

# Water Efficiency

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| SS       | <b>WE</b> | EA | MR | EQ | ID |
| Overview |           |    |    |    |    |

In the United States, approximately 340 billion gallons of fresh water are withdrawn per day from rivers, streams and reservoirs to support residential, commercial, industrial, agricultural and recreational activities. This accounts for about one-fourth of the nation's total supply of renewable fresh water. Almost 65% of this water is discharged to rivers, streams and other water bodies after use and, in some cases, treatment.

Additionally, water is withdrawn from underground aquifers. In some parts of the United States, water levels in these aquifers have dropped more than 100 feet since the 1940s. On an annual basis, the water deficit in the United States is currently estimated at about 3,700 billion gallons. In other words, Americans extract 3,700 billion gallons per year more than they return to the natural water system to recharge aquifers and other water sources.

On a positive note, U.S. industries today use 36% less water than they did in 1950 although industrial output has increased significantly. This reduction in water use is largely due to the rigorous water reuse strategies in industrial processes. In addition, the Energy Policy Act of 1992 (and as amended) mandated the use of water-conserving plumbing fixtures to reduce water use in residential, commercial and institutional buildings.

Using large volumes of water increases maintenance and lifecycle costs for building operations and increases consumer costs for additional municipal supply and treatment facilities. Conversely, facilities that use water efficiently can reduce costs through lower water use fees, lower sewage volumes to treat energy and chemical use reductions, and lower capacity charges and limits. Many water conservation

strategies involve either no additional cost or rapid paybacks. Other water conservation strategies such as biological wastewater treatment, rainwater harvesting and graywater plumbing systems often involve more substantial investment.

Water efficiency measures in commercial buildings can easily reduce water usage by 30% or more. In a typical 100,000-square-foot office building, low-flow fixtures coupled with sensors and automatic controls can save a minimum of 1 million gallons of water per year, based on 650 building occupants each using an average of 20 gallons per day. Non-potable water volumes can be used for landscape irrigation, toilet and urinal flushing, custodial purposes and building systems. Utility savings, though dependent on the local water costs, can save thousands of dollars per year, resulting in rapid payback on water conservation infrastructure.

## Water Efficiency Credit Characteristics

**Table 1** shows which credits were substantially revised from LEED-NC Version 2.2, which credits are eligible to be submitted in the Design Phase Submittal, and which project team members are likely to carry decision-making responsibility for each credit. The decision-making responsibility matrix is not intended to exclude any party, rather to emphasize those credits that are most likely to require strong participation by a particular team member.

### Overview of LEED® Prerequisites and Credits

**WE Credit 1.1**  
Water Efficient  
Landscaping—Reduce  
by 50%

**WE Credit 1.2**  
Water Efficient  
Landscaping—No  
Potable Water Use or No  
Irrigation

**WE Credit 2**  
Innovative Wastewater  
Technologies

**WE Credit 3.1**  
Water Use Reduction  
—20%

**WE Credit 3.2**  
Water Use Reduction  
—30%

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Table 1: WE Credit Characteristics

| Credit  | Significant Change from LEED-NC v2.2 |                  |                        |                       |                             |                            |
|---|--------------------------------------|------------------|------------------------|-----------------------|-----------------------------|----------------------------|
|   |                                      | Design Submittal | Construction Submittal | Owner Decision-Making | Design Team Decision-Making | Contractor Decision-Making |
| <b>WEc1.1:</b> Water Efficient Landscaping: Reduce by 50%                         |                                      | *                |                        |                       | *                           |                            |
| <b>WEc1.2:</b> Water Efficient Landscaping: No Potable Water Use or No Irrigation |                                      | *                |                        | *                     | *                           |                            |
| <b>WEc2:</b> Innovative Wastewater Technologies                                   | *                                    | *                |                        |                       | *                           |                            |
| <b>WEc3.1:</b> Water Use Reduction, 20%   |                                      | *                |                        |                       | *                           |                            |
| <b>WEc3.2:</b> Water Use Reduction, 30%   |                                      | *                |                        |                       | *                           |                            |

# Water Efficient Landscaping

## Reduce by 50%

### Intent

Limit or eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation.

### Requirements

Reduce potable water consumption for irrigation by 50% from a calculated mid-summer baseline case.

Reductions shall be attributed to any combination of the following items:

- Plant species factor
- Irrigation efficiency
- Use of captured rainwater
- Use of recycled wastewater
- Use of water treated and conveyed by a public agency specifically for non-potable uses

### Potential Technologies & Strategies

Perform a soil/climate analysis to determine appropriate plant material and design the landscape with native or adapted plants to reduce or eliminate irrigation requirements. Where irrigation is required, use high-efficiency equipment and/or climate-based controllers.

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| Credit 1.1 |           |    |    |    |    |

1 Point

|            |           |    |    |    |    |
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| SS         | <b>WE</b> | EA | MR | EQ | ID |
| Credit 1.2 |           |    |    |    |    |

1 Point  
in addition to  
WE Credit 1.1

## **Water Efficient Landscaping**

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### **No Potable Water Use or No Irrigation**

#### **Intent**

Eliminate the use of potable water, or other natural surface or subsurface water resources available on or near the project site, for landscape irrigation.

#### **Requirements**

Achieve WE Credit 1.1 and

Use only captured rainwater, recycled wastewater, recycled graywater, or water treated and conveyed by a public agency specifically for non-potable uses for irrigation.

OR

Install landscaping that does not require permanent irrigation systems. Temporary irrigation systems used for plant establishment are allowed only if removed within one year of installation.

#### **Potential Technologies & Strategies**

Perform a soil/climate analysis to determine appropriate landscape types and design the landscape with indigenous plants to reduce or eliminate irrigation requirements. Consider using stormwater, graywater, and/or condensate water for irrigation.

## Summary of Referenced Standard

There is no standard referenced for this credit.

## Approach and Implementation

Design landscaping with climate-tolerant plants that can survive on natural rainfall quantities after initial establishment. Contour the land to direct rainwater runoff through the site to give vegetation an additional water supply. Minimize the amount of site area covered with turf, and use techniques such as mulching, alternative mowing and composting to maintain plant health. These practices conserve water and help foster optimal soil conditions.

Recommended design principals

### 1. Planning and design

- Develop a site map showing existing or planned structures, topography, orientation, sun and wind exposure, use of space and existing vegetation.
- Perform shadow profiles of landscape areas for each season, based on middle of the day conditions and illustrate the plant selection within the profiles.
- Reduce heat island effect by providing adequate shade from trees and buildings; plant hard wood trees to increase shade canopy as necessary.
- Plan water use zones:
  - High – regular watering
  - Moderate – occasional watering
  - Low – natural rain fall

### 2. Practical turf areas

Plant turf grasses only for functional benefits such as recreational areas, pedestrian use, or specifically for soil conservation.

### 3. Soil analysis and preparation

- Analyze soil in each zone.
- Amend soil accordingly.

### 4. Appropriate use of plant materials

- Choose plants that will easily adapt to the site.
  - A. Consider the mature size and form when choosing plant material for the location and intended purpose.
  - B. Consider growth rate.
  - C. Determine that texture and color combine with surrounding plantings and building background.
  - D. Use no mono-species or excessive multi-species selections.
  - E. Diversify species to prevent elimination of a species from diseases or pest infestation.

### 5. Effective and efficient watering practices

- Regularly check irrigation systems for efficient and effective operation; verify watering schedules and duration on a monthly basis.
- Use drip, micro misters, and sub-surface irrigation systems where applicable, and smart irrigation controllers throughout. Provide computer interface for monitoring and schedule modifications from a central location.
- No irrigation of plants and turf in the months of November to April.
- No irrigation of shrubs from September to June.

### 6. Use of mulch on trees, shrubs and flower beds

- Keep landscape areas mulched to conserve moisture and prevent evaporative water loss from the soil surface to reduce the need for

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supplemental irrigation during periods of limited rainfall.

A number of factors, including owner preference, event uses, and maintenance expertise may also impact plant selection, but the intent of this credit is to create a landscape that maximizes the use of on-site natural resources to limit or eliminate the use of potable water for irrigation. This goal can be achieved by selecting native or adapted plants that require little or no irrigation after initial establishment. This goal also can be achieved by using high-efficiency irrigation equipment, captured rainwater, recycled graywater or treated wastewater to reduce the consumption of potable water. Often times, it is appropriate to use a combination of these strategies to first reduce potable water demand and then meet the irrigation demand in the most sustainable manner.

The use of native or adapted plants is an excellent approach because water conservation is built-in and is not reliant on high-tech equipment and controls. In some climates, it is possible to eliminate the need for permanent irrigation with this strategy. In other climates, irrigation requirements can be cut by 50% or greater compared to conventional building landscapes simply by plant selection.

### Technologies

The use of irrigation technology, rainwater capture, and/or advanced wastewater treatment is another excellent approach to achieving this credit because it allows for a broader plant species palette, while still conserving potable water supplies. High-efficiency irrigation strategies include micro-irrigation systems, moisture sensors, rain shut-offs, and weather-based evapotranspiration controllers. Drip systems apply water slowly and directly to the roots of plants, using 30 to 50%

less water than sprinkler irrigation<sup>1</sup>. Moisture and rain sensors save water by ensuring that plants only receive water when necessary.

A rainwater collection system (e.g., cisterns, underground tanks, ponds) can significantly reduce or completely eliminate the amount of potable water used for irrigation. Rainwater can be collected from roofs, plazas and paved areas and then filtered by a combination of graded screens and paper filters to prepare it for use in irrigation. Metal, clay or concrete-based roofing materials are ideal for rainwater harvest, as asphalt or lead-containing materials will contaminate the water. Rainwater with high mineral content or acidity may damage systems or plantings, but pollutants can be filtered out by soil or mechanical systems prior to being applied to plantings. It is important to check local rainfall quantity and quality, as collection systems may be inappropriate in areas with rainfall of poor quality or low quantity.

Wastewater recovery can be accomplished either on-site or at the municipal level. On-site systems include graywater and/or wastewater treatment. Graywater consists of wastewater from sinks, showers and washing machines; cooling tower bleed down water; condensation from air conditioning systems; and other building activities that do not involve human waste or food processing. In addition, many municipalities treat sewage to tertiary standards in central treatment plants and re-distribute that water regionally for irrigation use.

### Calculations

To calculate the percent reduction in potable use for this credit, establish a baseline water use rate for your project and

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1 Bilderback, T.E., and M.A. Powell. Efficient Irrigation. North Carolina Cooperative Extension Service, Publication Number AG-508-6, March 1996. 21 January 2005. [www.bae.ncsu.edu/programs/extension/publicat/wqwm/ag508\\_6.html](http://www.bae.ncsu.edu/programs/extension/publicat/wqwm/ag508_6.html)

then calculate the as-designed water use rate according to the steps listed below.

