## Attachments to Public Comments

**December 3, 2018**

<table>
<thead>
<tr>
<th>Public Comment #</th>
<th>Document Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC 024</td>
<td>BSD-151: Understanding Primary/Source and Site Energy</td>
<td>3</td>
</tr>
<tr>
<td>PC 107</td>
<td>BSD-151: Understanding Primary/Source and Site Energy</td>
<td></td>
</tr>
<tr>
<td>PC 328</td>
<td>BSR/ RESNET/ ICC Standard 1101: Standard for the Calculation and Labeling of the Water Use Performance of One and Two-Family Dwellings Using the Water Rating Index</td>
<td>13</td>
</tr>
</tbody>
</table>
This page intentionally left blank.
Abstract:

The difference between site and source energy is a vital concept to understand when looking at the energy performance of buildings—failing to account for the difference will result in an apples-to-oranges comparison that does not give the true picture of a building’s energy consumption. This document explains how these two types of energy are accounted for differently and why.

Introduction

The difference between site and source energy is a vital concept to understand when looking at the energy performance of buildings—failing to account for the difference will result in an apples-to-oranges comparison that does not give the true picture of a building’s energy consumption. Failing to report which metric (site or source) is being used is a practice that should be eliminated, given how significant the difference can be. Numerous building programs, like Building America, EPA Energy Star, Architecture 2030, and the German Passiv Haus, all use source energy metrics.

Site vs. Source

A building’s energy consumption can be measured in terms of its fuel use: gallons of fuel oil, kWh of electricity, or therms of gas. Although all of them are in different units, you can ultimately measure them in terms of units of energy—e.g., “How much water can you boil with this energy?” For our purposes, energy is commonly measured in Btus (U.S. units) or kWh (metric units); for reference, the definition of a Btu, or British thermal unit, is the energy it takes to heat one pound of water by one degree Fahrenheit. Note that kWh, although it is typically used for electricity, is a unit of energy (not just electricity)—and can be applied to any fuel source.

If you add up all the energy (Btus) you are consuming at the meter, this is what is known as “site” energy. However, this is not the full picture. The problem is that the
process of generating electricity incurs substantial losses—enough that for every unit of electricity at the plug, it might have been necessary to “burn” about 3 times that amount of energy (coal, gas, nuclear, etc.) at the power plant—see Figure 1.

Although transmission losses are a part of this inefficiency, they are rather modest—roughly 10%. Transmission losses are what causes the hum of high-voltage electrical lines, and are the reason why the millions of transformers in the grid are air cooled. These losses can be reduced by better technology and will be reduced in the future by distributed power generation (i.e., the “Smart Grid”), especially if power is generated reasonably close to where it is used (e.g. in the same community for example).

In general, it can be said that “the grid” is “~30% efficient”; with the majority of the losses occurring at the plant. To be specific: the power plant cooling towers that are dumping steam (i.e., waste heat) into the sky are where most of that missing 2/3 is going.

If you account for the energy consumed at the power plant, this is known as “source energy” or “primary energy.” The EPA’s definition is:

*Source energy is a measure that accounts for the energy consumed on site in addition to the energy consumed during generation and transmission in supplying the energy to your site.*

Source energy is much more important than site energy if the concern is environmental performance. Site energy is useful because it can be unambiguously measured.

**A Household Example**

Converting to source energy has a major effect on electricity (factor of 3), and has a small effect for fossil fuels like natural gas. So what difference does this make? Here is an example:
Site and Source Energy

- A typical gas tank water heater has an efficiency level (energy factor or EF) of 0.59, or 59%.
- In comparison, a typical electric tank water heater has an EF of 0.92 or 92%.

So in terms of site energy, the electric tank has an efficiency level about 1.5 times better than that of gas tank. But if you factor in source energy:

- The same gas tank has a “source efficiency” of roughly 54%
- The same electric tank has a “source efficiency” of roughly 27%

![Figure 2: Site-Source Comparison for Domestic Water Heating](image)

So the electric tank is half as efficient, in terms of source energy and, loosely, environmental impact. **Obviously, if one doesn’t account for source vs. site differences, there are some pretty serious distortions when comparing electric heating with gas heating.**

As another example: some argue that superinsulated buildings are so efficient (with heating loads so low) that using electric resistance heating is a reasonable solution, instead of installing a full heating system (e.g., using point-source electric resistance heaters instead of a furnace). Based on the conversions below, this is the equivalent to...
installing a ~30% efficiency furnace (compared to 80-95%+ AFUE gas furnaces commonly available), when source energy is accounted for.

**Site/Source Conversion Factors**

A complete set of site-to-source conversions can be found in Deru & Torcellini (2007); these figures change from state to state, every day, or even hourly. This occurs because the power mix of the electric grid is constantly changing to meet load—for instance, peaking power (versus average or baseload) can have a significant effect. Also, as more and more renewable energy sources (wind, solar, etc.) are added to the grid, this “source energy penalty” will decrease. But some of the current United States national average figures are:

- Site-to-source electricity: 3.365
- Site-to-source natural gas: 1.092
- Site-to-source fuel oil: 1.158
- Site-to-source propane: 1.151

When people talk about electricity being “clean power,” this typically fails to acknowledge the reality of source energy. All that’s happened is that the pollution has been moved from your chimney to somewhere that you can’t see it—it hasn’t magically disappeared. In fact, with our current power mix, it is reasonable to argue that electricity is America’s dirtiest fuel. This does not mean electricity should not be used, only that it should be used wisely.

For calculating source energy from raw “billed” fuel units (kWh of electricity, therms of gas), see the conversion factors in Conversions for Calculating Your Source Energy Use (sidebar).

But overall, when people start throwing energy numbers at you, make sure that they first answer the question, ‘Are you talking about site or source?’

**The Fuel Mix of the Grid**

As described above, the electricity grid in the United States is powered by a mixture of fuel sources. The US power grid is divided into three main grids, which have minimal connection between them: the Western Interconnection, the Eastern Interconnection, and the Electric Reliability Council of Texas (ERCOT) Interconnection (see Figure 3).
Figure 3: North American electrical grid interconnections, including the 10 NERC regional reliability councils (NERC 2007) (via Deru and Torcellini 2007)

Based on the 2004 EIA data cited by Deru and Torcellini, the fuel mix for the US average and these three grids is shown below (Figure 4). It is clear that the US grid is largely powered by fossil fuels (71% on average), and 50% by highly polluting coal plants. In comparison, only 2% of the grid is powered by renewable energy, which includes renewable fuels, geothermal, wind, and solar (PV).
Of course, over time, the fraction of renewable energy is expected to increase, making the grid “greener.” With the retirement of old coal, the addition of wind, high efficiency gas, biomass, tidal, or even nuclear, the carbon intensity of producing electricity will drop, and the source-site ratio will drop. Perhaps the largest change will be as a result of millions of buildings feeding energy into the grid from PV arrays or co-generation facilities, since these have a source-site ratio of nearly one.

However, this optimism should be tempered by the fact that in our current market, generating electricity with fossil fuels is still one of the cheapest options. This was elegantly pointed out by Professor Nate Lewis of Caltech, in a 2007 interview with Paul Krugman (Krugman 2007):

“So building an emissions-free energy infrastructure is not like sending a man to the moon,” Lewis went on. “With the moon shot, money was no object — and all we had to do was get there. But today, we already have cheap energy from coal, gas and oil. So getting people to pay more to shift to clean fuels is like trying to get funding for NASA to build a spaceship to the moon — when Southwest Airlines already flies there and gives away free peanuts! I already have a cheap ride to the moon, and a ride is a ride. For most people, electricity is electricity, no matter how it is generated.”

Global Warming Potential

Another factor to consider when looking at site-source energy conversions is not just energy or resource consumption, but also carbon emissions. Global warming potential is commonly measured in units of carbon dioxide equivalent (CDE, or CO$_2$equivalent),
expressed as mass (e.g., the average passenger vehicle produces 5.48 metric tons CO₂equivalent per year).

