LEED Building Design and Construction
Activity #5 – Water Efficiency (WE)
Before completing this Activity Read: Reference Guide for Building Design and Construction v4 – Pages 256-317

Note the following abbreviations are used in this activity:

NC	LEED BD+C: New Construction and Major Renovation
CS	LEED BD+C: Core and Shell Development
S	LEED BD+C: Schools
R	LEED BD+C: Retail
DC	LEED BD+C: Data Centers
WDC	LEED BD+C: Warehouses and Distribution Centers
HOS	LEED BD+C: Hospitality
HC	LEED BD+C: Healthcare

Although the LEED BD+C reference guide does not number the LEED prerequisites and credits, for this exercise they have been numbered in the order presented in the credit category.

Fill-In, Multiple Choice, Matching

1. Test your knowledge of how well you know the names of the credits for the Water Efficiency (WE) credit category:

LEED BD+C: NC, CS, S, R, DC, WDC, HOS, HC	
Credit	Name
P1	Outdoor Water Use Reduction
P2	Indoor Water Use Reduction
P3	Building-Level Water Metering
C1	Outdoor Water Use Reduction
C2	Indoor Water Use Reduction
C3	Cooling Tower Water Use
C4	Water Metering

2. Match the intent shown below to the prerequisite or credit:

LEED BD+C: NC, CS, S, R, DC, WDC, HOS, HC

Credit	ANS	Credit	ANS
WE – P1	C	WE – C1	C
WE – P2	B	WE – C2	B
WE – P3	D	WE – C3	A
		WE – C4	D

	INTENT
A	To conserve water used for cooling tower makeup while controlling microbes, corrosion, and scale in the condenser water system.
B	To reduce indoor water consumption.
C	To reduce outdoor water consumption.
D	To support water management and identify opportunities for additional water savings by tracking water consumption.

3. List the four areas of water use that are addressed by the Water Efficiency (WE) credits:
   1. Indoor use
   2. Outdoor use
   3. Speacialized uses
   4. metering

4. The conservation and creative reuse of water are important because only 3% of Earth's water is fresh water, and of that, slightly over two-thirds is trapped in glaciers.

5. In the U.S., buildings account for 13.6% of potable water use, the third-largest category, behind thermoelectric power and irrigation.

6. Designers and builders can construct green buildings that use significantly less water than conventional construction by incorporating native landscapes that eliminate the need for irrigation, installing water efficient fixtures, and reusing wastewater, for nonpotable water needs.

7. WE Prerequisite Outdoor Water Use Reduction requirements:
   Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from the landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.

   OPTION 1. NO Irrigation Required
   Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

   OR

   OPTION 2. Reduced Irrigation
   Reduce the project's landscape water requirement by at least 30% from the calculated baseline for the site's peak watering month. Reductions must be achieved through plant species selection and irrigation system efficieney, as calculated by the Environmental Protection Agency (EPA) WaterSense Water Budget tool.

8. Good landscape design and use of native, adapted, and drought tolerant plants can dramatically reduce and even eliminate the need for irrigation while better integrating the building site into its surroundings and attracting native wildlife.

9. Native plants also tend to require less fertilizer and fewer chemical pesticides, which degrade water quality when carried away in stormwater runoff.

10. Projects with no landscape area are exempt from this prerequisite.

11. For U.S. projects, the WaterSense Water Budget Tool automatically derives rainfall and evapotranspiration from the project's zip code.

12. Use the WaterSense Water Budget Data Finder to estimate the evapotranspiration rate (ETo) in inches per month for the critical month of the year, based on a project's zip code.

13. Hot, dry, and windy locations have higher ETo values than cool, humid locations.

14. WE Prerequisite Indoor Water use Reduction requirements:

Building Water Use

For the fixtures and fittings listed in Table 1, as applicable to the project scope, reduce aggregate water consumption by 20% from the baseline. Base calculations on the volumes and flow rates shown in Table 1.

All newly installed toilets, urinals, private lavatory faucets, and showerheads that are eligible for labeling must be WaterSense labeled (or a local equivalent for projects outside the U.S.).

Complete Table 1. Baseline water consumption of fixtures and fittings:

Table 1. Baseline water consumption of fixtures and fittings

Fixture or fitting	Baseline (IP units)	Baseline (SI units)
Toilet (water closet)*	1.6 gpf	6 lpf
Urinal*	1.0 gpf	3.8 l[f
Public lavatory (restroom) faucet	0.5 gpm at 60 psi all others except private applications	1.9 lpm at 415 kPa, all others except private applications
Private lavatory faucet	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Kitchen faucet (excluding faucets used exclusively for filling operations)	2.2 gpm at 60 psi	8.3 lpm at 415 kPa
Showerhead*	2.5 gpm at 80 psi per shower stall	9.5 lpm at 550 kPa per shower stall

* WaterSense label available for this product type

gpf = gallons per flush

gpm = gallons per minute

psi = pounds per square inch

Appliance and Process Water Use

Install appliances, equipment, and processes within the project scope that meet the requirements listed in the tables below.