### Standard Assumptions & Variables

- ❑ All calculations are based on irrigation during the month of July.
- ❑ The **Landscape Coefficient (KL)** indicates the volume of water lost via evapotranspiration and is dependent on the landscape species, the microclimate and the planting density. The formula for determining the landscape coefficient is given in **Equation 1**.
- ❑ The **Species Factor (ks)** accounts for variation of water needs by different plant species. The species factor can be divided into three categories (high, average and low) depending on the plant species considered. To determine the appropriate category for a plant species, use plant manuals and professional experience. This factor is somewhat subjective but landscape professionals should have a general idea of the water needs of particular plant species. Landscapes can be maintained in acceptable condition at about 50% of the reference evapotranspiration (ET0) value and thus, the average value of ks is 0.5. (Note: If a species does not require irrigation once it is established, then the effective ks = 0 and the resulting KL = 0.)
- ❑ The **Density Factor (kd)** accounts for the number of plants and the total leaf area of a landscape. Sparsely planted areas will have lower evapotranspiration rates than densely planted areas. An average kd is applied to areas where ground shading from trees is in the range of 60% to 100%. This is also equivalent to shrubs and ground cover shading 90% to 100% of the landscape area. Low kd values are found where ground shading from trees is less

than 60% or shrub and groundcover is less than 90%. For instance, a 25% ground shading from trees results in a kd value of 0.5. In mixed landscape plantings where trees cover understory groundcover and shrubs, evapotranspiration increases. This represents the highest level of landscape density and the kd value should be between 1.0 and 1.3.

- ❑ The **Microclimate Factor (kmc)** accounts for environmental conditions specific to the landscape, including temperature, wind and humidity. For instance, parking lot areas increase wind and temperature effects on adjacent landscapes. The average kmc is 1.0 and this refers to conditions where the landscape evapotranspiration rate is unaffected by buildings, pavements, reflective surfaces and slopes. Higher kmc conditions occur where evaporative potential is increased due to landscapes surrounded by heat-absorbing and reflective surfaces or are exposed to particularly windy conditions. Examples of high kmc areas include parking lots, west sides of buildings, west and south sides of slopes, medians, and areas experiencing wind tunnel effects. Low microclimate areas include shaded areas and areas protected from wind. North sides of buildings, courtyards, areas under wide building overhangs, and north sides of slopes are low microclimate areas.

### Step 1 — Create Design Case

Determine the landscape area for the project. This number must represent the as-designed landscape area and must use the same project boundary as is used in all other LEED credits. Sort the total landscape area into the major vegetation types (trees, shrubs, groundcover, mixed and turfgrass), listing the area for each.

#### Equation 1

$$K_L = k_s \times k_d \times k_{mc}$$

Determine the following characteristics for each landscape area: Species Factor ( $k_s$ ), Density Factor ( $k_d$ ), and Microclimate Factor ( $k_{mc}$ ). Recommended values for each of these factors are provided in **Table 1**. Select the “low,” “average,” or “high” value for each parameter as appropriate for your design. Any variance from these recommended values should be explained in the credit narrative.

Calculate the Landscape Coefficient ( $K_L$ ) by multiplying the three area characteristics as shown in **Equation 1**.

Determine the reference evapotranspiration rate ( $ET_0$ ) for your region. The **evapotranspiration rate** is a measurement of the total amount of water needed to grow a certain reference plant (such as grass or alfalfa) expressed in millimeters or inches. The values for  $ET_0$  in various regions throughout the United States can be found in regional agricultural data (see Resources section). The  $ET_0$  for July is used in the LEED calculation because this is typically the month with the greatest evapotranspiration effects and, therefore, the greatest irrigation demands.

Calculate your project-specific evapotranspiration rate ( $ET_L$ ) for each landscape area by multiplying the ( $ET_0$ ) by your  $K_L$ , as shown in **Equation 2**.

Determine your **Irrigation Efficiency (IE)** by listing the type of irrigation used for each landscape area and the corresponding

efficiency. **Table 2** lists irrigation efficiencies for different irrigation systems.

Determine, if applicable, the Controller Efficiency (CE). CE is the percent reduction in water use from any weather-based controllers or moisture sensor-based systems. This number must be supported by either manufacturer documentation or detailed calculations by the landscape designer.

Determine, if applicable, the volume of reuse water (captured rainwater, recycled graywater or treated wastewater) available in the month of July. Reuse water volumes may depend on rainfall volume/frequency, building-generated graywater/wastewater, and on-site storage capacity. On-site reuse systems should be modeled to predict volumes generated on a monthly basis as well as optimal storage capacity. For captured rainwater calculations, project teams may use either the collected rainwater total for July based on historical average precipitation, or the historical data for each month in order to model collection and reuse throughout the year. The latter method allows the project team to determine what volume of water is expected to be in the storage

**Table 1:** Landscape Factors

| Vegetation Type                    | Species Factor ( $k_s$ ) |         |      | Density Factor ( $k_d$ ) |         |      | Microclimate Factor ( $k_{mc}$ ) |         |      |
|------------------------------------|--------------------------|---------|------|--------------------------|---------|------|----------------------------------|---------|------|
|                                    | low                      | average | high | low                      | average | high | low                              | average | high |
| Trees                              | 0.2                      | 0.5     | 0.9  | 0.5                      | 1.0     | 1.3  | 0.5                              | 1.0     | 1.4  |
| Shrubs                             | 0.2                      | 0.5     | 0.7  | 0.5                      | 1.0     | 1.1  | 0.5                              | 1.0     | 1.3  |
| Groundcovers                       | 0.2                      | 0.5     | 0.7  | 0.5                      | 1.0     | 1.1  | 0.5                              | 1.0     | 1.2  |
| Mixed: trees, shrubs, groundcovers | 0.2                      | 0.5     | 0.9  | 0.6                      | 1.1     | 1.3  | 0.5                              | 1.0     | 1.4  |
| Turfgrass                          | 0.6                      | 0.7     | 0.8  | 0.6                      | 1.0     | 1.0  | 0.8                              | 1.0     | 1.2  |

**Equation 2**

$$ET_L [in] = ET_0 \times K_L$$

**Table 2:** Irrigation Types

| Irrigation Type | IE    |
|-----------------|-------|
| Sprinkler       | 0.625 |
| Drip            | 0.90  |



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| Credit 1 |    |    |    |    |    |

cistern at the beginning of July and add it to the expected rainwater volume collected during the month. This approach also allows the project team to determine the optimal size of the rainwater cistern.

Now you are ready to calculate your Total Water Applied (TWA) and Total Potable Water Applied (TPWA) for each landscape area and the Design Case. **Equations 3 and 4** show how to calculate these values.

### Step 2 — Create Baseline Case

The Baseline Case is calculated by setting the Species Factor (ks), Density Factor (kd), and Irrigation Efficiency (IE) to average values representative of conventional equipment and design practices. The same Microclimate Factors (kMC), and the reference Evapotranspiration Rate (ET<sub>0</sub>) are used in both the Design and Baseline cases. If the design of the project included substitutions of low water-using landscape types (such as shrubs) for high water-using types (such as turfgrass), the landscape areas can be re-allocated in the baseline case, but the total landscape area must remain the same in the two cases. Also, it is unreasonable to assume that the baseline is 100% turfgrass if the project

includes substantial areas of trees, shrubs and planting beds.

Calculate your TWA for the Baseline Case using **Equation 5**.

### Step 3 — Calculate Percent Reduction in Total Irrigation Water Use (Potable and Reuse) AND Percent Reduction of Potable Water Use for Irrigation

Calculate your percent reduction of potable water use according to **Equation 6**.

If the Percent Reduction of Potable Water is equal to or greater than 50%, WE Credit 1.1 is earned.

If the Percent Reduction of Potable Water is 100%, you must also calculate the Percent Reduction of Total Water (Potable plus Reuse) according to **Equation 7**.

If the Percent Reduction of Potable Water is 100% AND the Percent Reduction of Total Water is equal to or greater than 50%, WE Credit 1.2 is earned in addition to WE Credit 1.1.

### Example

An office building in Austin, Texas, has a total site area of 6,000 square feet. The site consists of three landscape types:

#### Equation 3

$$\text{Design Case TWA [gal]} = (\text{Area [sf]} \times (\text{ET}_L \text{ [in]} / \text{IE})) \times \text{CE} \times 0.6233 \text{ gal/sf/in}$$

#### Equation 4

$$\text{Design Case TPWA [gal]} = \text{TWA [gal]} - \text{Reuse Water [gal]}$$

#### Equation 5

$$\text{Baseline Case TWA [gal]} = \text{Area [sf]} \times (\text{ET}_L \text{ [in]} / \text{IE}) \times 0.6233 \text{ gal/sf/in}$$

#### Equation 6

$$\text{Percent Reduction of Potable Water [\%]} = (1 - \text{Design TPWA} / \text{Baseline TWA}) \times 100$$

#### Equation 7

$$\text{Percent Reduction of Total Water [\%]} = (1 - \text{Design TWA} / \text{Baseline TWA}) \times 100$$

groundcover, mixed vegetation and turf grass. All of the site areas are irrigated with a combination of potable water and graywater harvested from the building. The reference evapotranspiration rate (ET<sub>0</sub>) for Austin in July was obtained from the local agricultural data service and is equal to 8.12. The high-efficiency landscape irrigation case utilizes drip irrigation with an efficiency of 90% and reuses an estimated 4,200 gallons of graywater during the month of July. **Table 3** shows the calculations to determine potable water use for the design case.

The baseline case uses the same reference evapotranspiration rate and total site area. However, the baseline case uses sprinklers for irrigation (IE = 0.625), does not take advantage of graywater harvesting, and uses only shrubs and turf grass. Calculations to determine potable water use for the baseline case are presented in **Table 4**.

The example illustrates that the design case has an irrigation water demand of 23,474 gallons. Graywater reuse provides 4,200 gallons towards the demand, and this volume is treated as a credit in the

water calculation. Thus, the total potable water applied to the design case in July is 19,274 gallons. The baseline case has an irrigation demand of 62,518 gallons and reuses no graywater. The difference between the two cases results in potable water savings of 69% for the design case.

### Exemplary Performance

There is no exemplary performance point available for this credit.