The process of treating and pumping (via pipeline) natural gas generates (before combustion) 0.088 lbs CO₂equivalent for each kWhequivalent of delivered energy. Combusting one therm of natural gas, at 100% efficiency release another 11.7 lbs CO₂equivalent, which is another 0.40 lbs CO₂ for each kWhequivalent for a total of about 0.49.

- **Natural gas**: ~0.49 lbs CO₂equivalent per kWhequivalent

Electricity from the national grid, results in the emission of 1.67 lbs of CO₂equivalent as delivered to the building’s meter (Deru & Torcellini 2007, EPA eGrid).

- **Electricity**: 1.67 lbs CO₂equivalent per kWh

Hence, providing heat by electric resistance heat releases 1.67/0.49 = 3.4 times as much greenhouse gases as heating with a perfectly efficient natural gas appliance. Top quality natural gas furnaces, and even some boilers, can achieve 95% efficiency, which changes the emission factors per unit of heat delivered to the building to 0.516 lbs CO₂equivalent for each kWhequivalent (which changes the ratio to 3.2 instead of 3.4).

According to the US Energy Information Administration (EIA), 4110 billion kWh of electricity were generated in 2008 (“total net generation”). Of this energy, 1994 billion kWh was generated by coal, 248 billion kWh by hydroelectricity, and 124 billion kWh by renewables other than hydroelectricity. This consumed just over 1 billion tons of coal alone (plus other fossil fuels) and resulted in the emissions of 2.516 billion tons of CO₂, and 9.0 million tons of SO₂.

The 2005 Residential Energy Consumption Survey (RECS) notes that the 111 million households in the US consumed 1275 billion kWh over that year. If ten million homes had a 4 kWp array, each generating 4500 kWh/yr, then 4.5 billion kWh would be produced, or about 3.5% of total electrical energy consumption. However, this relatively modest impact in overall kWh consumption reduces source energy by 3.4 times as much, or 15.1 billion kWh. This is a rather significant impact, demonstrating the disproportionate effect of offsetting electricity use.

**What about using energy costs instead?**

Some (notably ASHRAE 90.1 and LEED) have considered using the cost of energy as a metric, instead of bothering with site-source conversions, Btus, kWh, etc. First, costs are commonly used in economic analyses, and are what many building owners care about the most. Second, energy costs are actually a rough surrogate for/approximation of source energy. This is part of the reason why ASHRAE Standard 90.1 (the energy efficiency standard for large buildings), uses cost in its “building energy cost method” (which calculates the effectiveness of various energy conservation measures) (Jarnagin, 2010).

Unfortunately, energy costs can vary greatly by geographic region, season, and even time of day. So if someone is trying to compare buildings A and B, energy cost can
easily give you a distorted picture—or one that is only accurate for the next week or two. It is better to take the energy units, and then figure out the energy costs as necessary. This allows estimation (for instance) what would happen if energy costs change over time.

Energy costs are also somewhat meaningless across time and space: a high performance building in Europe may have the same energy cost as a mediocre building in Arizona, but use less than half as much energy and emit a third as much pollution. Similarly, it is difficult to assess the relative performance of a home reported to use “$60/month” in heating energy based on a 2004 magazine article. Without knowing how much energy costs, and what proportion was gas or electric, the dollars are meaningless. Reporting the source energy consumption would allow a comparison of buildings on different continents and at different times.

Conclusions

The difference between site and source energy must be accounted for when looking at the energy performance of buildings—failing to do so will result in an apples-to-oranges comparison that does not give the true picture of a building’s energy consumption. Electricity, as a fuel, requires roughly three times the energy input (“source”) to produce one unit of energy at the plug (“site). In addition, the electricity grid is primarily fed by fossil fuels (71% on average): with the current power mix, it is reasonable to argue that electricity is America’s dirtiest fuel. However, over time, the fraction of renewable energy is expected to increase, making the grid “greener.”

References


Acknowledgements

This report and the supporting background materials were developed under the US Department of Energy’s Building America Program.
Kohta Ueno is a Senior Associate at Building Science Corporation.

John Straube is a principal of Building Science Corporation, and teaches in the Department of Civil Engineering and the School of Architecture at the University of Waterloo. More information about John Straube can be found at www.johnstraube.com

Direct all correspondence to: J.F. Straube, Department of Civil Engineering, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

Limits of Liability and Disclaimer of Warranty:

Building Science Digests are information articles intended for professionals. The author and the publisher of this article have used their best efforts to provide accurate and authoritative information in regard to the subject matter covered. The author and publisher make no warranty of any kind, expressed or implied, with regard to the information contained in this article.

The information presented in this article must be used with care by professionals who understand the implications of what they are doing. If professional advice or other expert assistance is required, the services of a competent professional shall be sought. The author and publisher shall not be liable in the event of incidental or consequential damages in connection with, or arising from, the use of the information contained within this Building Science Digest.

Sidebar: Conversions for Calculating Source Energy Use

The following conversions from billed units to source energy are provided for some common fuel types. The energy use for the year should be added up, and then converted to million Btu/year (source) by type of fuel.

- Natural Gas: therms\(^1\) $\times 0.1092 =$ million Btu (source energy)
- Electricity: kWh $\times 0.01148 =$ million Btu (source energy)
- Fuel Oil: gallons $\times 0.1781 =$ million Btu (source energy)
- Propane: gallons $\times 0.1187 =$ million Btu (source energy)

\(^1\): Note that natural gas use is often given in hundreds of cubic feet (CCF): this is roughly equivalent to therms, but requires a “thermal conversion factor” (typically 2-5%) to obtain therms.

As mentioned above, these conversions use today’s site-source conversion factors, and assume certain fuel energy contents (Deru and Torcellini 2007), which will vary by region and time of year.
BSR/RESNET/ICC

Standard 1101

Standard for the Calculation and Labeling of the Water Use Performance of One- and Two-Family Dwellings Using the Water Rating Index
Contents
1. Purpose ........................................................................................................................................ 5
2. Scope ........................................................................................................................................... 5
3. Definitions ...................................................................................................................................... 5
   3.1. General ..................................................................................................................................... 5
   3.2. Definitions ................................................................................................................................ 5
4. Home Water Rating Calculation Procedures .................................................................................. 6
   4.1. Determining the Water Rating Index ......................................................................................... 6
   4.2 Calculating the Water Rating Index ............................................................................................ 6
   4.3. Determining the Daily Indoor Water Use for the Reference Home .......................................... 6
       4.3.1. Determining Daily Reference Home Fixture Water Use ......................................................... 7
       4.3.2. Determining Daily Reference Home Hot Water Waste ......................................................... 7
       4.3.3. Determining Daily Reference Home Dish Washer Water Use .............................................. 7
       4.3.4. Determining Daily Reference Home Clothes Washer Water Use ........................................ 8
       4.3.5. Determining Daily Reference Home Toilet Water Use ......................................................... 8
       4.3.6. Determining Daily Reference Home Water Softener Use ...................................................... 8
       4.3.7. Determining Daily Reference Home Other Water Use ............................................................ 8
   4.4. Determining the Reference Home Outdoor Annual Water Use .............................................. 9
       4.4.1. Determining Irrigated Area for the Reference Home ............................................................... 10
   4.5. Determining Daily Indoor Water Use of the Rated Home ....................................................... 10
       4.5.1. Determining Daily Shower Water Use for the Rated Home .................................................. 10
       4.5.2. Determining Daily Kitchen Faucet Water Use for the Rated Home .................................... 11
       4.5.3. Determining Daily Lavatory Faucet Water Use for the Rated Home ................................. 11
       4.5.4. Determining Daily Hot Water Waste for the Rated Home ..................................................... 11
       4.5.5. Determining Daily Clothes Washer Water Use for the Rated Home ................................... 12
       4.5.6. Determining Daily Dishwasher Water Use for the Rated Home .......................................... 12
       4.5.7. Determining Daily Toilet Water Use for the Rated Home .................................................. 12
       4.5.9. Determining Daily Other Water Use for the Rated Home .................................................... 13
       4.5.10. Determining Daily Excess Pressure Adjustment Water Use for the Rated Home ............ 13
   4.6. Determining Outdoor Water Use for the Rated Home .............................................................. 13
       4.6.1. Smart Controllers .................................................................................................................. 14
       4.6.2. Commissioning of an Automatic Irrigation System ............................................................... 14
       4.6.3. Residential Irrigation Capacity Index (RICI) ...................................................................... 15
       4.6.3.1. Applying RICI .................................................................................................................... 15
4.6.4. Applying Adjustments to the Outdoor Water Use of Rated Homes. 

