use break up from another building may be used, subject to suitable justification that the comparable building is representative (i.e. that it satisfies the comparability requirements) and is based on one of the accepted data sources listed here (e.g. audit report, sub-metering). An example of this may be data on water use within building types that is published by water utilities or industry associations.

4. **If none of the required data sources listed above can be incorporated,** building owners may apply for an alternative methodology to the GBCA through a Credit Interpretation Request (CIR).

Water End-use adjustments

Building owners and managers have the option to perform a series of end-use adjustments to the comparable buildings, to effectively adjust the end-use breakup, such that a 'like for like' comparison is enabled between the rated and peer group buildings.

End-use adjustments are to account for specific, known differences that will prevent a fair comparison. These may include additional or missing water end-uses, or special events that have caused non-routine consumption. Examples of this may include the filling of a swimming pool, or periodic site shutdown due to renovation, or an extreme weather event.

Where end-use adjustments are necessary, a number of options are available to building owners and managers for performing adjustments. Acceptable methods are listed as follows, in order of preference:

1. **Measure the water consumption associated with the end-use to be adjusted.**

- The total water consumption associated with the adjusted end-use may be measured by means of separately sub-metering the end-use and subtracting from the total building consumption. This option is only available where the comparable building has a dissimilar end-use, in addition to the rated building end-use breakup (e.g. a comparable building has an irrigated garden area, whereas the rated building does not).

2. **Data from a recent water audit report.**

- Where available, building owners and managers may use information provided in a recent water audit report (complete within three years of the start date of the 'performance period') to calculate end-use adjustment.

3. **Use published KPI's or suitable reference sources to calculate adjusted end-use consumption.**

- Where available, building owners and managers may use published source data and other reference material to calculate the end-use adjustment. Published data and reference material may take the form of published water efficiency guides and reports, best practice guidelines and existing benchmarks, published source data, manufacturer's guidelines or other source material that can be verified and approved by the GBCA.

4. **Calculate a suitable adjustment KPI based on the other buildings in the comparable peer group.**

- Where data is available, a relevant adjustment KPI may be calculated using consumption data and system or activity metrics from other comparable buildings in the peer group. For example, where two of the three comparable buildings have water-cooled HVAC systems (with cooling towers), and one comparable building in

the peer group has an air-cooled HVAC system (without cooling towers), an average cooling tower water consumption intensity (i.e. kL/kWr or kL/m2) associated with the water-cooled HVAC systems may be estimated, and then applied to the air-cooled comparable building to determine the appropriate end-use adjustment.

5. **Calculate a suitable adjustment KPI based on the rated building.**

- Where data is available, a relevant adjustment KPI may be calculated using consumption data and system or activity metrics from the rated building, and then applied to the other comparable buildings in the peer group to estimate the required consumption adjustment. For example, where the rated building has a large commercial kitchen end-use, and the comparable buildings don't, an adjustment KPI may be determined from the rated building, and applied to each of the peer group-comparable buildings.

Adjustments are only applied to peer group buildings. Each adjustment must be accompanied by clear reasoning and documentation. All adjustment methods will be subject to a GBCA peer review and approval process before credit points can be awarded.

Selection of relevant Operating Variables

For pathways 19B, 19C and 19D, building owners and managers are required to select a series of operating variables which will be used in normalising the potable water baseline. These operating variables are selected on the basis that they are key drivers of water use within the rated building – that is, the change in any one of these variables will have some impact on the water consumption of the rated building. The type of operating variable and the magnitude of each variable's impact on water consumption will vary between building types and between buildings; therefore, building owners and managers are responsible for selecting appropriate operating variables that are relevant to their specific building.

Operating variables are split into two categories, primary and secondary variables:

- Primary Operating Variables (compulsory)
    - Area - appropriate to the building type (e.g. net lettable area, gross floor area, effective area, usable floor area, etc).
    - Postcode (Informs heating and cooling degree days based on location of building).
- Secondary Operating Variables (at least one variable compulsory)
    - At least one secondary variable must be used to normalise the potable water baseline (e.g. occupancy, operating hours, irrigated area, transactions, products sold, equipment manufactured etc.) that relates specifically to that building type, and is a key driver of water consumption within the rated building.
    - Variables must be applicable to all comparable buildings in peer group, except where end-use adjustments are required.

Typical examples of operating variables and affected end-uses are presented in the table below. Note that this is not an exhaustive list, and that the direct correlation between end-use water consumption and operational variables has not yet been statistically proven. However, the examples represent a reasonable estimate of relevant operating variables and effect on water end-use categories.

Water End-use	Influencing Operating Variable
Amenities	Building Area
Cooling Towers	Building Area, Cooling Degree Days
Leakage	Building Area
Irrigation	Irrigated Area, Cooling Degree Days
Swimming Pool	Swimming Pool Area, Occupancy, Cooling Degree Days
Laundry	No. washes/annum or Customers/annum
Commercial Kitchen	Meals produced, transactions, customers
Evaporative Cooling HVAC	HVAC System Capacity, Cooling Degree Days
Process water	Products produced, litres produced, tonnes produced.

Example of water end-uses and relevant operating variables

Where operating variables can be defined for each functional space within the rated building, these must be used and adjusted, based on the duration of occupancy for each functional space during the rating period. However, if operating variables cannot be assigned to separate functional spaces within the building, then whole building variables may be used.

Non-utility meter validation

Non-utility meters are open to a wide source of variability, due to incorrect wiring, incorrect meter multipliers and programming errors in meter reading software. Due to this potential variance in the meter readings, all non-utility meters are required to be validated. Refer to NABERS – Non-utility meter validation methodology for details.

Treatment of missing data

Where the records of utility and non-utility meter data are not continuous (i.e. missing utility bills and unrecorded data), users may interpolate for the missing data using billing data from adjacent periods. Full details of the interpolation method used must be provided with the billing data, as well as supporting commentary to explain why the missing data could not be obtained.

The treatment of missing data will be subject to review through Green Star Performance assessment process.

Documentation and record-keeping

For all source data used in calculating potable water performance, original documents or verifiable copies of original documents must be provided to the GBCA upon request, by attaching electronic copies of the documents with the input

source data in the online rating tool. Users are to include any email correspondence between parties that provides additional evidence in verifying source data.

Extracts, partial copies, summaries of the original documents, and documents which simply reference the original source documents may be provided. However all originals must be retained by the applicant and made available to the GBCA (or its nominated assessor) as requested.