### Precertification Submittal Documentation

Provide the LEED-CS Precertification Submittal Templates, which include the following:

- Narrative describing how the project intends to accomplish the credit requirements on the credit specific Submittal Template signed by the appropriate design team member
- Confirmation of this intent from the owner/developer on the LEED-CS Precertification Submittal Template

**Table 3:** Design Case (July)

| Landscape Type                             | Area [sf] | Species Factor (k <sub>s</sub> ) | Density Factor (k <sub>d</sub> ) | Microclimate Factor (k <sub>mc</sub> ) | KL  | ETL  | IE        | TPWA [gal]    |
|--|-----------|----------------------------------|----------------------------------|--|-----|------|-----------|---------------|
| Shrubs                                     | 1,200     | Low 0.2                          | Avg 1.0                          | High 1.3                               | 0.3 | 2.11 | Drip      | 2,815         |
| Mixed                                      | 3,900     | Low 0.2                          | Avg 1.1                          | High 1.4                               | 0.3 | 2.50 | Drip      | 10,837        |
| Turfgrass                                  | 900       | Avg 0.7                          | Avg 1.0                          | High 1.2                               | 0.8 | 6.82 | Sprinkler | 9,822         |
| <b>Subtotal [gal]</b>                      |           |                                  |                                  |  |     |      |           | <b>23,474</b> |
| July Rainwater and Graywater Harvest [gal] |           |                                  |                                  |  |     |      |           | (4,200)       |
| <b>Net GPWA [gal]</b>                      |           |                                  |                                  |  |     |      |           | <b>19,274</b> |

**Table 4:** Base line Case (July)

| Landscape Type        | Area [sf] | Species Factor (k <sub>s</sub> ) | Density Factor (k <sub>d</sub> ) | Microclimate Factor (k <sub>mc</sub> ) | KL  | ETL  | IE        | TPWA [gal]    |
|-----------------------|-----------|----------------------------------|----------------------------------|--|-----|------|-----------|---------------|
| Shrubs                | 1,200     | Avg 0.5                          | Avg 1.0                          | High 1.3                               | 0.7 | 5.28 | Sprinkler | 10,134        |
| Turfgrass             | 4,800     | Avg 0.7                          | Avg 1.0                          | High 1.2                               | 0.8 | 6.82 | Sprinkler | 52,384        |
| <b>Net GPWA [gal]</b> |           |                                  |                                  |  |     |      |           | <b>62,518</b> |

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| Credit 1 |    |    |    |    |    |

## Certification Submittal Documentation

### Design and Construction Credit Compliance

This credit is submitted in the **Design Submittal**.

The following project data and calculation information is required to document credit compliance using the LEED-CS v2.0 Submittal Templates:

- The project's calculated baseline Total Water Applied (TWA [gal]). This data can be obtained using **Equation 5**.
- The project's calculated design case Total Water Applied (TWA [gal]). This data can be obtained using **Equation 5**.
- The total non-potable water supply (gal) available for irrigation purposes.
- Narrative describing the landscaping and irrigation design strategies employed by the project; description of the water use calculation methodology used to determine savings; and for projects using non-potable water, specific information regarding source and available quantity of non-potable supplies.

### Tenant Sales or Lease Agreement Credit Compliance

This compliance method is not available for this credit.

### Considerations

Landscape irrigation practices in the United States consume large quantities of potable water. Outdoor uses, primarily landscaping, account for 30% of the

26 billion gallons of water consumed daily in the United States<sup>2</sup>. Improved landscaping practices can dramatically reduce and even eliminate irrigation needs. Maintaining or reestablishing native or adapted plants on building sites fosters a self-sustaining landscape that requires minimal supplemental water and provides other environmental benefits. Improved irrigation systems can also reduce water consumption. Irrigation typically uses potable water, although non-potable water (e.g., rainwater, graywater or reclaimed water) is equally effective. Irrigation system efficiency varies widely, and high-efficiency irrigation systems can also reduce potable water consumption. For example, high-efficiency drip irrigation systems can be 95% efficient, while sprinkler or spray irrigation systems are only 60% to 70% efficient.<sup>3</sup>

### Environmental Issues

Reduction in the amount of potable water used for irrigation lessens demand on limited supplies. Since landscape irrigation uses large amounts of potable water, it is an important opportunity to reduce overall consumption. Native or adapted landscaping can reduce the amount of water needed for irrigation while also attracting native wildlife and creating a building site integrated with its natural surroundings. In addition, native or adapted plants tend to require less fertilizer and pesticides, and thus reduce water quality degradation and other environmental impacts.

### Economic Issues

Currently, the most effective strategy to avoid escalating water costs for irrigation is to design landscaping adapted to the local climate and the site's microclimate.

<sup>2</sup> United States Environmental Protection Agency, Office of Water. Water-Efficient Landscaping. EPA Publication 832-F-02-002, September 2002. 21 January 2005. [www.epa.gov/owm/water-efficiency/final\\_final.pdf](http://www.epa.gov/owm/water-efficiency/final_final.pdf)

<sup>3</sup> Connellan, Geoff. Efficient Irrigation: A Reference Manual for Turf and Landscape. University of Melbourne. 2002. 21 January 2005. [www.sewl.com.au/sewl/upload/document/WaterConManual.pdf](http://www.sewl.com.au/sewl/upload/document/WaterConManual.pdf)

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The cost can be reduced or eliminated through thoughtful planning and careful plant selection and layout. Native or adapted plants further reduce operating costs because they require less fertilizer and maintenance than turf grass. Although the additional design cost for a drip irrigation system may make it more expensive than a conventional system, a drip system usually costs less to install and has lower water use and maintenance requirements. This usually leads to a very short payback period. Many municipalities offer rebates or incentives for water-efficient irrigation systems, dedicated water meters and rain or moisture sensors.

### Community Issues

Water-efficient landscaping helps to conserve local and regional potable water resources. Maintaining natural aquifer conditions is important to providing reliable water sources for future generations. Consideration of water issues during planning can encourage development when resources can support it, and prevent development if it exceeds the resource capacity.

### Synergies and Trade-Offs

Successful water-efficient landscaping depends on site location and design. It is advantageous to couple landscape improvements with water use reduction strategies. The use of native or adapted plants can reduce site maintenance needs. Landscape plantings can mitigate climate conditions and reduce building energy consumption, for example by shading south-facing windows. Vegetation can aid passive solar design, serve as a windbreak, provide pleasant views for building occupants, and muffle off-site noise. Native plants can restore habitat for wildlife. In addition to reducing potable water consumption, rainwater capture systems can be used to manage rainwater runoff. Using graywater for irrigation reduces the

amount of wastewater delivered to water treatment facilities.

## Resources

### Websites

#### America Rainwater Catchment Systems Association (ARCSA)

[www.arcsa-usa.org](http://www.arcsa-usa.org)

ARCSA was founded to promote rainwater catchment systems in the United States. Its website provides regional resources, publications, suppliers and membership information.

#### Graywater Systems, Compost Toilets & Rain Collection

[www.rmi.org/sitepages/pid287.php](http://www.rmi.org/sitepages/pid287.php)

This web resource from the Rocky Mountain Institute provides general information and links to resources on rain collection and graywater systems.

#### The Irrigation Association

[www.irrigation.org](http://www.irrigation.org)

This nonprofit organization focuses on promoting products that efficiently use water in irrigation applications.

#### Texas Evapotranspiration Network Website

<http://texaset.tamu.edu>

This website provides evapotranspiration data from the state of Texas with a discussion of crop water use and sprinkler efficiencies.

#### Texas Water Development Board Website

[www.twdb.state.tx.us](http://www.twdb.state.tx.us)

This website provides data from the state of Texas regarding water resources and services, such as groundwater mapping and water availability modeling. The site also provides published brochures regarding indoor and outdoor water efficiency strategies.

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### Water-Efficient Landscaping

<http://muextension.missouri.edu/xplor/agguides/hort/g06912.htm>

This website has general descriptions and strategies for water efficiency in gardens and landscapes.

### Water-Efficient Landscaping: Preventing Pollution and Using Resources Wisely

[www.epa.gov/owm/water-efficiency/final\\_final.pdf](http://www.epa.gov/owm/water-efficiency/final_final.pdf)

This manual from the Environmental Protection Agency provides information about reducing water consumption through creative landscaping techniques.

### Water Wiser: The Water Efficiency Clearinghouse

[www.awwa.org/waterwiser/](http://www.awwa.org/waterwiser/)

This clearinghouse provides articles, reference materials and papers on all forms of water efficiency.

### Print Media

*Landscape Irrigation: Design and Management* by Stephen W. Smith, John Wiley and Sons, 1996. This text is comprehensive guide to landscape irrigation strategies, techniques, and hardware.

*Turf Irrigation Manual*, Fifth Edition by Richard B. Choate and Jim Watkins, Telsco Industries, 1994. This manual covers all aspects of turf and landscape irrigation.

### Definitions

**Conventional Irrigation** refers to the most common irrigation system used in the region where the building is located. A common conventional irrigation system uses pressure to deliver water and distributes it through sprinkler heads above the ground.

**Drip Irrigation** is a high-efficiency irrigation method in which water is delivered

at low pressure through buried mains and sub-mains. From the sub-mains, water is distributed to the soil from a network of perforated tubes or emitters. Drip irrigation is a type of micro-irrigation.

**Graywater** is defined by the Uniform Plumbing Code (UPC) in its Appendix G, titled “Graywater Systems for Single-Family Dwellings,” as “untreated household wastewater which has not come into contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washer and laundry tubs. It shall not include wastewater from kitchen sinks or dishwashers.” The International Plumbing Code (IPC) defines graywater in its Appendix C, titled “Graywater Recycling Systems,” as “wastewater discharged from lavatories, bathtubs, showers, clothes washers, and laundry sinks.” Some states and local authorities allow kitchen sink wastewater to be included in graywater. Other differences with the UPC and IPC definitions can probably be found in state and local codes. Project teams should comply with graywater definitions as established by the authority having jurisdiction in their areas.

The **Landscape Area** of the site is equal to the total site area less the building footprint, paved surfaces, water bodies, patios, etc.

**Micro-irrigation** involves irrigation systems with small sprinklers and micro-jets or drippers designed to apply small volumes of water. The sprinklers and micro-jets are installed within a few centimeters of the ground, while drippers are laid on or below grade.

Potable Water is water suitable for drinking and supplied from wells or municipal water systems.

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## Case Study

### Abercorn Commons Savannah, Georgia

Abercorn Commons is a 177,000-sq.ft. all-retail core and shell project featuring renovation and over 70,000 sq.ft. of new construction. The project scope features a combination of boutique shops, big-box stores and restaurants, and encompasses a number of sustainable site attributes. The development decreased the amount of stormwater leaving the site by 25% due to an acre of porous pavement used in the parking. Storm drains are situated with the porous pavement fields, forcing water from impervious areas to sheet flow over the pervious pavement before reaching the storm drain. Abercorn Common also features a 500,000-gallon cistern that collects all rainwater from the roof. Rainwater is then stored and used to meet the irrigation needs of the landscaping. Native vegetation is located throughout the site, allowing water in these areas to infiltrate naturally and recharge local watersheds.

Alternative transportation features include the development location within a quarter-mile radius of three different bus lines, numerous bike racks throughout the site and locker-room/shower areas for tenant employees. A total of 35 preferred parking spaces are dedicated to hybrid vehicle parking. And, the project was able to obtain a variance to reduce the parking from the city requirement by 20%.