5. Minimum Rated Features. 

5.1. Data Sources. 
5.1.1. Net Evapotranspiration. 
5.1.2. Hardness of Water. 
5.2 Default Values. 
5.3. Incomplete Outdoor Area. 


6.1. Rating Requirements. 
6.1.2.1. Water Cost Savings. 
6.1.2.1.1. Water Prices. 
6.1.2.1.2. Relevant Rates and Charges. 
6.1.2.1.3. Water Cost Savings Calculations. 
6.1.2.1.3.1. Average Billed Indoor Volume of the Reference Home. 
6.1.2.1.3.2. Determine Outdoor Water Use for a Billing Period. 
6.1.2.1.3.2.1. Peak Outdoor Use. 
6.1.2.1.3.2.2. Year-Round Use. 
6.1.2.1.3.3. Combine Indoor and Outdoor Water Use Charges. 
6.1.2.1.3.4. Determine Water Use Cost for the Rated Home. 
6.1.2.1.3.5. Total Estimated Water Cost Savings. 
6.1.2.2. Sanitary Sewer Service Cost Savings. 
6.1.2.2.1. Sewer Service Prices. 
6.1.2.2.2. Relevant Rates and Charges. 
6.1.2.2.3. Sewer Cost Savings Calculations. 
6.1.2.2.3.1. Average Billed Indoor Volume of the Water Rating Reference Home. 
6.1.2.2.3.2. Annual Sewer Volume Charge for the Water Rating Reference Home. 
6.1.2.2.4. Determine Annual Sewer charge for the Rated Home. 
6.1.2.2.5. Estimated Sewer Cost Savings. 
6.1.2.2.6 Combined Presentation of Cost Savings. 
6.1.2.4. Other Cost Savings. 
6.1.3. Reports. 
6.1.4. Rating Types. 

July 3, 2018
FORWARD (Informative)

This Standard provides a consistent, uniform methodology for evaluating, quantifying, and labeling the water use performance of one- and two-family dwellings. The methodology compares the water use performance of an actual home (rated home) with the water use performance of a reference home of the same geometry, resulting in a relative Water Use Rating called the Water Rating Index (WRI). Where the water use performance of the actual home and the reference home are equal, the Water Rating Index is 100.

The Water Rating Reference Home used for this comparative analysis has the attributes of a standard home built circa 2006. The underpinnings of the indoor Water Rating Reference Home model are based on ANSI/RESNET/ICC Standard 301-2014, Addendum A. The outdoor Water Rating Reference Home model is adapted using data from the Water Research Foundation’s Residential End Uses of Water Study II. Both the indoor and outdoor calculation models are grounded in actual field water use data. It is the opinion of the Standard Development Committee that alternatives not included in the calculation of the Water Rating Index did not have sufficient data to develop an equation (on par with the existing indoor and outdoor model) to confidently and accurately predict their water consumption.

One such element that did not make it into this Preliminary Draft Standard is the use of alternative water sources to displace potable water use. The committee considered this issue, and there was agreement that eventually this standard should account for the impact of alternative water sources, like gray water and harvested rainwater. However, the committee decided that, at this point, there was insufficient reliable data on how these alternative water systems impact water use under a variety of field conditions to develop a calculation to quantify their impact on a home’s potable water use. Therefore, in order to maintain the technical rigor of the calculations in the rest of the standard, alternative water sources do not provide water use reductions in a rated home in this current draft. RESNET and ICC are interested in performance and usage data on alternative water sources and systems, and request such data to be submitted through the public comment process.

It should be noted that Section 6.2 does allow Water Rating providers to petition for adjustment to the Water Rating Index for a Rated Home with features or technologies not addressed by Approved Software Rating Tools or this Standard. This process for innovative design requests will allow for technologies or features, not specifically covered in the standard, to petition for credit.

A WRI rating includes water use for: toilets, kitchen faucets, lavatory faucets, showerheads, clothes washers, dishwashers, water softeners, outdoor/landscape irrigation systems and pools/spas. There are additional factors that also influence the rating, including: excess water pressure, house size, geographic location, number of bedrooms, lot and landscape size and hot water distribution layout. The following components are not included in the standard, due to a lack of data: whole house humidifiers, water filtration systems and alternative water sources.
This Standard contains both normative and informative material. The body of the Standard is normative and must be complied with to conform to the Standard. Informative materials are not mandatory and are limited to this forward, footnotes, references and annexes, all of which are clearly marked as informative.

1. **Purpose.** The provisions of this document establish a uniform methodology for evaluating, rating and labeling the water use performance of single family and duplex dwelling unit.

2. **Scope.** This standard is applicable to the indoor and outdoor water use of all single-family dwellings, including townhomes and duplexes.

3. **Definitions.** The following terms and acronyms have specific meanings as used in this Standard. In the event that definitions given here differ from definitions given elsewhere, the definitions given here shall govern.

3.1. **General.** Unless stated otherwise, the terms and words in Section 3.2 shall have the meanings indicated therein. Words used in the present tense include the future, words in the masculine gender include the feminine and neuter, and singular and plural are interchangeable. Terms not defined in Section 3.2 shall have ordinary accepted meanings the context implies.

3.2. **Definitions.**

   **Approved** — shall mean approved by an entity adopting and requiring the use of this Standard as a result of investigation and tests conducted by the entity or by reason of accepted principles or tests by nationally recognized organizations.

   **Approved Rating Provider** — An approved entity responsible for the certification of home water efficiency raters working under its auspices and who is responsible for the quality assurance of such Certified Raters and for the quality assurance of water efficiency ratings produced by such home water efficiency raters.

   **Approved Software Rating Tool** — A computerized procedure that is approved for the purpose of conducting home water efficiency ratings and calculating the annual water consumption, annual water costs and a Water Rating Index for a home.

   **Bedroom** — A room or space 70 square feet of floor area or greater, with egress window and closet, used or intended to be used for sleeping. A "den," "library," "home office" with a closet, egress window, and 70 square feet of floor area or greater or other similar rooms shall count as a Bedroom, but living rooms and foyers shall not.

   **Automatic Irrigation System** — An irrigation system that is initiated by a clock timer, irrigation controller, or other method that does not require human intervention to initiate an irrigation event.

   **Irrigated Area** — the portion of a lot that receives supplemental water for irrigation.

   **Irrigated Area** — the portion of the landscaped Area that is served by an irrigation system.

   **Lot Size** — the area of a single parcel of land upon which the Rated Home is located.

4.1. Determining the Water Rating Index. The Water Rating Index shall be determined in accordance with Sections 4.2 through 4.6. The Water Rating Reference Home shall be configured in accordance with Sections 4.3 and 4.4; and the Rated Home shall be configured in accordance with Section 4.5 and 4.6.