Complete Table 2. Standards for appliances

Table 2. Standards for appliances

Appliance	Requirement
Residential Clothes Washer	Energy Star or performance equivalent
Commercial Clothes Washer	CEE Tier 3A
Residential Dishwasher (standard and compact)	Energy Star or performance equivalent
Prerinse spray valve	≤ 1.3 gpm (4.9 lpm)
Ice machine	ENERGY STAR or performance equivalent and use either air-cooled or closed-loop cooling, such as chilled or condenser water system

gpm = gallons per minute lpm = liters per minute

Complete Table 3. Standards for processes

Table 3. Standards for processes	
Process	**Requirement**
Heat rejection and cooling	No once-through cooling with potable water for any equipment or appliances that reject heat
Cooling towers and evaporative condensers	Equip with • makeup water meters • conductivity controllers and overflow alarms • efficient drift eliminators that reduce drift to maximum of 0.002 % of recirculated water volume for counterflow towers and 0.005 % of recirculated water flow for cross-flow towers

gpm = gallons per minute lpm = liters per minute

Healthcare, Retail, Schools, and Hospitality Only
In addition, water-consuming appliances, equipment, and processes must meet the requirements listed in Tables 4 and 5.

Complete Table 4. Standards for appliances

Table 4. Standards for appliances			
Kitchen equipment		**Requirement (IP units)**	**Requirements (SI units)**
Dishwasher	Undercounter	≤ 1.6 gal/rack	≤ 6.0 liters/rack
	Stationary, single tank, door	≤ 1.4 gal/rack	≤ 5.3 liters/rack
	Single tank, conveyor	≤ 1.0 gal/rack	≤ 3.8 liters/rack
	Multiple tank, conveyor	≤ 0.9 gal/rack	≤ 3.4 liters/rack
	Flight machine	≤ 180 gal/hour	≤ 680 liters/hour
Food steamer	Batch	≤ 6 gal/hour/pan	≤ 23 liters/hour/pan
	Cook-to-order	≤ 10 gal/hour/pan	≤ 38 liters/hour/pan
Combination oven	Countertop or stand	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan
	Roll-in	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan

Complete Table 5. Process requirements

Table 5. Process requirements

Process	Requirement
Discharge water temperature tempering	Where local requirements limit discharge temperature of fluids into drainage system, use tempering device that runs water only when equipment discharges hot water OR Provide thermal recovery heat exchanger that cools drained discharge water below code-required maximum discharge temperatures while simultaneously preheating inlet makeup water OR If fluid is steam condensate, return it to boiler
Venturi-type flow-through vacuum generators or aspirators	Use no device that generates vacuum by means of water flow through device into drain

The WaterSense label was developed by the U.S. Environmental Protection Agency to identify these efficient fixtures and ensure that higher efficiency does not come at the cost of performance.

15. Compliance Path 1 Prescriptive Achievement is for projects whose installed fixtures do not exceed WaterSense maximum levels. Compliance is documented through product cutsheets or fixture schedules.

16. List the fixtures that the WaterSense label can be found for:
    1. Tank-type toilets (water closet)
    2. Water-using urinals
    3. Private lavatory faucets
    4. Showerheads

17. List the fixture types that are not labeled by WaterSense:
    1. Tankless Toilets
    2. composting toilets and waterless toilets
    3. waterless urinals
    4. Public lavatory faucets

18. Complete Table 6. Maximum installed flush or flow rate for prescriptive path

Table 6. Maximum installed flush or flow rate for prescriptive path

Fixture or fitting	Maximum installed flush or flow rate (IP)	Maximum installed flush or flow rate (SI)	Threshold below code baseline
Toilet (water closet)*	1.28 gpf	4.8 lpf**	20%
Urinal*	0.5 gpf	1.9 lpf	50%
Public lavatory (restroom) faucet	0.40 gpm	1.5 lpf	20%
Private lavatory faucets*	1.5 gpm	5.7 lpf	32%
Kitchen faucet	1.75 gpm	6.7 lpf	20%
Showerhead*	2.00 gpm	7.6 lpf	20%

* The WaterSense label is available for this fixture type.
**The average flush rate for dual-flush toilets must be calculated as the average flush volume of one full flush and two reduced flushes, using a 1:2 (high flush:low flush) ratio.
gpf = gallons per flush gpm = gallons per minute lpf = liters per flush lpm = liters per minute

19. Compliance Path 2 Usage-Based Calculation is for projects that cannot demonstrate the 20% reduction for each fixture, based on manufacturers' documentation. Using the indoor water use calculator provided by USGBC, the project team must perform calculations to show that, in aggregate, the fixtures comply with prerequisite requirements. Projects pursuing points under WE Credit Indoor Water Use Reduction must use this compliance path.