Photo courtesy of Jim Holmes

## Innovative Wastewater Technologies

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### Intent

Reduce generation of wastewater and potable water demand, while increasing the local aquifer recharge.

### Requirements

#### OPTION 1

Reduce potable water use for building sewage conveyance by 50% through the use of water-conserving fixtures (water closets, urinals) or non-potable water (captured rainwater, recycled graywater, and on-site or municipally treated wastewater).

OR

#### OPTION 2

Treat 50% of wastewater on-site to tertiary standards. Treated water must be infiltrated or used on-site.

### Potential Technologies & Strategies

Specify high-efficiency fixtures and dry fixtures such as composting toilet systems and non-water-consuming urinals to reduce wastewater volumes. Consider reusing stormwater or graywater for sewage conveyance or on-site wastewater treatment systems (mechanical and/or natural). Options for on-site wastewater treatment include packaged biological nutrient removal systems, constructed wetlands, and high-efficiency filtration systems.

1 Point

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## Summary of Referenced Standard

There is no standard referenced for this credit.

### Approach and Implementation

Potable water is used for many functions that do not require high-quality water such as toilet and urinal flushing, and landscape irrigation. Rainwater and graywater systems can significantly reduce potable water demand. Graywater systems reuse the wastewater collected from sinks, showers and other sources for the flushing of toilets, landscape irrigation, and other functions that do not require potable water. Graywater treatment may be required prior to reuse according to end use and state jurisdiction. If it is likely that a graywater system will be used in the future, install dual plumbing lines during the initial construction to avoid the substantial costs and difficulty in adding them later. Rainwater systems provide non-potable water suitable for landscape irrigation, flushing toilets and urinals, and process water needs. Rainwater systems have significantly fewer code requirements than graywater systems and are often less expensive than graywater systems. Rainwater from roofs or site can also be collected and harvested to help displace potable water demand. Rainwater collected from impervious surfaces reduces rainwater runoff and control infrastructure requirements. Rainwater retention or detention systems can be designed with cisterns to hold rainwater runoff for non-potable usage.

The necessity and availability of wastewater reuse and treatment strategies is heavily influenced by the project's size and location. Very large projects or campus settings may provide sufficient economic reason to warrant on-site wastewater treatment. Close proximity to a municipal or

private treatment facility can provide an opportunity to reuse treated wastewater to displace potable water demand. In remote locations, it may be more cost-effective to use an on-site wastewater treatment system than to extend existing infrastructure.

Conversely, a project located in a dense urban environment with little available site area may not be able to achieve this credit through development of on-site wastewater systems, graywater or rainwater systems, but may be able to utilize municipally provided recycled water to reduce potable water demand.

This credit has close ties to water efficiency efforts because a greater amount of potable water saved often results in less blackwater generated. For instance, water efficient water closets, urinals, showerheads and faucets not only reduce potable water demand but also reduce blackwater volumes created. Thus, performance results will often overlap with those of WE Credit 3.

Additional energy use may be needed for certain on-site treatment operations or for reuse strategies. These active systems also require commissioning and Measurement & Verification attention. Reuse of an existing building could hinder adoption of an on-site wastewater treatment facility.

When considering an on-site rainwater, graywater collection or blackwater treatment system it is important to first check with local government agencies for regulations governing the use of this water for irrigation and the permits required.

Each state has its own standards and requirements for the installation and operation of rainwater, graywater and water treatment systems. Texas and California, for example, have standards that encourage the use of graywater systems while other states have regulations that may limit or prohibit graywater use. In many areas, irrigation with graywater must be



subsurface, although some regions allow above-ground irrigation.

Projects that plan to treat wastewater on-site should consider a treatment system such as constructed wetlands, a mechanical recirculating sand filter, or anaerobic biological treatment reactor.

In the case of any specialized system, it is imperative that key maintenance staff be trained in the operations and maintenance of the water systems.

## Calculations

The following calculation methodology is used to support achievement of **Option 1**.

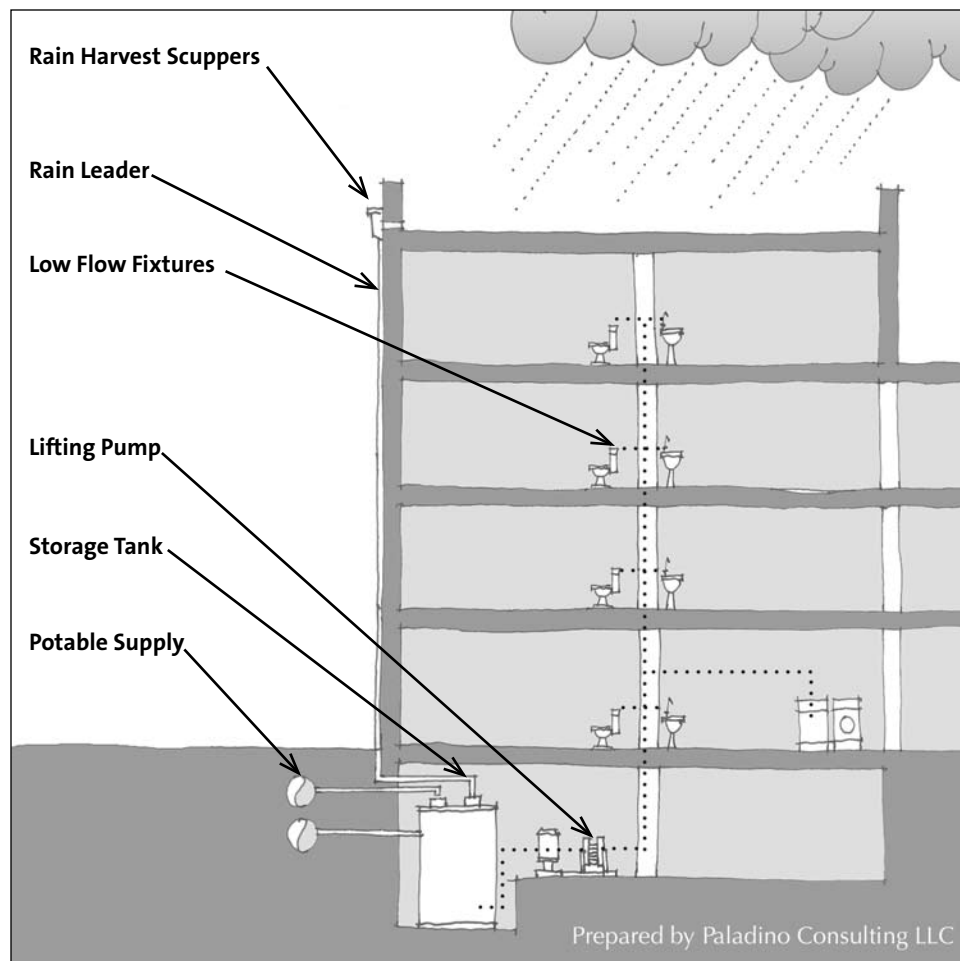
## Occupancy

Calculate the **Full-Time Equivalent (FTE)** building occupants based on a standard 8-hour occupancy period. An 8-hour occupant has an FTE value of 1.0 while a part-time occupant has an FTE value based on their hours per day divided by 8. (Note that FTE calculations for the project must be used consistently for all LEED-CS credits.) In buildings with multiple shifts, use the number of FTEs from all shifts, since this credit is based on annual water consumption.

Core and shell building projects may not have identified the final occupancy count. Projects that do not know the occupancy count must utilize the default occupancy

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**Figure 1:** An illustration of a Rain Harvesting System



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counts provided in Appendix 1 (see **Equation 2**). Projects that do know the tenant occupancy must use the tenant occupancy count as long as the gross square foot per employee is not greater than that in the default occupancy count table.

Estimate the **Transient** building occupants, such as visitors and customers. Since this credit is based on annual water consumption, use a transient occupancy number that is a representative daily average.

If the building has both FTE and Transient occupants, calculate the water use for each fixture separately for each occupancy type. This separation is necessary to represent the unique use patterns. For residential projects, the number of residents is used as the occupancy number.

**Note:** WE Credit 3, Table 2 provides default fixture use values for different occupancy types.

### Design Case

Wastewater calculations are based on the annual generation of blackwater volumes from plumbing fixtures such as water closets and urinals. The calculations compare the design case with a baseline case. The steps to calculate the design case are as follows:

1. Create a spreadsheet listing each type of blackwater-generating fixture and frequency-of-use data. Frequency-of-use data includes the number of

female and male daily uses, and the sewage generated per use. Use the daily use assumptions shown in **Table 1** as the basis for the calculations, unless alternate assumptions on daily use can be supported by specific back-up documentation. Using these values, calculate the total sewage generated for each fixture type and gender (see **Equation 1**).

2. Sum all of the sewage generation volumes used for each fixture type to obtain male and female daily sewage generation volumes.
3. Multiply the male and female sewage generation volumes by the number of male and female building occupants and sum these volumes to obtain the daily total sewage generation volume (see **Equation 2**).
4. Multiply the total daily sewage volume by the number of workdays in a typical year to obtain the total annual sewage generation volume for the building (see **Equation 3**).
5. If rainwater harvest or graywater reuse strategies are employed in the building, subtract these annual volumes from the annual sewage generation volume. The result shows how much potable water is used for sewage conveyance annually.

**Table 1** shows example potable water calculations for sewage conveyance for a two-story office building with a capacity

#### Equation 1

$$\text{Sewage Volume [gal]} = \text{Uses} \times \text{Duration [mins or flushes]} \times \frac{\text{Water Volume [gal]}}{\text{Use [min or flush]}}$$

#### Equation 2

$$\text{Daily Sewage Generation [gal]} = \text{Male Occupants} \times \text{Male Sewage Generation [gal]} + \text{Female Occupants} \times \text{Female Sewage Generation [gal]}$$

#### Equation 3

$$\text{Annual Sewage Generation [gal]} = \text{Total Sewage Generation} \left[ \frac{\text{gal}}{\text{day}} \right] \times \text{Workdays [days]}$$

Table 1: Design Case

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| Fixture Type                        | Daily Uses | Flowrate [GPF] | Occupants | Sewage Generation [gal] |
|-------------------------------------|------------|----------------|-----------|-------------------------|
| Low-Flow Water Closet (Male)        | 0          | 1.1            | 150       | 0                       |
| Low-Flow Water Closet (Female)      | 3          | 1.1            | 150       | 495                     |
| Composting Toilet (Male)            | 1          | 0.0            | 150       | 0                       |
| Composting Toilet (Female)          | 0          | 0.0            | 150       | 0                       |
| Waterless Urinal (Male)             | 2          | 0.0            | 150       | 0                       |
| Waterless Urinal (Female)           | 0          | 0.0            | 150       | 0                       |
| <b>Total Daily Volume [gal]</b>     |            |                |           | <b>495</b>              |
| Annual Work Days                    |            |                |           | 260                     |
| Annual Volume [gal]                 |            |                |           | 128,700                 |
| Rainwater or Graywater Volume [gal] |            |                |           | (36,000)                |
| <b>TOTAL ANNUAL VOLUME [gal]</b>    |            |                |           | <b>92,700</b>           |

of 300 occupants. The calculations are based on a typical 8-hour workday. It is assumed that building occupants are 50% male and 50% female. Male occupants are assumed to use water closets once and urinals twice in a typical work day. Female occupants are assumed to use water closets three times.