4.2 Calculating the Water Rating Index. A Water Rating Index shall be calculated as follows:

\[
WRI = \frac{\text{indoor and outdoor daily water use for the Rated Home}}{\text{indoor and outdoor daily water use for the Water Rating Reference Home}} \times 100
\]

4.3. Determining the Daily Indoor Water Use for the Water Rating Reference Home. The indoor daily water use for the Water Rating Reference Home shall be calculated as follows:

\[
ref_{in\,gpd} = ref_{FG\,gpd} + ref_{WG\,gpd} + ref_{DW\,gpd} + ref_{CW\,gpd} + ref_{T\,gpd} + ref_{Sof\,gpd} + tot_{ref\,Other}
\]
Where:

\[ \text{refF}_{\text{gpd}} = \text{daily fixture water use for the Water Rating Reference Home} \]
\[ \text{refW}_{\text{gpd}} = \text{daily water use wasted from hot water outlets for the Water Rating Reference Home} \]
\[ \text{refDW}_{\text{gpd}} = \text{daily dishwasher water use for the Water Rating Reference Home} \]
\[ \text{refCW}_{\text{gpd}} = \text{daily clothes washer water use for the Water Rating Reference Home} \]
\[ \text{refT}_{\text{gpd}} = \text{daily toilet water use for the Water Rating Reference Home} \]
\[ \text{refSo}_{\text{gpd}} = \text{daily water softener water use for the Water Rating Reference Home} \]
\[ \text{totRefOther} = \text{daily total other/unidentified water use for the Water Rating Reference Home} \]

### 4.3.1. Determining Daily Water Rating Reference Home Fixture Water Use.

**Water Rating** Reference Home daily fixture water use shall be calculated as follows:

\[ \text{refF}_{\text{gpd}} = 14.6 + 10 \times Nbr \]  
(Eq 4.3-2)

Where:

Nbr= number of bedrooms in the Rated Home

This value is determined in accordance with ANSI/RESNET/ICC 301 Addendum A.

### 4.3.2. Determining Daily Water Rating Reference Home Hot Water Waste Fixture Water Use Wasted.

**Water Rating** Reference Home daily fixture hot water use wasted shall be calculated as follows:

\[ \text{refW}_{\text{gpd}} = 9.8 \times Nbr^{0.43} \]  
(Eq 4.3-3)

Where:

Nbr= number of bedrooms

This value is determined in accordance with ANSI/RESNET/ICC 301 Addendum A.

### 4.3.3. Determining Daily Water Rating Reference Home Dish Washer Water Use.

**Water Rating** Reference Home dish washer water use shall be calculated as follows:

\[ \text{refDW}_{\text{gpd}} = \frac{(88.4 + 34.9 \times Nbr) \times 8.16}{365} \]  
(Eq 4.3-4)

Which simplifies to:

\[ \text{refDW}_{\text{gpd}} = 1.97 + 0.7802 \times Nbr \]

Where:
Nbr = number of bedrooms

This value is determined in accordance with ANSI/RESNET/ICC 301Addendum A.

4.3.4. **Determining Daily Water Rating Reference Home Clothes Washer Water Use.**

Water Rating Reference Home daily clothes washer water use shall be calculated as follows:

\[
refCW_{gpd} = \frac{4.52 \times (164 + 46.5 \times Nbr) \times \left(\frac{(3 \times 2.08 + 1.59)}{(2.874 \times 2.08 + 1.59)}\right)}{365} \times 9.5
\]

(Eq 4.3-5)

Which simplifies to:

\[
refCW_{gpd} = 19.96 + 5.66 \times Nbr
\]

Where:

- **refCW** = the daily clothes washer water use references
- **Nbr** = number of bedrooms

This value is determined in accordance with ANSI/RESNET/ICC 301Addendum A.

4.3.5. **Determining Daily Water Rating Reference Home Toilet Water Use.**

Water Rating Reference Home daily toilet water use shall be calculated as follows:

\[
refT_{gpd} = refFPO \times refGPF \times Occ
\]

(Eq 4.3-6)

Where:

- **refFPO** = the daily flushes per person per day = 5.05
- **refGPF** = the gallons per flush for toilets = 1.6
- **Occ** = the number of occupants = 1.09 + 0.54 \times Nbr

4.3.6. **Determining Daily Water Rating Reference Home Water Softener Use.**

Where the Rated Home has a water softener and the water hardness at the Rated Home location is greater than or equal to 180 milligrams/liter, the Water Rating Reference Home water softener daily water use shall be calculated as follows:

\[
refSof_{gpd} = \frac{\text{grains of hardness}}{\text{gallon of water}} \times \frac{\text{sum of indoor water uses in the Water Rating Reference Home}}{5 \text{ gallons used}} \times \frac{1,000 \text{ grains removed}}{\text{1,000 grains removed}}
\]

(Eq 4.3-7)

Where Rated Home does not meet these conditions the **refSof_gpd** = 0.

4.3.7. **Determining Daily Water Rating Reference Home Other Water Use.**

Water Rating Reference Home daily other water use shall be determined as follows:
\[ \text{to}_\text{ref} \times \text{Other} = 5.93 \times \text{Nbr} \]  
\text{(Eq 4.3-8)}

Where:
\( \text{Nbr} \) = the number of bedrooms in the Rated Home

4.4. Determining the Water Rating Reference Home Outdoor Annual Water Use (in thousands of gallons per year). The reference home outdoor annual water use shall be calculated using the following two equations:

If the rated home has a netET of less than 12 inches/year OR the rated home has an automatic irrigation system, use Equation 1.

Equation 1:
\[ \left[ \frac{\exp(A)}{1 + \exp(A)} \right] \times 1.18086 \times \left[ 2.0341 \times \text{netET}^{0.7154} \times \text{Ref}_\text{Irr\_Area}^{0.6227} + 0.5756 \times \text{ind\_Pool} \times \text{netET} \right] \]
\text{(Eq 4.4-1a)}

If the rated home has a netET of greater than 12 inches/year AND the rated home does NOT have an automatic irrigation system, use Equation 2.

Equation 2:
\[ \left[ \frac{\exp(B)}{1 + \exp(B)} \right] \times 1.22257 \times \left[ 1.4233 + 0.6311 \times \text{netET} + 0.9376 \times \text{Ref}_\text{Irr\_Area} \right] + \text{ref\_Pool} \]
\text{(Eq 4.4-1b)}

Either equation shall be constrained as follows:

\text{IF} \quad \text{Rat\_Irr\_Area} < \text{Ref\_Irr\_Area} \text{ THEN} \quad \text{Ref\_Out} = \text{equation 1 or 2 (as identified above)}

\text{equation 1 (Using \text{Rat\_Irr\_Area} and \text{ind\_Pool} = 0)}

\text{equation 1 (with \text{Ref\_Irr\_Area} and \text{ind\_Pool} = 0)}

\text{AND}

Outdoor Reference Home Annual Water Use shall never be lower than equation 2

Where:
\( \exp(A) \) = exponent of \([1.4416 + 0.5069 \times (\text{IrrArea}/1,000)]\)
\( \exp(B) \) = exponent of \([0.6911 + 0.00301 \times \text{netET} \times (\text{IrrArea}/1,000)]\)
\text{Ref\_Irr\_Area} = The size of the irrigated area in the reference home, calculated in accordance with section 4.4.1
\text{Rat\_Irr\_Area} = The size of the irrigated area in the rated home
\text{netET} = The annual historic sum of mean reference evapotranspiration minus the mean precipitation for all months that evapotranspiration exceeds precipitation
4.4.1. Determining Irrigated Area for the Water Rating Reference Home. Water Rating Reference Home Irrigated Area shall be calculated as follows:

Where the lot size of the Rated Home is less than 7,000 ft², the Irrigated Area of the Water Rating Reference Home shall be calculated as follows:

\[ \text{Ref}_\text{Irr}_\text{Area} = \text{Lot}_\text{Area} \times (0.002479 \times \text{Lot}_\text{Area}^{0.6157}) \]  
\hspace{1cm} (Eq 4.4-2a)

Where the Lot Size of the Rated home is greater than or equal to 7,000 ft², the Irrigation-Irrigated Area of the Water Rating Reference Home shall be calculated as follows:

\[ \text{Ref}_\text{Irr}_\text{Area} = \text{lot}_\text{area} \times 0.577 \]  
\hspace{1cm} (Eq 4.4-2b)

Where:
- \text{Ref}_\text{Irr}_\text{Area}= \text{The size of the landscape that receives supplemental water in the Water Rating Reference Home}
- \text{Lot}_\text{Area}= \text{The size of the lot on which the Rated Home is being constructed}

4.5. Determining Daily Indoor Water Use of the Rated Home. The daily Indoor Water Use of the Rated Home shall be calculated as follows:

\[ \text{Indoor}_{\text{gpd}} = \text{Shower}_{\text{gpd}} + \text{KitchF}_{\text{gpd}} + \text{LavF}_{\text{gpd}} + \text{Waste}_{\text{gpd}} + \text{CW}_{\text{gpd}} + \text{DW}_{\text{gpd}} + \text{Toilets}_{\text{gpd}} + \text{Soft}_{\text{gpd}} + \text{Other} + \text{EP}_{\text{gpd}} \]  
\hspace{1cm} (Eq 4.5-1)

Where:
- \text{Shower}_{\text{gpd}} = \text{daily shower water use for the Rated Home}
- \text{KitchF}_{\text{gpd}} = \text{daily kitchen faucet water use for the Rated Home}
- \text{LavF}_{\text{gpd}} = \text{daily lavatory water use for the Rated Home}
- \text{Waste}_{\text{gpd}} = \text{daily water use wasted for the Rated Home}
- \text{CW}_{\text{gpd}} = \text{daily clothes washer water use for the Rated Home}
- \text{DW}_{\text{gpd}} = \text{daily dishwasher water use for the Rated Home}
- \text{Toilets}_{\text{gpd}} = \text{daily toilet water use for the Rated Home}
- \text{Soft}_{\text{gpd}} = \text{daily water softener water use for the Rated Home}
- \text{Other}_{\text{gpd}} = \text{daily other/ unidentified water use for the Rated Home}
- \text{EP}_{\text{gpd}} = \text{daily excess pressure adjustment}

4.5.1. Determining Daily Shower Water Use for the Rated Home. Rated Home daily shower water use shall be calculated as follows:

\[ \text{Shower}_{\text{gpd}} = \text{FixtureTot} \times \text{shower}_{\text{pc}} \times \text{ShEff} \]  
\hspace{1cm} (Eq 4.5-2)
Where:

\[ \text{FixtureTot} = \frac{\text{adjFmix}}{\text{Fmix}} \times \text{refFgpd} \times \text{VintFact} \]

Shower\_pc = Percent of fixture water use consumed by showers = 54%
SHeff = the ratio of the average rated flow rate of showerheads to the reference home flow rate

\[ \text{SHeff} = \frac{\text{average flow rate of showerheads in the rated home}}{2.5} \]

This value is derived from ANSI/RESNET/ICC 301 Addendum A.


Rated Home daily kitchen faucet water use shall be calculated as follows:

\[ \text{KitchF\_gpd} = \text{FixtureTot} \times \text{faucet\_pc} \times \text{KitchFeff} \times \text{Kitch} \]  
(Eq 4.5-3)

Where:

\[ \text{FixtureTot} = \frac{\text{adjFmix}}{\text{Fmix}} \times \text{refFgpd} \times \text{VintFact} \]

faucet\_pc = Percent of fixture water use consumed by faucets = 46%
KitchFeff = the ratio of the average rated flow rate of kitchen faucets to the reference home flow rate

\[ \text{KitchFeff} = \frac{\text{average flow rate of kitchen faucets in the rated home}}{2.2} \]

Kitch = the percentage of faucet use that is attributed to kitchen faucets = 69%

This value is derived from ANSI/RESNET/ICC 301 Addendum A.

4.5.3. Determining Daily Lavatory Faucet Water Use for the Rated Home.

Rated Home daily lavatory faucet use shall be calculated as follows:

\[ \text{LavF\_gpd} = \text{FixtureTot} \times \text{faucet\_pc} \times \text{LavFeff} \times \text{Lav} \]

(Eq 4.5-4)

Where:

Lav = the percentage of faucet use that is attributed to lavatory faucets = 31%

\[ \text{FixtureTot} = \frac{\text{adjFmix}}{\text{Fmix}} \times \text{refFgpd} \times \text{VintFact} \]

faucet\_pc = Percent of fixture water use consumed by faucets = 46%
LavFeff = the ratio of the average rated flow rate of lavatory faucets to the Water Rating Reference Home flow rate = 1 for standard faucets and 0.95 for high efficiency faucets

This value is derived from ANSI/RESNET/ICC 301 Addendum A.

4.5.4. Determining Daily Hot Water Fixture Water Use Wasted for the Rated Home.
Rated Home daily hot water fixture water use wasted shall be calculated as follows:

\[
\text{Waste}_{\text{gpd}} = F_{\text{eff}} \times (oW_{\text{gpd}} + sW_{\text{gpd}} \times W_{\text{Def}})
\]  
(Eq 4.5-5)

Where:
- \(F_{\text{eff}}\) = Fixture efficiency of showerheads, kitchen faucets, and lavatory faucets weighted by contribution to total fixture use (by volume)
- \(oW_{\text{gpd}}\) = daily standard operating condition hot water wasted quantity as determined by ANSI/RESNET/ICC 301 Addendum A
- \(sW_{\text{gpd}}\) = daily structural hot water wasted quantity as determined by ANSI/RESNET/ICC 301 Addendum A
- \(W_{\text{Def}}\) = distribution system water use effectiveness from Table 4.2.5.2.11(3) of ANSI/RESNET/ICC 301 Addendum A

This value is determined in accordance with ANSI/RESNET/ICC 301 Addendum A.

**4.5.5. Determining Daily Clothes Washer Water Use for the Rated Home.** Rated Home daily clothes washer water use shall be calculated as follows:

\[
\text{CW}_{\text{gpd}} = \frac{\text{CAP}_w \times \text{CW}_w f \times ACY}{365}
\]  
(Eq 4.5-6)

Where:
- \(\text{CAP}_w\) = washer capacity in cubic feet = the manufacturer’s data or the CEC database or the EPA Energy Star website or the default value of 2.874 ft³
- \(\text{CW}_w f\) = clothes washer water factor from manufacturer’s data
- \(ACY\) = Adjusted cycles per year determined in accordance with ANSI/RESNET/ICC 301 Addendum A

This value is determined in accordance with ANSI/RESNET/ICC 301-2014 Addendum A.

**4.5.6. Determining Daily Dishwasher Water Use for the Rated Home.** Rated Home daily dish washer water use shall be calculated as follows:

\[
\text{DW}_{\text{gpd}} = \left(\frac{88.4 + 34.9*\text{Nbr}}{\text{dW}_{\text{cap}}} \times (12/\text{dW}_{\text{cap}}) \times (4.6415*(1/\text{DW}_{\text{EF}})-1.9295)\right) / 365
\]  
(Eq 4.5-7)

Where:
- \(\text{Nbr}\) = number of bedrooms in the Rated Home
- \(\text{dW}_{\text{cap}}\) = capacity of the dishwasher in the Rated Home (in cubic feetplace settings) as included in the manufacturer’s data
- \(\text{DW}_{\text{EF}}\) = The energy factor of the dishwasher installed in the Rated Home

This value is determined in accordance with ANSI/RESNET/ICC 301 Addendum A.