When using graywater and rainwater volumes, calculations are required to demonstrate that these reuse volumes are sufficient to meet water closet demands. These quantities are then subtracted from the gross daily total because they reduce potable water usage. In the example in **Table 1**, 36,000 gallons of rainwater are harvested and directed to water closets for flushing.

### Baseline Case

Repeat the above calculation methodology for the baseline case. Use Energy

Table 2: Baseline Case

| Fixture Type                     | Daily Uses | Flowrate [GPF] | Occupants | Sewage Generation [gal] |
|----------------------------------|------------|----------------|-----------|-------------------------|
| Water Closet (Male)              | 1          | 1.6            | 150       | 240                     |
| Water Closet (Female)            | 3          | 1.6            | 150       | 720                     |
| Urinal (Male)                    | 2          | 1.0            | 150       | 300                     |
| Urinal (Female)                  | 0          | 1.0            | 150       | 0                       |
| <b>Total Daily Volume [gal]</b>  |            |                |           | <b>1,260</b>            |
| Annual Work Days                 |            |                |           | 260                     |
| <b>TOTAL ANNUAL VOLUME [gal]</b> |            |                |           | <b>327,600</b>          |

Policy Act of 1992 (and as amended) fixture flow rates for the baseline case (see **WE Credit 3, Table 1**). Do not change the number of building occupants, the number of workdays, or the frequency data. Do not include graywater or rainwater harvest volumes.

**Table 2** provides a summary of baseline calculations. The baseline case estimates that 327,600 gallons of potable water per year are used for sewage conveyance.

Comparison of the baseline to the designed building indicates that a 72% reduction in potable water volumes used for sewage conveyance is realized ( $1 - 92,700/327,600$ ). Thus, this strategy earns one point for this credit. When developing the baseline, only the fixtures, sewage generation rates and the water reuse credit are different from the designed building. Usage rates, occupancy

and number of workdays are identical for the design case and the baseline case. See **Table 3** for sample fixture flow rates.

When reusing graywater volumes from the building, it is necessary to model the system on an annual basis to determine graywater volumes, generated storage capacity of the system and any necessary treatment processes before reusing the water volumes. Graywater volumes may or may not be consistently available throughout the year because these volumes are dependent on building occupant activities. For instance, in a typical office building, graywater volumes will change slightly due to vacation schedules and holidays but should be relatively consistent over the year.

In contrast, graywater volumes in a school building will substantially decrease in summer months due to the school calendar, and therefore, graywater volumes may not be available for irrigation.

If the project uses rainwater volume as a substitute for potable volumes in water closets or urinals, it is necessary to calculate water savings over a time period of one year. Rain harvest volume depends on the amount of precipitation that the project

site experiences, the rainwater collection surface's area and efficiency, and storage tank capacity. See **Equation 4** and consult a rainwater harvesting guide for more detailed instruction. Rainfall data is available from the local weather service (see the Resources section). Rainwater volume depends on variations in precipitation, and thus, it is necessary to model the reuse strategy on an annual basis. A model of rainwater capture based on daily precipitation and occupant demand is helpful to determine the rainwater volumes captured and storage tank size. Subtract annual rainwater use for sewage conveyance in the design case calculations.

The following calculation methodology is used to support achievement of **Option 2**.

1. Create a spreadsheet listing each type of blackwater-generating fixture and frequency-of-use data. Frequency-of-use data includes the number of female and male daily uses, and the sewage generated per use. Use the daily use assumptions shown in **Table 1** as the basis for the calculations, unless alternate assumptions on daily use can be supported by specific back-up

**Table 3:** Sample Fixture Flow Rates

| Flush Fixture Type  | Water Use [gpf]  |
|---|------------------|
| Conventional Low-Flow Toilet (Water Closet)   | 1.6              |
| High-Efficiency Toilet (Water Closet)   | Below 1.3*       |
| Dual-Flush Toilet   | 0.8 to 1.1/1.6** |
| Composting Toilet   | 0.0              |
| Conventional Low-Flow Urinal  | 1.0              |
| High-Efficiency Urinal  | 0.5 or below***  |
| Non-Water Consuming Urinal  | 0.0***           |
| *High-efficiency toilets (HETs) include dual-flush toilets, 1.0-gpf pressure-assist toilets, and 1.28-gpf gravity-fed single-flush toilets.   |                  |
| ** Dual flush toilets have an option of full flush (1.6 gal) or liquid-only flush (ranges between 0.8 gpf and 1.1 gpf, depend upon design). When calculating water use reductions from installation of these fixtures, use a composite (average) flush volume of 1.2 gal. |                  |
| ***High-efficiency urinals are currently available at 0.5 gpf and 0.0 gpf. Urinals at 0.25 gpf will be available in 2005.   |                  |

**Equation 4**

$$\text{Rainwater Volume [gal]} = \text{collection area [sf]} \times \text{collection efficiency [\%]} \times \text{average rainfall [in]} \times 0.6233 \text{ gal/sf/in}$$

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documentation. Using these values, calculate the total sewage generated for each fixture type and gender (see **Equation 1**).

2. Sum all of the sewage generation volumes used for each fixture type to obtain male and female daily sewage generation volumes.
3. Multiply the male and female sewage generation volumes by the number of male and female building occupants and sum these volumes to obtain the daily total sewage generation volume (see **Equation 2**).
4. Multiply the total daily sewage volume by the number of workdays in a typical year to obtain the total annual sewage generation volume for the building (see **Equation 3**).
5. Divide the annual volume of wastewater that is treated and reused and/or infiltrated on site by the calculated annual sewage generation volume for the building to determine the percent reduction of wastewater that is released into the municipal sewer system.

### Exemplary Performance

Projects that demonstrate a 100% reduction in potable water use for sewage conveyance, OR, on-site treatment and re-use/infiltration of 100% of generated wastewater will be considered for one additional point under the Innovation in Design category.

### Precertification Submittal Documentation

Provide the LEED-CS Precertification Submittal Templates, which include the following:

- Narrative describing how the project intends to accomplish the credit requirements on the credit specific Submittal Template signed by the appropriate design team member

- Confirmation of this intent from the owner/developer on the LEED-CS Precertification Submittal Template

### Certification Submittal Documentation

#### Design and Construction Credit Compliance

This credit is submitted in the **Design Submittal**.

The following project data and calculation information is required to document credit compliance using the LEED-CS v2.0 Submittal Templates:

- Upload the applicable plumbing drawings from the construction documents that provide data regarding any on-site wastewater treatment facilities.
- The project's calculated occupants. The template will use a default one-to-one men to women ratio. Projects with special occupancy situations that result in an unbalanced ratio may enter project specific data for this credit.
- The project's calculated baseline water usage for sewage conveyance. This data is calculated using typical fixture types (provided in the template) and the project's mix of occupants.
- The project's calculated design case water usage for sewage conveyance. This data is calculated using project specified fixture types and the project's mix of occupants. Note: project teams must provide the following fixture information for each typical installed flush fixture type: fixture manufacturer, fixture model, flush rate in gallons per flush (gpf).
- For projects using non-potable water for sewage conveyance, provide the total non-potable water supply (gal) available for sewage conveyance purposes.
- For projects treating wastewater on-site, provide the annual quantity (gal)

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of water treated, the annual quantity (gal) of treated water that is infiltrated, and the annual quantity (gal) of treated water that is re-used on-site.

- ❑ Narrative describing the potable water reduction strategies employed by the project. For projects using non-potable water, include specific information regarding any reclaimed water usage (graywater reuse/rainwater reuse/on-site or municipally treated wastewater). If the project is treating wastewater on-site to tertiary standards, include specific information regarding the use(s) of the treated wastewater.

### Tenant Sales or Lease Agreement Credit Compliance

This compliance method is available to core and shell projects that incorporate requirements into tenant sales or lease agreements for the use of water conserving fixtures or non-potable water as part of the tenant scope of work. Provide the LEED letter template for the credit pursued indicating the following:

- ❑ That 100% of leased square footage complies with credit requirements. Lease or sales agreements may be requested.
- ❑ That 100% of the unleased square footage shall comply with the credit requirements when leased. A statement signed by the owner/developer that all leases and/or sales agreements will comply may be requested.
- ❑ The project's calculated occupants. The template will use a default one-to-one men to women ratio. Projects with special occupancy situations that result in an unbalanced ratio may enter project specific data for this credit.
- ❑ The project's calculated baseline water usage for sewage conveyance. This data is calculated using typical fixture types (provided in the template) and the project's mix of occupants.

- ❑ The project's calculated design case water usage for sewage conveyance. This data is calculated using fixture performance specified in the tenant sales or lease agreement and the project's mix of occupants. Note: project teams must provide the flush rate in gallons per flush (gpf) for each flush fixture type.

## Considerations

### Cost Issues

Commercial and industrial facilities that generate large amounts of wastewater can realize considerable savings by recycling graywater. For example, car washes and truck maintenance facilities generate large volumes of graywater that can be effectively treated and reused. Often, a separate tank, filter and special emitters are necessary for a graywater irrigation system. Dual sanitary and graywater distribution piping doubles construction piping costs. In addition, local codes requiring filtration, disinfection treatment, overflow protection, etc., add to the cost of construction, operation, and maintenance; all of which should be considered by the owner when making a decision to collect graywater. Collection and use of rainwater for non-potable water applications has significantly fewer code requirements and associated costs. The highest cost in most rainwater systems is for water storage. Storage tanks and cisterns come in a variety of sizes and materials. Designers can lower construction costs by finding synergies such as adding a cistern to collect rainwater to a stormwater detention system. In some systems, pumps are required for distribution, incurring additional energy costs required for operation.

Water recovery systems are most cost-effective in areas where there is no municipal water supply, where the developed wells are unreliable, or if well water requires

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treatment. Collecting and using rainwater or other site water volumes reduces site runoff and the need for runoff devices. It also minimizes the need for utility-provided water, thus reducing some initial and operating costs. In some areas with a decentralized population, collection of rainwater offers a low-cost alternative to a central piped water supply.

A constructed wetland for wastewater treatment can add value to a development as a site enhancement. Wetlands are beneficial because they provide flood protection and stabilize soils on site. Currently, packaged biological wastewater systems have an initial high cost, relative to the overall building cost, due to the novelty of the technology.