**4.5.7. Determining Daily Toilet Water Use for the Rated Home.** Rated Home daily toilet water use shall be calculated as follows:
Toilet\_gpd = refFPO \times gpf \times Occ

Where:

refFPO = the reference flushes per person per day = 5.05

gpf = the average gallons per flush of all toilets installed in the Rated Home

Occ = the number of predicted occupants in the Rated Home = 1.09 + 0.54*Nbr

Nbr = the number of bedrooms in the Rated Home

4.5.8. Determining Daily Water Softener Water Use for the Rated Home. Rated Home daily water softener water Use shall be calculated as follows:

\[ Soft\_gpd = \frac{\text{grains of hardness}}{\text{gallon of water}} \times \left[ \text{sum of indoor water uses in the Rated Home} \right] \times \left[ \text{gallons used per 1,000 grains of hardness} \right] \]  

(Eq 4.5-8)

4.5.9. Determining Daily Other Water Use for the Rated Home. Rated Home daily other water use shall be calculated as follows:

\[ Other\_gpd = TotOther\_br \times 5.93 \times Nbr \]  

(Eq 4.5-9)

Where:

TotOther\_br = the average value in gallons per day of other/unidentified usage per bedroom = 5.93 gpd

Nbr = the number of bedrooms in the rated home


Where a Rated Home does not have a pressure-reducing valve or pressure tank, additional water use attributed to excess water pressure shall be calculated as follows:

\[ EP\_gpd = MAX \{[(Shower\_gpd + 0.5 \times (LavF\_gpd + KitchF\_gpd + Other\_gpd))) \times 0.006 \times (PR - 90)] , 0 \} \]  

(Eq 4.5-10)

Where:

\[ PR = \text{Static water pressure (in psi) measured at the indoor fixture outlet on the lowest floor and (if more than one) closest to the water service entry to the house} \]

Note: Shower and lavatory faucets controlled by integral or accessory pressure-compensating devices may be excluded from this equation.

4.6. Determining Outdoor Water Use for the Rated Home. The Rated Home Outdoor Water Use shall be calculated as follows:

Where the Rated Home has an Automatic Irrigation System, Outdoor Water Use shall be calculated as follows:

Equation 1:
Where the Rated Home does not have an Automatic Irrigation System, Outdoor Water Use shall be calculated as follows:

Equation 2:

\[
\left[ \frac{\exp(B)}{1 + \exp(B)} \right] \times 1.22257 \times \left[ 1.4233 + 0.6311 \times netET + 0.9376 \times Rat_Irr_Area \right] + Pool\_use
\]

(Eq 4.6-2)

The Outdoor Water Use for the Rated Home shall never be less than the result of the following calculation:

\[
\left[ \frac{\exp(B)}{1 + \exp(B)} \right] \times 1.22257 \times \left[ 1.4233 + 0.6311 \times netET + 0.9376 \times Rat_Irr_Area \right]
\]

(Eq 4.6-3)

Where:
- Exp(A) = exponent of \([1.4416 + 0.5069 \times \text{(Rat\_Irr\_Area}/1,000)]\)
- Exp(B) = exponent of \([0.6911 + 0.00301 \times \text{netET} \times \text{(Rat\_Irr\_Area}/1,000)]\)
- Rat\_Irr\_Area = The size of the landscape that might receive supplemental water in the rated home
- netET = The annual historic sum of mean reference evapotranspiration minus the mean precipitation for all months that evapotranspiration exceeds precipitation
- ind\_Pool = Indicator representing the presence or absence of a swimming pool
- Pool\_use = equation 1 (using ind\_Pool = 1) – equation 1 (using ind\_Pool = 0)

4.6.1. **Smart Controllers.** Sensor and weather based irrigation controllers that are certified by the U.S. EPA WaterSense program shall decrease the portion of predicted rated home outdoor water use associated with irrigation (less the water use associated with pools) by 15% in homes that have automatic irrigation.

4.6.2. **Commissioning of an Automatic Irrigation System.** In rated homes, with an automatic irrigation system, where documentation is provided the water use associated with irrigation shall be decreased by 5% where a certified professional, as identified by a WaterSense labeled certification, and the irrigation system has been inspected according to the protocols identified in ASABE 626 and verified as follows:
- Average distribution uniformity of at least 65% on turf areas
- Sprinklers are operating at the correct manufacturer’s recommended water pressure +/- 10%
- The system operates without leaks
- The system prevents runoff and overspray from leaving the property (checked during the audit)
4.6.3. **Residential Irrigation Capacity Index (RICI).** In a Rated Home, with an automatic irrigation system, where documentation is provided, a RICI shall be calculated as follows:

\[
RICI_{\text{rat}} = \frac{\text{sum of flow (gpm) of all irrigation valves}}{\text{square feet irrigated area}} \times 1,000
\]

(Eq 4.6-4)

4.6.3.1. **Applying RICI.** A Rated Home where documentation for a RICI is provided may adjust the portion volume of water use associated with irrigation (less the water use associated with pools) in the Outdoor Water Use of the Rated Home by 10% for every point from a baseline RICI (RICI_ref) of 5.

4.6.4. **Applying Adjustments to the Outdoor Water Use of Rated Homes.** Because the Water Rating Index model includes a number of percent adjustments for the outdoor water use of the rated home, the order of application becomes important. The correct order in which to apply these adjustments is as follows:

| Table 4.6.4. Applying Adjustments to Outdoor Water Use of the Rated Home |
| --- | --- |
| 1  | 4.6.1- Smart Controllers  | Shall be determined by the presence or absence of a smart controller in the installed portion of the landscape. |
| 2  | 4.6.2- Commissioning of an Automatic Irrigation System  | Shall be determined by the presence or absence of commissioning in the installed portion of the landscape. |
| 3  | 4.6.3- Residential Irrigation Capacity Index (RICI)  | Shall be calculated as sum of flow (gpm) + 0.005 * Predicted Back_yard |

5. **Minimum Rated Features.** The estimated annual indoor and outdoor water use shall be determined using the minimum rated features set forth in Table 5.0.

<p>| Table 5.0. Minimum Rated Features |
| --- | --- |
| Building Element | Minimum Rated Feature |
| 1. Toilet | Flush volume for each toilet as measured on-site or from manufacturer’s data. |
| 2. Shower/Bath | As imprinted on the product, stated by manufacturer in product documentation, or tested via flow rate test in the field. |
| 3. Bathroom Faucet | As imprinted on the product, stated by manufacturer in product documentation, or tested via flow rate test in the field. |</p>
<table>
<thead>
<tr>
<th>4. Kitchen Faucet</th>
<th>As imprinted on the product, stated by manufacturer in product documentation, or tested via flow rate test in the field.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. Clothes Washer</td>
<td>Washer capacity (cubic feet) from manufacturer’s data or the CEC Appliance Efficiency Database or the EPA ENERGY STAR website. Location, source of hot water, type (residential or commercial), Labeled Energy Rating (kWh/y), electric rate ($/kWh), annual gas cost (AGC), and gas rate ($/therm) from Energy Guide label; and washer capacity (cubic feet) from manufacturer’s data or the CEC Appliance Efficiency Database or the EPA ENERGY STAR website, for all clothes washers located within the Rated Home and/or any clothes washers in the building intended for use by the Rated Home occupants, as defined in Section 4.5.5.</td>
</tr>
<tr>
<td>6. Dishwasher</td>
<td>Capacity of the dishwasher (in place settings) as included in the manufacturer’s data, labeled energy factor (cycles/kWh), Labeled Energy Factor (cycles/kWh) or labeled energy consumption (kWh/y), for all dishwashers located within the Rated Home and/or any dishwashers outside the Rated Home intended for daily use by the Rated Home occupants as defined in Section 4.5.6.</td>
</tr>
<tr>
<td>7. Water Softener</td>
<td>Gallons of water used per 1,000 grains of hardness removed.</td>
</tr>
<tr>
<td>8. Hot Water Distribution</td>
<td>Insulation R-value of pipe insulation, type of recirculation system, length of pipe Distribution System Type (Standard, recirculation), Recirculation System controls [none, timer, temperature, demand (manual) or demand (sensor)], pipe insulation R-value, pipe length for standard distribution, branch length for recirculation, supply + return loop length, pump power (Watts, HP)</td>
</tr>
<tr>
<td>9. Outdoor Water Use</td>
<td>Irrigation system type (automatic or manual), lot size, irrigated area (square feet)</td>
</tr>
<tr>
<td>10. Pool/Spa</td>
<td>Indicate presence or absence of a pool or spa.</td>
</tr>
<tr>
<td>11. Service Water Pressure</td>
<td>Service pressure of water being supplied to the home, as established by the setting of an installed pressure-reducing valve OR the setting of an installed pressure tank OR written documentation from the water supplier that service pressure to the site is ≤ 90 psi OR an on-site static pressure test. Pressure tank installed and set ≤ 60 psi, OR Pressure Regulating Valve installed upstream of fixtures and...</td>
</tr>
</tbody>
</table>
5.1. Data Sources. Data required for the calculation of indoor and outdoor daily water use in the Rated and Reference Homes shall be determined by the location of the Rated Home and using data as set forth in 5.1.1 and 5.1.2.