### Environmental Issues

On-site wastewater treatment systems transform perceived “wastes” into resources that can be used on the building site. These resources include treated water volumes for potable and non-potable use, as well as nutrients that can be applied to the site to improve soil conditions. Reducing wastewater treatment at the local wastewater treatment works minimizes public infrastructure, energy use and chemical use. In rural areas, on-site wastewater treatment systems avoid aquifer contamination problems prevalent in current septic system technology.

By reducing potable water use, the local aquifer is conserved as a water resource for future generations. In areas where aquifers cannot meet the needs of the population economically, rainwater and other recovered water is the least expensive alternative source of water.

### Economic Issues

Wastewater treatment systems and water recovery systems involve an initial capital investment in addition to the maintenance requirements over the building’s lifetime. These costs must balance with

the anticipated savings in water and sewer bills. This savings can minimize the amount of potable water that a municipality must provide, thereby leading to more stable water rates and resources needed for economic growth.

### Regional Issues

Local precipitation throughout the year should be factored into determining the feasibility of rainwater harvesting systems for use in the reduction of potable water for plumbing fixture flushing and landscape irrigation. Local building and health codes/ordinances vary with regards to allowance of graywater or harvested rainwater systems; and they are prohibited in some states. Additionally, codes differ in how alternative plumbing fixtures, such as dual-flush water closets, composting toilets and non-water using urinals are handled. It is critical to confirm acceptability of non-traditional approaches with code officials prior to commitment to specific water saving strategies.

Supply water quality from graywater and recycled water systems should also be considered in fixture selection. Project teams should identify if minimum supply water quality standards have been established for specific fixtures by manufacturers. When recycled graywater or collected rainwater is used with plumbing fixtures designed for use with municipally supplied potable water, it is good practice to verify that supply water quality is acceptable and will not compromise long-term fixture performance.

### Resources

Please see the USGBC website at [www.usgbc.org/resources](http://www.usgbc.org/resources) for more specific resources on materials sources and other technical information.

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## Websites

### American Rainwater Catchment Systems Association

[www.arcsa-usa.org](http://www.arcsa-usa.org)

Includes a compilation of publications, such as the Texas Guide to Rainwater Harvesting.

### Constructed Wetlands for Wastewater Treatment and Wildlife Habitat: 17 Case Studies

#### U.S. EPA

EPA Publication No. 832/B-93-005, 1993.

[www.epa.gov/owow/wetlands/construct/](http://www.epa.gov/owow/wetlands/construct/)

The case studies in this document provide brief descriptions of 17 wetland treatment systems that provide water quality benefits while also providing habitat. The projects described include systems involving constructed and natural wetlands, habitat creation and restoration, and the improvement of municipal effluent, urban stormwater and river water quality.

### On-site Wastewater Treatment Systems Manual

#### U.S. EPA

[www.epa.gov/owm/septic/pubs/septic\\_2002\\_osdm\\_all.pdf](http://www.epa.gov/owm/septic/pubs/septic_2002_osdm_all.pdf)

This manual provides a focused and performance-based approach to on-site wastewater treatment and system management, including information on a variety of on-site sewage treatment options.

## Print Media

*Mechanical & Electrical Equipment for Buildings*, Eighth Edition by Benjamin Stein and John Reynolds, John Wiley and Sons, 1992.

*Sustainable Building Technical Manual*, Public Technology, Inc., 1996. ([www.pti.org](http://www.pti.org))

## Definitions

**Aquatic Systems** are ecologically designed treatment systems that utilize a diverse community of biological organisms (e.g., bacteria, plants and fish) to treat wastewater to advanced levels.

**Blackwater** does not have a single definition that is accepted nationwide. Wastewater from toilets and urinals is, however, always considered blackwater.

**Wastewater** from kitchen sinks (perhaps differentiated by the use of a garbage disposal), showers or bathtubs may be considered blackwater by state or local codes. Project teams should comply with the blackwater definition as established by the authority having jurisdiction in their areas.

**Composting Toilet Systems** are dry plumbing fixtures that contain and treat human waste via microbiological processes.

**Graywater** (also spelled greywater and gray water) is defined by the Uniform Plumbing Code (UPC) in its Appendix G, titled “Gray water Systems for Single-Family Dwellings,” as “untreated household wastewater which has not come into contact with toilet waste. Grey water includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washer and laundry tubs. It shall not include wastewater from kitchen sinks or dishwashers.”

The International Plumbing Code (IPC) defines graywater in its Appendix C, titled “Graywater Recycling Systems,” as “wastewater discharged from lavatories, bathtubs, showers, clothes washers, and laundry sinks.”

Some states and local authorities allow kitchen sink wastewater to be included in graywater. Other differences with the UPC and IPC definitions may be found in state and local codes. Project teams should comply with the graywater



definitions as established by the authority having jurisdiction in their areas.

**Non-potable Water** is water that is not suitable for human consumption without treatment that meets or exceeds EPA drinking water standards.

**Non-Water-Consuming Urinal (also know as a dry urinal)** is a urinal that uses no water, but instead replaces the water flush with a specially designed trap that contains a layer of buoyant liquid that floats above the urine layer, blocking sewer gas and urine odors from the room. Other non-water technologies are also available for urinals.

**On-site Wastewater Treatment** uses localized treatment systems to transport, store, treat and dispose of wastewater volumes generated on the project site.

**Potable Water** is water that is suitable for drinking and is supplied from wells or municipal water systems.

**Process Water** is water used for industrial processes and building systems such as cooling towers, boilers and chillers.

**Tertiary Treatment** is the highest form of wastewater treatment that includes the removal of nutrients, organic and solid material, along with biological or chemical polishing (generally to effluent limits of 10 mg/L BOD5 and 10 mg/L TSS).

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| Credit 3.1 |           |    |    |    |    |

## Water Use Reduction

### 20% Reduction

#### Intent

Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

#### Requirements

Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 (and as amended) fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.

#### Potential Technologies & Strategies

Use high-efficiency fixtures, including dry fixtures such as composting toilet systems and non-water-consuming urinals, to reduce the potable water demand. Consider reuse of stormwater and treated graywater for non-potable applications such as toilet and urinal flushing, landscape irrigation, clothes washing, and custodial uses.

1 Point

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1 Point  
in addition to  
We Credit 3.1

## Water Use Reduction

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### 30% Reduction

#### Intent

Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.

#### Requirements

Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting the Energy Policy Act of 1992 (and as amended) fixture performance requirements. Calculations are based on estimated occupant usage and shall include only the following fixtures (as applicable to the building): water closets, urinals, lavatory faucets, showers and kitchen sinks.

#### Potential Technologies & Strategies

Use high-efficiency fixtures, including dry fixtures such as composting toilets and non- water-consuming urinals, to reduce the potable water demand. Consider reuse of stormwater and treated graywater for non-potable applications such as toilet and urinal flushing, landscape irrigation, clothes washing, mechanical systems, and custodial uses.

## Summary of Referenced Standard

The Energy Policy Act (EPAcT) of 1992 (and as amended)

This Act was promulgated by the U.S. government and addresses energy and water use in commercial, institutional and residential facilities. The water usage requirements of the Energy Policy Act of 1992 (and as amended) are provided in **Table 1**.

## Approach and Implementation

Water use strategies depend on the site location and site design. Project sites with no access to municipal potable water service typically use groundwater wells to satisfy potable water demands. Site locations with significant precipitation volumes may determine that reuse of these volumes is more cost-effective than creating stormwater treatment facilities. Potable water use is significant for irrigation applications and is directly correlated with the amount of wastewater generated on-site.

Some water-saving technologies impact energy performance and require commissioning and Measurement & Verification (M&V) attention. Reuse of existing buildings may hinder water efficiency measures due to space constraints or characteristics of existing plumbing fixtures.

While graywater collection and storage may not be a water reduction method that many owners and designers have the opportunity to include in their projects, high-efficiency plumbing fixtures are. Early planning should focus on the code related issues (both plumbing code and health and safety code) associated with installation and use of water harvesting and collection systems, graywater recycling systems, and high-performance plumbing fixtures such as non-water-consuming urinals.

Effective methods to reduce potable water use include: reuse of roof runoff or collected graywater volumes for non-potable applications; installation and maintenance of fixture metering controls; installation of flow restrictors and/or reduced flow aerators on lavatory, sink, and shower fixtures; installation of high-efficiency toilets (HETs) such as dual-flush water closets and high-efficiency urinals (HEUs) such as 0.5-gallon, 0.2-gallon and non-water-consuming urinals; installation of dry fixtures such as composting toilet systems and non-water-consuming urinals.

Although water efficient dishwashers, clothes washers and other water consuming fixtures are not counted in the calculations for this credit they may be included in exemplary performance calculations. (See Exemplary Performance for this credit) A variety of high-efficiency plumbing fixtures and appliances are currently available in the marketplace and

**Table 1:** Energy Policy Act of 1992 (and as amended) Standards for Plumbing Fixture Water Usage

| Fixture                             | Energy Policy Act of 1992 (and as amended) Standards for Plumbing Fixture Water Usage |
|-------------------------------------|---|
| Water Closets [gpf]                 | 1.60  |
| Urinals [gpf]                       | 1.00  |
| Showerheads [gpm]*                  | 2.50  |
| Faucets [gpm]**                     | 2.20  |
| Faucet Replacement Aerators [gpm]** | 2.20  |
| Metering Faucets [gal/cy]           | 0.25  |

\*When measured at a flowing water pressure of 80 pounds per square inch (PSI)

\*\*When measured at a flowing water pressure of 60 pounds per square inch (PSI)

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can be installed in the same manner as conventional EPAAct fixtures and non-efficient appliances.

To determine the most effective strategies for a particular condition, the project team should analyze the water conservation options available to the project based on location, code compliance (plumbing and life safety) and overall project function. Using the EPAAct numbers as a baseline for plumbing fixtures, estimate the potable water needs for the project based on estimated occupant uses. Determine areas of high water usage and evaluate potential alternative water saving technologies. Using the same calculation method, examine the impacts of alternative fixture types and technologies. Compare the design case water usage to the calculated EPAAct baseline to determine the optimal water savings for the project for plumbing fixtures.

In order to ensure continued water savings and owner/occupant satisfaction, it is imperative that key maintenance staff is trained in the operations and maintenance of any specialized equipment. For example, non-water-consuming urinals generally need to be cleaned according to manufacturer's specifications and their chemical traps appropriately maintained. Similarly, other HEUs, such as 0.5-gallon and 0.2-gallon flushing urinals, must likewise be maintained according to manufacturer's specifications.

### Calculations

The following section describes the calculation methodology for determining water use savings under this credit. The calculated water use reduction for the project is the difference between the calculated design case and a baseline case. The credit percentage is determined by dividing the design case usage by the baseline usage.

The methodology differs from traditional plumbing design where the calculations

are based on fixture counts; under this credit, the water use calculation is based on estimated occupant usage and fixture flow rates. Estimated occupant usage is determined by calculating Full-Time Equivalent (FTE) and transient occupants and applying appropriate fixture use rates to each type of occupant.

### Occupancy

Calculate the **Full-Time Equivalent (FTE)** building occupants based on a standard 8-hour occupancy period. An 8-hour occupant has an FTE value of 1.0 while a part-time occupant has an FTE value based on their hours per day divided by 8. (Note that FTE calculations for the project must be used consistently for all LEED-CS credits.) In buildings with multiple shifts, use the number of FTEs from all shifts, since this credit is based on annual water consumption.

Core and shell building projects may not have identified the final occupancy count. Projects that do not know the occupancy count must utilize the default occupancy counts provided in Appendix 1 (see **Equation 2**). Projects that do know the tenant occupancy must use the tenant occupancy count as long as the gross square foot per employee is not greater than that in the default occupancy count table.

Estimate the **Transient** building occupants, such as visitors and customers. Since this credit is based on annual water consumption, use a transient occupancy number that is a representative daily average.

If the building has both FTE and Transient occupants, calculate the water use for each fixture separately for each occupancy type. This separation is necessary to represent the unique use patterns. For residential projects, the number of residents is used as the occupancy number.

**Table 2** provides default fixture use values for different occupancy types. These values should be used in the calculations for this credit unless special circumstances exist

**Table 2:** Standard Fixture Uses by Occupancy Type

|   |        |     |     |     |     |
|---|--------|-----|-----|-----|-----|
| <b>Water Closet</b>   |        |     |     |     |     |
|   | female | 3   | 0.5 | 0.2 | 5   |
|   | male   | 1   | 0.1 | 0.1 | 5   |
| <b>Urinal</b>   |        |     |     |     |     |
|   | female | 0   | 0   | 0   | n/a |
|   | male   | 2   | 0.4 | 0.1 | n/a |
| <b>Lavatory Faucet</b><br>(duration 15 sec;<br>12 sec with autocontrol) |        |     |     |     |     |
|   |        | 3   | 0.5 | 0.2 | 5   |
| <b>Shower</b><br>(duration 300 sec)                                     |        |     |     |     |     |
|   |        | 0.1 | 0   | 0   | 1   |
| <b>Kitchen Sink, non-residential</b><br>(duration 15 sec)               |        |     |     |     |     |
|   |        | 1   | 0   | 0   | n/a |
| <b>Kitchen Sink, residential</b><br>(duration 60 sec)                   |        |     |     |     |     |
|   |        | n/a | n/a | n/a | 4   |

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within the project to require modification. The FTE uses are identical to those used in LEED-NC v2.1 and v2.2. The uses for the other occupancy types are provided as compromise default values based on v2.1 projects. Note that most buildings with Student/Visitor and Retail Customer occupants will also have FTE occupants. The Student/Visitor category is intended for college buildings, libraries, museums, and similar building types. 50% of all Student/Visitor occupants are assumed to use a flush fixture and a lavatory faucet in the building and are not expected to use a shower or kitchen sink. 20% of Retail Customer occupants are assumed to use a flush and a flow fixture in the building and no shower or kitchen sink. The default for Residential occupants is 5 uses per day of flush and flow fixtures, 1 shower, and 4 kitchen sink uses.

For consistency across LEED projects, the calculations require the use of a balanced, one-to-one gender ratio unless specific project conditions warrant an alternative. For these special situations, the project team will need to provide a narrative description to explain the unique circumstances.

The total fixture uses by all occupants must be consistent in the design and baseline cases.

### Design Case

The design case annual water use is determined by totaling the annual volume of each fixture type and subtracting any reuse of stormwater/graywater. The design case must use the actual flow rates and flush volumes for installed fixtures. The flow and flush data should be obtained from manufacturer's published product literature.

In addition to the typical fixtures shown on the flush and flow fixture charts (**Table 3 and Table 4 respectively**), the project team may add others, as applicable.

**Table 5** provides an example design case water use calculation. Note that flush fixtures, which include water closets and urinals, differentiate between females and males. The calculation should ensure that both the male and female occupants are appropriately represented. Zeros may be used when appropriate.

Where on-site collected graywater or rainwater is used for sewage conveyance, the project team should enter the estimated quantity in the calculation. The total annual graywater quantity is subtracted from the total annual design case water usage.

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**Table 3:** Sample Flush Fixture Types

| Flush Fixture Type                          | Water Use [gpf]  |
|---|------------------|
| Conventional Low-Flow Toilet (Water Closet) | 1.6              |
| High-Efficiency Toilet (Water Closet)       | Below 1.3*       |
| Dual-Flush Toilet                           | 0.8 to 1.1/1.6** |
| Composting Toilet                           | 0.0              |
| Conventional Low-Flow Urinal                | 1.0              |
| High-Efficiency Urinal                      | 0.5 or below***  |
| Non-Water Consuming Urinal                  | 0.0***           |

\*High-efficiency toilets (HETs) include dual-flush toilets, 1.0-gpf pressure-assist toilets, and 1.28-gpf gravity-fed single-flush toilets.

\*\* Dual flush toilets have an option of full flush (1.6 gal) or liquid-only flush (ranges between 0.8 gpf and 1.1 gpf, depend upon design). When calculating water use reductions from installation of these fixtures, use a composite (average) flush volume of 1.2 gal.

\*\*\*High-efficiency urinals are currently available at 0.5 gpf and 0.0 gpf. Urinals at 0.25 gpf will be available in 2005.

**Table 4:** Sample flow Fixture Types

| Flow Fixture Type                         | Water Use [gpm]           |
|---|---------------------------|
| Conventional Low-Flow Lavatory Faucet     | 2.2                       |
| High-Efficiency Lavatory Faucet           | 1.8                       |
| Conventional Low-Flow Kitchen Sink Faucet | 2.2                       |
| High-Efficiency Kitchen Sink Faucet       | 1.8                       |
| Conventional Low-Flow Showerhead          | 2.5                       |
| High-Efficiency Showerhead                | 2.0 and below             |
| Low-Flow Janitor Sink Faucet              | 2.5                       |
| Low-Flow Hand Wash Fountain               | 0.5                       |
| Conventional Low Flow Self Closing Faucet | 0.25 gals./cycle          |
| High Efficiency Self Closing Faucet       | 0.2 gals./cycle and below |

### Baseline Case

The baseline case annual water use is determined by duplicating the Design Case table and then setting the fixture flush rates and flow rates to the EPAAct default values (as opposed to actual installed values in the Design Case). **Table 6** provides an example baseline case water use calculation, based on the Design Case presented in **Table 5**.

### Eligible Fixtures

This credit is limited to savings generated by water using fixtures regulated by the Energy Policy Act of 1992 (and as amended). EPAAct covers the following fixture types: lavatories, kitchen sinks, showers, hand wash fountains, janitor sinks, water closets and urinals. Project teams are encouraged to apply for Innovation

in Design credits for water use reduction in non-EPAAct regulated and process water consuming fixtures. Examples of non-regulated and process water use include but are not limited to dishwashers, clothes washers and cooling towers.

### Exemplary Performance

In addition to earning WE Credits 3.1 and 3.2, project teams that achieve a projected water savings of 40% are eligible for an exemplary performance ID credit.

Project teams may also achieve an ID credit for demonstrating potable water use reduction in process and non-regulated water consuming fixtures. The calculation methodology for demonstrating process and non-regulated water savings is similar to the calculation outlined above for



regulated water use. Project teams define reasonable usage assumptions and calculate design and baseline water consumption based on high efficiency and standard water use fixtures. Process and non-regulated water use savings is then compared

to regulated water use. If the process and non-regulated water use savings is at least 10% of the total design regulated water use, the project team is eligible for an Innovation in Design point.

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**Table 5:** Sample Design Case Water Use Calculations

| Flush Fixture                             | Daily Uses | Flow Rate [GFP] | Duration [flush] | Occupants | Water Use [gal] |
|---|------------|-----------------|------------------|-----------|-----------------|
| Dual Flush Toilet (Male)                  | 0          | 1.2             | 1                | 150       | 0               |
| Dual Flush Toilet (Female)                | 3          | 1.2             | 1                | 150       | 540             |
| Composting Toilet (Male)                  | 1          | 0.0             | 1                | 150       | 0               |
| Composting Toilet (Female)                | 0          | 0.0             | 1                | 150       | 0               |
| Non-Water Consuming Urinal (Male)         | 2          | 0.0             | 1                | 150       | 0               |
| Non-Water Consuming Urinal (Female)       | 2          | 0.0             | 1                | 150       | 0               |
|   |            |                 |                  |           |                 |
| Flow Fixture                              | Daily Uses | Flow Rate [GFM] | Duration [sec]   | Occupants | Water Use [gal] |
| Conventional Low-Flow Lavatory Faucet     | 3          | 2.2             | 12               | 300       | 396             |
| Conventional Low-Flow Kitchen Sink Faucet | 1          | 2.2             | 12               | 300       | 132             |
| Conventional Low-Flow Showerhead          | 0.1        | 2.5             | 300              | 300       | 375             |
| Total Daily Volume [gal]                  |            |                 |                  |           | 1443            |
| Annual Work Days                          |            |                 |                  |           | 260             |
| Annual Volume [gal]                       |            |                 |                  |           | 375,180         |
| Graywater Reuse Volume [gal]              |            |                 |                  |           | (36,000)        |
| <b>TOTAL ANNUAL VOLUME</b>                |            |                 |                  |           | <b>339,180</b>  |

**Table 6:** Sample Baseline Case Water Use Calculations

| Flush Fixture                                | Daily Uses | Flow Rate [GFP] | Duration [flush] | Occupants | Water Use [gal] |
|--|------------|-----------------|------------------|-----------|-----------------|
| Conventional Low-Flow Toilet (Male)          | 1          | 1.6             | 1                | 150       | 240             |
| Conventional Low-Flow Toilet Toilet (Female) | 3          | 1.6             | 1                | 150       | 720             |
| Conventional Low-Flow Urinal (Male)          | 2          | 1.0             | 1                | 150       | 300             |
| Conventional Low-Flow Urinal (Female)        | 2          | 1.0             | 1                | 150       | 0               |
|  |            |                 |                  |           |                 |
| Flow Fixture                                 | Daily Uses | Flow Rate [GFM] | Duration [sec]   | Occupants | Water Use [gal] |
| Conventional Low-Flow Lavatory Faucet        | 3          | 2.2             | 15               | 300       | 495             |
| Conventional Low-Flow Kitchen Sink Faucet    | 1          | 2.2             | 15               | 300       | 165             |
| Conventional Low-Flow Showerhead             | 0.1        | 2.5             | 300              | 300       | 375             |
| Total Daily Volume [gal]                     |            |                 |                  |           | 2295            |
| Annual Work Days                             |            |                 |                  |           | 260             |
| <b>TOTAL ANNUAL VOLUME</b>                   |            |                 |                  |           | <b>596,700</b>  |

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## Precertification Submittal Documentation

Provide the LEED-CS Precertification Submittal Templates, which include the following:

- Narrative describing how the project intends to accomplish the credit requirements on the credit specific Submittal Template signed by the appropriate design team member
- Confirmation of this intent from the owner/developer on the LEED-CS Precertification Submittal Template

## Certification Submittal Documentation

### Design and Construction Credit Compliance

This credit is submitted as part of the **Design Submittal**.