5.1.1. Net Evapotranspiration. Data for net evapotranspiration shall be determined for the location of the rated home using a dataset approved by RESNET.

5.1.2. Hardness of Water. Data for the hardness of water shall be determined by the location of the Rated Home and one of the following:
   a) A dataset approved for use by RESNET
   b) Data provided by the local water supplier
   c) A hardness test conducted at the site

5.2 Default Values. Values that are not available in accordance with Table 5.0 or are absent from the home at time of the rating shall use default values in accordance with Table 5.2. Values for building elements that are not specified in table 5.0 are required for a rating to be issued.

Table 5.2 Default Values

<table>
<thead>
<tr>
<th>Building Element</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Water Softeners</td>
<td>Can be entered as 0 if they are absent from a Rated Home. If they are present and no documentation is available they may be assumed to use 5 gallons/1,000 grains removed for cation water softeners if information is unavailable.</td>
</tr>
<tr>
<td>2. Clothes Washer</td>
<td>Determined by ANSI/RESNET/ICC 301. Same as Reference Home</td>
</tr>
<tr>
<td>4. Hot Water Distribution</td>
<td>Determined by ANSI/RESNET/ICC 301 Addendum A</td>
</tr>
<tr>
<td>5. Outdoor Water Use</td>
<td>Must be done in accordance with Section 4.2.3</td>
</tr>
</tbody>
</table>

5.3. Incomplete Outdoor Area. To receive a rating, a home must (at a minimum) have the front yard landscape completed. Homes that do not have landscaping completed in the back yard shall be determined in accordance with Section 4.6 with the portion of landscaping that is done determining the presence or absence of an automatic irrigation system. The following steps shall be followed in determining irrigated area in this instance.

Rater must determine a line between the front and back area (front_area + back_area must = total available area)

\[ \text{Lot Area} - \text{Pad Footprint} = \text{total available area} \]
\[ (\text{Back area}/\text{total available area}) \times \text{Ref Irr Area} = \text{Predicted Back Irr Area} \]
\[ \text{Irr Area} = \text{Predicted Back Irr Area} + \text{Front Irr Area} \]
CANDIDATE--BSR/RESNET/ICC Standard 1101-- Water Rating Index
PDS-01.2
July 3, 2018

Where:

Pad Footprint = the portion of the lot area covered by the dwelling unit and any attached or detached garage.
Total available area = The portion of the lot excluding the pad of the house that is available for landscaping or other design features (hardscape, softscape, etc.)
Front_area = the area (in sq. ft.) of the total available area that is located primarily in front of the house
Back_area = the area (in sq. ft.) of the total available area that is located primarily behind the house
Front_irryard = The area located primarily in front of the house that has been landscaped and receives supplemental water for irrigation at the time of the rating
Predicted Back_irryard = the portion of the non-landscaped area located primarily behind the house that can be predicted to receive supplemental water for irrigation in the future

6. Certification and Labeling. This section establishes minimum uniform standards for certifying and labeling home water use performance using the Water Rating Index. These include minimum requirements of the home water use rating process, standard methods for estimating water use, minimum reporting requirements, and specification of the types of ratings that are performed in accordance with this Standard.

6.1. Rating Requirements.
6.1.1. General. The rating for a home shall be determined in accordance with sections 6.1.1.1 through 6.1.1.2.

6.1.1.1. For an existing home, required data shall be collected on site.
6.1.1.1.1. For a new, to-be-built home, the procedures of Section 5.0 shall be used to collect required data.
6.1.1.2. The collected data shall be used to estimate the annual water consumption for indoor and outdoor water use for both the Rated Home and the Water Rating Reference Home as specified by Section 4.0.

6.1.2. Cost Savings Estimates. Where determined, cost savings estimates for water and wastewater (sanitary sewer) service for the Rated Home shall be calculated in accordance with Sections 6.1.2.1 through 6.1.2.3.

6.1.2.1. Water Cost Savings.

6.1.2.1.1. Water Prices. Water cost savings for homes receiving potable water service from a water supplier shall be based on the schedule of rates and charges adopted by the water supplier serving the Rated Home.

6.1.2.1.2. Relevant Rates and Charges. Water cost savings shall be calculated from the volumetric portion of the schedule of rates and charges, sometimes referred to as
the commodity charge. Fixed or flat charges that do not vary with the volume of water
delivered to the home, sometimes referred to as the meter charge or service charge,
shall not contribute to the cost savings estimate.

6.1.2.1.3. Water Cost Savings Calculations.

6.1.2.1.3.1. Average Billed Indoor Volume of the Water Rating Reference Home. Convert the total annual volume of indoor water use by the Water Rating Reference Home to an increment of indoor use during a water billing period by dividing the annual indoor volume by the number of bills per year generated by the water supplier, e.g., for monthly billing divide by 12 and for quarterly billing divide by 4. Convert the units of consumption of the Water Rating Reference Home as necessary to match the units of the rate schedule (e.g., 1.000 gallons, 100 cubic feet) to yield the average billed indoor volume of the Water Rating Reference Home.

6.1.2.1.3.2. Determine Outdoor Water Use for a Billing Period. Convert the total annual volume of outdoor water use in the Water Rating Reference Home to an increment of outdoor use during a water billing period using one of two methods, based on prevailing practice at the location of the Rated Home.

6.1.2.1.3.2.1. Peak Season Irrigation. Divide the annual outdoor volume by the number of bills generated by the water supplier during the irrigation season, e.g. for a 6-month irrigation season with monthly billing, divide by 6; for a 6-month irrigation season with quarterly billing, divide by 2. Convert the units of consumption of the Reference Home as necessary to match the units of the rate schedule (e.g., 1.000 gallons, 100 cubic feet) to yield the average billed outdoor volume of the Water Rating Reference Home.

6.1.2.1.3.2.2. Year-Round Irrigation. Divide the annual outdoor volume by the number of bills generated by the water supplier during a full year, e.g., for monthly billing divide by 12 and for quarterly billing divide by 4. Convert the units of consumption of the Water Rating Reference Home as necessary to match the units of the rate schedule (e.g., 1.000 gallons, 100 cubic feet) to yield the average billed outdoor volume of the Water Rating Reference Home.

6.1.2.1.3.3. Combine Indoor and Outdoor Water Use Charges. For each billing period in a year, calculate the billed water volume by combining the average billed indoor volume with any average billed outdoor volume applicable to such billing period. Note that where peak season irrigation has been calculated, the billed water volume for billing period outside of the irrigation season will consist entirely of the average billed indoor volume. Apply the volumetric portion of the rate schedule to the billed volume for each billing period, accounting for any rate blocks or seasonal variations in the rate schedule, to produce the billed volume charge (in dollars) for each billing period. Combine the billed volume charge for each billing period to yield the annual water volume charge of the Water Rating Reference Home.