The following project data and calculation information is required to document credit compliance using the LEED-CS v2.0 Submittal Templates:

- The project's calculated occupant(s). The template will use a default one-to-one men to women ratio. Projects with special occupancy situations that result in an unbalanced ratio may enter project specific data for this credit.
- The project's calculated design case water usage (flush and flow fixtures.) This data is calculated using project specified fixture types and the project's mix of occupants. Note: project teams must provide the following fixture information for each typical installed flush fixture type: fixture manufacturer, fixture model, rated flush rate in gallons per flush (gpf) or flow rate in gallons per minute (gpm).
- The project's calculated baseline water usage (flush and flow fixtures.) This data is calculated using typical fixture

types (provided in the template) and the project's mix of occupants.

- For projects using non-potable water for sewage conveyance, provide the total non-potable water supply (gal) available for sewage conveyance purposes.
- Narrative describing the potable water reduction strategies employed by the project. For projects using non-potable water, include specific information regarding any reclaimed water usage (graywater reuse/rainwater reuse/on-site treated wastewater).

### Tenant Sales or Lease Agreement Credit Compliance

This compliance method is available to core and shell projects that incorporate requirements into tenant sales or lease agreements for the installation of water reducing fixtures as part of the tenant scope of work. Provide the LEED letter template for the credit pursued indicating the following:

- That 100% of leased square footage complies with credit requirements. Lease or sales agreements may be requested.
- That 100% of the unleased square footage shall comply with the credit requirements when leased. A statement signed by the owner/developer that all leases and/or sales agreements will comply may be requested.
- The project's calculated occupant(s). The template will use a default one-to-one men to women ratio. Projects with special occupancy situations that result in an unbalanced ratio may enter project specific data for this credit.
- The project's calculated design case water usage (flush and flow fixtures.) This data is calculated using fixture performance specified in the tenant sales or lease agreement and the project's mix of occupants. Note: project teams must

provide the flow rates required in gallons per minute (gpm).

- The project's calculated baseline water usage (flush and flow fixtures.) This data is calculated using typical fixture types (provided in the template) and the project's mix of occupants.

## Considerations

### Cost Issues

Water-efficient fixtures that use less water than requirements in the Energy Policy Act of 1992 (and as amended) may have higher initial costs, although such fixtures as high-efficiency toilets generally do not. Additionally, there may be a longer lead time for delivery because of their limited availability. However, installation of water-efficient fixtures and equipment can result in significant, long-term financial and environmental savings.

For example, the first cost of non-water-consuming urinals is marginally higher than conventional urinals and additional training of maintenance personnel is required to ensure that O&M staff follow the specific cleaning and maintenance procedures. Minor construction savings may be realized by eliminating the urinal water supply piping. Significant long-term operational savings can occur as a result of reduced sewage generation and elimination of potable water use. Significant additional operational costs may occur as a result of maintenance requirements, including maintenance supplies such as cartridge components, and cleaning and sealing fluids. A full benefit/cost life-cycle study should be undertaken before recommending such products.

### Environmental Issues

The reduction of potable water use in buildings for toilets, showerheads and faucets reduces the total amount withdrawn from rivers, streams, underground aquifers and other water bodies. Another

benefit of potable water conservation is reduced energy use and chemical inputs at municipal water treatment works.

Water use reductions, in aggregate, allow municipalities to reduce or defer the capital investment needed for water supply and wastewater treatment infrastructure. These strategies protect the natural water cycle and save water resources for future generations.

### Economic Issues

Reductions in water consumption minimize overall building operating costs. In certain cases, these benefits may be partially or fully offset by increased operating costs associated with maintenance. Reductions can also lead to more stable municipal taxes and water rates. By reducing water use and resultant disposal to the sewer, water treatment facilities can delay expansion and maintain stable wastewater treatment prices.

Accelerated replacements of conventional non-efficient plumbing fixtures with high-efficiency fixtures through incentive programs has become a cost-effective way for some water and wastewater utilities to defer, reduce or avoid capital investments associated with water supply and wastewater facilities expansion.

### Regional Issues

Local weather conditions should be factored into determining the feasibility of rainwater harvesting systems for use in reduction of potable water for flushing. Local building and health and safety codes/ordinances vary with regards to allowance of graywater or harvested rainwater for use in sewage conveyance. Additionally, codes differ in how alternative plumbing fixtures, such as composting toilets and non-water-consuming urinals are handled. It is critical to confirm acceptability of non-traditional approaches with code officials prior to commitment to specific water saving strategies.

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Supply water quality from graywater and recycled water systems should also be considered in fixture selection. Project teams should identify if minimum supply water quality standards have been established for specific fixtures by manufacturers. When recycled graywater or collected rainwater is used with plumbing fixtures designed for use with municipally supplied potable water, it is good practice to verify that supply water quality is acceptable and will not compromise long-term fixture performance or void product warranties.

## Resources

### Websites

Please see the USGBC website at [www.usgbc.org/resources](http://www.usgbc.org/resources) for more specific resources on materials sources and other technical information.

#### American Rainwater Catchment Systems Association

[www.arcsa-usa.org](http://www.arcsa-usa.org)

Includes a compilation of publications, such as the Texas Guide to Rainwater Harvesting.

#### Choosing a Toilet

[www.taunton.com/finehomebuilding/pages/h00042.asp](http://www.taunton.com/finehomebuilding/pages/h00042.asp)

An article in Fine Homebuilding that includes several varieties of water efficient toilets.

#### Composting Toilet Reviews

[www.buildinggreen.com/features/mr/waste.html](http://www.buildinggreen.com/features/mr/waste.html)

(802) 257-7300

An Environmental Building News article on commercial composting toilets.

#### National Climatic Data Center

[www.ncdc.noaa.gov/oa/climate/aasc.html](http://www.ncdc.noaa.gov/oa/climate/aasc.html)

Useful site for researching local climate data, such as rainfall data for rainwater

harvesting calculations. Includes links to state climate offices.

#### Rocky Mountain Institute

[www.rmi.org/sitepages/pid15.php](http://www.rmi.org/sitepages/pid15.php)

This portion of RMI's website is devoted to water conservation and efficiency. The site contains information on commercial, industrial and institutional water use, watershed management, and articles on policy and implementation.

#### Smart Communities Network

This U.S. Department of Energy project provides information about water efficiency and national and regional water efficiency assistance programs, and links to additional resources.

#### Terry Love's Consumer Toilet Reports

[www.terrylove.com/crtoilet.htm](http://www.terrylove.com/crtoilet.htm)

This website offers a plumber's perspective on many of the major toilets used in commercial and residential applications.

#### Water Closet Performance Testing

[www.cuwcc.org/MapTesting.lasso](http://www.cuwcc.org/MapTesting.lasso)

This site provides the most comprehensive and up-to-date reports on toilet flush performance of over 200 different models, including HETs.

#### High-Efficiency Toilet Fixtures and Other Water-Efficient Products

[www.cuwcc.org/products\\_tech.lasso](http://www.cuwcc.org/products_tech.lasso)

This site provides the latest listing of High-Efficiency Toilets (HETs) currently offered in the North American marketplace as well as much other technical information on water-efficient products, performance, and savings.

#### Water Efficiency Manual for Commercial, Industrial and Institutional Facilities

[www.p2pays.org/ref/01/00692.pdf](http://www.p2pays.org/ref/01/00692.pdf)

A straightforward manual on water efficiency from a number of different North Carolina government departments.

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**Water Measurement Manual: A Water Resources Technical Publication**

[www.usbr.gov/pmts/hydraulics\\_lab/pubs/wmm/](http://www.usbr.gov/pmts/hydraulics_lab/pubs/wmm/)

This U.S. Department of the Interior publication is a guide to effective water measurement practices for better water management.

**Water Use Efficiency Program**

[www.epa.gov/owm/water-efficiency](http://www.epa.gov/owm/water-efficiency)

This website provides an overview of the U.S. EPA’s Water Use Efficiency Program and information about using water more efficiently.

**Water Wiser: The Water Efficiency Clearinghouse**

[www.awwa.org/waterwiser](http://www.awwa.org/waterwiser)

(800) 926-7337

This web clearinghouse provides articles, reference materials and papers on all forms of water efficiency.

**Definitions**

**Automatic Fixture Sensors** are motion sensors that automatically turn on/off lavatories, sinks, water closets and urinals. Sensors may be hard wired or battery operated.

**Blackwater** does not have a single definition that is accepted nationwide. Wastewater from toilets and urinals is, however, always considered blackwater.

**Wastewater** from kitchen sinks (perhaps differentiated by the use of a garbage disposal), showers, or bathtubs may be considered blackwater by state or local codes. Project teams should comply with the blackwater definition as established by the authority having jurisdiction in their areas.

**Composting Toilet Systems** are dry plumbing fixtures that contain and treat human waste via microbiological processes.

**Graywater (also spelled greywater, gray water)** is defined by the Uniform Plumbing Code (UPC) in its Appendix G, titled “Gray water Systems for Single-Family Dwellings” as “untreated household wastewater which has not come into contact with toilet waste. Gray water includes used water from bathtubs, showers, bathroom wash basins, and water from clothes-washer and laundry tubs. It shall not include wastewater from kitchen sinks or dishwashers.”

The International Plumbing Code (IPC) defines graywater in its Appendix C, titled “Gray Water Recycling Systems” as “wastewater discharged from lavatories, bathtubs, showers, clothes washers, and laundry sinks.”

Some states and local authorities allow kitchen sink wastewater to be included in graywater. Other differences with the UPC and IPC definitions may be found in state and local codes. Project teams should comply with the graywater definitions as established by the authority having jurisdiction in their areas.

**Metering Controls** are generally manual on/automatic off controls which are used to limit the flow time of water. These types of controls are most commonly installed on lavatory faucets and on showers.

**Non-Water-Consuming Urinal (also known as a dry urinal)** is a urinal that uses no water, but instead replaces the water flush with a specially designed trap that contains a layer of buoyant liquid that floats above the urine layer, blocking sewer gas and urine odors from the room. Other non-water technologies are also available for urinals.

**Potable Water** is water that is suitable for drinking and is supplied from wells or municipal water systems.

**Process Water** is water used for industrial processes and building systems such as cooling towers, boilers and chillers.

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