6.1.2.1.3.4. Determine Water Use Cost for the Rated Home. Repeat the process described in Section 6.1.2.1.3 through 6.1.2.1.3.3 for the Rated Home to calculate the
annual water volume charge of the Rated Home.

6.1.2.1.3.5. **Total Estimated Water Cost Savings.** Estimated water cost savings shall be the difference between the estimated annual water volume charge of the Reference Home and the estimated annual water volume charge of the Rated Home.

6.1.2.2. **Sanitary Sewer Service Cost Savings.**

6.1.2.2.1. **Sewer Service Prices.** Sanitary sewer service cost savings for homes with a permanent connection to sanitary collection and treatment works shall be based on the schedule of rates and charges adopted by the sanitary sewer service provider serving the Rated Home. Note that collection and treatment of sanitary discharges may be performed by separate entities, and that billing to the Rated Home by such entities may be combined or separate.

6.1.2.2.2. **Relevant Rates and Charges.** Sanitary sewer service cost savings shall be calculated from the volumetric portion of the schedule of rates and charges. Fixed or flat charges that do not vary with the volume of water delivered to the home shall not contribute to the cost savings estimate.

6.1.2.2.3. **Sewer Cost Savings Calculations.**

6.1.2.2.3.1. **Average Billed Indoor Volume of the Water Rating Reference Home.** Convert the total annual volume of indoor water use by the Water Rating Reference Home to an increment of indoor use during a sewer billing period by dividing the annual indoor volume by the number of bills per year generated by the sewer service provider, e.g., for monthly billing divide by 12 and for semi-annual billing divide by 2. Convert the units of consumption of the Water Rating Reference Home as necessary to match the units of the rate schedule (e.g., 1.000 gallons, 100 cubic feet) to yield the average billed indoor volume of the Water Rating Reference Home.

6.1.2.2.3.2. **Annual Sewer Volume Charge for the Water Rating Reference Home.** Apply the volumetric portion of the sewer rate schedule to the average billed indoor volume for each billing period, accounting for any rate blocks or seasonal variations in the rate schedule, to produce the billed volume charge (in dollars) for each billing period. Combine the billed volume charge for each billing period to yield the annual sewer volume charge of the Water Rating Reference Home.

6.1.2.2.4. **Determine Annual Sewer charge for the Rated Home.** Repeat the process described in Section 6.1.2.2.3 for the Rated Home to calculate the annual sewer volume charge of the Rated Home.

6.1.2.2.5. **Estimated Sewer Cost Savings.** Estimated sewer cost savings shall be the difference between the estimated annual sewer volume charge of the Reference Home and the estimated annual sewer volume charge of the Rated Home.
6.1.2.2.6 Combined Presentation of Cost Savings. Estimated water cost savings and estimated sewer cost savings may be presented as a total estimated cost savings when designated as “water and sewer” savings.

6.1.2.4. Other Cost Savings. Performance attributes of the Rated Home may influence other types of charges, depending on the fee structure in the jurisdiction of the Rated Home. While less common, these savings may be significant. Any determinations for cost savings associated with the following charges shall be submitted for individual review and approval by the body providing quality assurance for the rating service provider of the Rated Home.

(a) water service connection charges, also known as tap fees;
(b) sanitary sewer service connection charges, also known as capacity charges;
(c) stormwater fees.

6.1.3. Reports. All reports generated by an Approved Software Rating Tool shall, at a minimum, contain the information specified by Sections 6.1.3.1 through 6.1.3.6.

6.1.3.1. The property location, including city, state, zip code and either the street-address or the Community Name and Plan Name for the Rating.

6.1.3.2. The name of the certified rater conducting the Rating.

6.1.3.3. The name of the Approved Rating Provider under whose auspices the rater is certified.

6.1.3.4. The date the Rating was conducted.

6.1.3.5. The name and version number of the Approved Software Rating Tool used to determine the Rating.

6.1.3.6. The following statement in no less than 10-point font: “The Home Water Rating Standard Disclosure for this home is available from the Rating Provider.” At a minimum, this statement shall also include the Rating Provider’s mailing address and phone number.

6.1.4. Rating Types. There shall be three Rating Types in accordance with Sections 6.1.4.1 through 6.1.4.3.

6.1.4.1. Confirmed Rating. A Rating Type that encompasses one individual dwelling and is conducted in accordance with Sections 6.1.4.1.1 through 6.1.4.1.3.

6.1.4.1.1. All Minimum Rated Features of the Rated Home shall be field-verified through inspection and testing in accordance with Section 5.

6.1.4.1.2. All field-verified Minimum Rated Features of the Rated Home shall be entered into the Approved Software Rating Tool that generates the home water rating. The home water rating shall report the Water Rating Index that comports with these inputs.

6.1.4.1.3. Confirmed Ratings shall be subjected to Quality Assurance requirements equivalent to Section 900 of the Mortgage Industry National Home Energy Rating Systems Standard.

6.1.4.2. Sampled Ratings. A Rating Type that encompasses a set of dwellings and is conducted in accordance with Sections 6.1.4.2.1 through 6.1.4.2.3.

6.1.4.2.1. For the set of Rated Homes, all Minimum Rated Features shall be field
verified through inspection and testing of a single home in the set, or distributed across multiple homes in the set, in accordance with the requirements equivalent to Section 600 of the Mortgage Industry National Home Energy Rating Systems Standard.

6.1.4.2.2. The threshold specifications from the Worst-Case Analysis for the Minimum Rated Features of the set of Rated Homes shall be entered into the Approved Software Rating Tool that generates the home water use rating. The home water use rating shall report the Water Rating Index that comports with these inputs.

6.1.4.2.3. Sampled Ratings shall be subjected to Quality Assurance requirements equivalent to Section 900 of the Mortgage Industry National Home Energy Rating Systems Standard.

6.1.4.3. Projected Ratings. A Rating Type that encompasses one individual dwelling and is conducted in accordance with Sections 6.1.4.3.1 through 6.1.4.3.5.

6.1.4.3.1. All Minimum Rated Features of the Rated Home shall be determined from architectural drawings, threshold specifications, and the planned location for a new home or from a site audit and threshold specifications for an existing home that is to be improved.

6.1.4.3.2. Unknown values shall be determined in accordance with Section 5.2.

6.1.4.3.3. The Projected Rating Report shall contain the following text in no less than 14-point font at the top of the first page of the report: “Projected Rating Based on Plans—Field Confirmation Required.”

6.2. Innovative Design Requests.

6.2.1. Petition. Water Rating providers can petition for adjustment to the Water Rating Index for a Rated Home with features or technologies not addressed by Approved Software Rating Tools or this Standard. Innovative Design Requests (IDRs) shall be submitted to an Approved IDR authority and shall include, at a minimum, the following:

6.2.1.1. A Rating generated from Approved Software Rating Tool for the Rated Home without feature(s) that cannot be modeled in the software tool.

6.2.1.2. Written description of feature(s) not included in Rating generated from software.

6.2.1.3. Manufacturer’s technical and/or performance specifications for feature(s) not included in the Rating generated from the Approved Software Rating Tool.

6.2.1.4. Estimated water use impact. Calculations or simulation results estimating the water use impact of feature(s) not included in the Rating generated from an Approved Software Rating Tool and documentation to support the calculation methodology and/or describe the modeling approach used.

6.2.1.5. Estimated adjustment to the Water Rating Index. Calculations shall follow procedures of Sections 4.1 and 4.2.
6.2.2. Approval. IDRs shall be approved on a case by case basis. The Approved IDR review authority shall accept or reject the IDR as submitted, or request additional information. The Approved IDR review authority shall assign a unique identifier to each IDR and maintain a database of IDRs. If the IDR is approved, the Water Rating provider is authorized to issue a supplemental report that adjusts the Water Rating Index, as approved.

7. References