20. List the information that is required for the indoor water use calculator:
    1. Project Occupancy
    2. Gender Ratio
    3. Days of operation
    4. Fixture types used in the project

21. List the information required to complete the calculation for the design case (installed) flush and flow fixtures:
    1. Fixture Type
    2. Flush or Flow rate
    3. Fixtrie manufacturer and model
    4. Percentage of occupants using each fixture model

22. Complete Equation 1. Basic indoor water use reduction calculation

Daily water use for each fixture type = [Fixture flush or flow rate] X [Duration of use] X [Users] X [Uses per person per day]

23. Appliances and equipment that use water on materials intended for human consumption may be excluded. For example, bread and produce misters, soda machines, coffee-making machines, and fixtures used to fill sinks for washing produce are excluded.

24. Lavatory faucets must be classified as public or private. The Uniform Plumbing Code, International Plumbing Code, and the National Standard Plumbing Code each define private as those fixtures in residences, hotel or motel guest rooms, and private rooms in hospitals. All other applications are deemed to be public.

25. Complete Table 7. Typical public and private lavatory faucet applications

Table 7. Typical public and private lavatory faucet applications

Lavatory faucet	Classification
Restroom sink School classroom sinks (if used primarily for hand washing)	Public (baseline 0.5 gpm)
Residential bathroom sink Hotel or motel bathroom sink Dormitory bathroom sink Patient room sink Patient bathroom sink in hospital or nursing home	Private (baseline 2.2 gpm)

gpm = gallons per minute lpm = liters per minute

26. Complete Table 8. Nonresidential default fixture uses

Table 8. Nonresidential default fixture uses

Fixture type	Duration (sec)	Uses per day			
		Employees (FTE)	Visitors	Retail Customers	Students
Water Closet (female)	n/a	3	0.5	0.2	3
Water closet (male)	n/a	1	0.1	0.1	1
Urinal (female)	n/a	0	0	0	0
Urinal (male)	n/a	2	0.4	0.1	2
Public lavatory faucet	30	3	0.5	0.2	3
Shower	300	0.1	0	0	0
Kitchen sink	15	1	0	0	0

27. Complete Table 9. Residential default fixture uses

Table 9. Residential default fixture uses		
Equipment	**Duration (sec)**	**Uses per day**
Water Closet (female)	n/a	5
Water closet (male)	n/a	5
Private lavatory faucet	60	5
Shower	480	1
Kitchen sink	60	4

28. Rating System Variations

Core and Shell

If no eligible plumbing fixtures, appliances, and process water are installed as part of the Core and Shell project scope of work, the project automatically achieves this prerequisite.

Schools

For K–12 schools that close on weekends, holidays, and for eight weeks of school vacation, assume 195 days of operation.

29. Complete Table 10. Default uses in schools, by occupancy type

Table 10. Default uses in schools, by occupancy type			
Fixture type	**FTE**	**Student**	**Visitor**
Water Closet			
Female	3	3	0.5
Male	1	1	0.1
Urinal			
Female	0	0	0
Male	2	2	0.4
Lavatory faucet	3	3	0.5
Shower	0.1	0	0
Kitchen sink	1	0	0

30. WE Prerequisite Building-Level Water Metering requirements:

Building Water Use

Install permanent water meters that measure the total potable water use for the building and associated grounds. Meter data must be compiled into monthly and annual summaries; meter readings can be manual or automated.

Commit to sharing with USGBC the resulting whole-project water usage data for a five-year period beginning on the date the project accepts LEED certification or typical occupancy, whichever comes first. This commitment must carry forward for five years or until the building changes ownership or lessee.

31. List examples of end uses of potable water in a project building and on the grounds:
    1. plumbing fixtures
    2. cooling towers and evaporative condensers
    3. laundering
    4. dishwashing
    5. indoor and outdoor water features
    6. irrigation
    7. exterior cleaning
    8. manufacturing processes

32. If all water comes from a public water supply and the utility's water meter provides monthly consumption data, that system's meter meets the prerequisite requirements.

33. WE Credit Outdoor Water Use Reduction requirements:
    Reduce outdoor water use through one of the following options. Nonvegetated surfaces, such as permeable or impermeable pavement, should be excluded from landscape area calculations. Athletic fields and playgrounds (if vegetated) and food gardens may be included or excluded at the project team's discretion.

    Option 1. No Irrigation Required (2 points except Healthcare, 1 point Healthcare)
    Show that the landscape does not require a permanent irrigation system beyond a maximum two-year establishment period.

    OR

    Option 2. Reduced Irrigation (2 points except Healthcare, 1 point Healthcare)
    Reduce the project's landscape water requirement (LWR) by at least 50% from the calculated baseline for the site's peak watering month. Reductions must first be achieved through plant species selection and irrigation system efficiency as calculated in the Environmental Protection Agency (EPA) WaterSense Water Budget Tool. Additional reductions beyond 30% may be achieved using any combination of efficiency, alternative water sources, and smart scheduling technologies.

34. Complete Table 1. Points for reducing irrigation water

Table 1. Points for reducing irrigation water

Percentage reduction from baseline	Points (except HC)	Points (HC)
50%	1	1
100%	2	—

35. List examples of alternative water sources:
    1. reclaimed wastewater
    2. graywater
    3. swimming pool backwash filter
    4. refrigeration system condensate
    5. captured rainwater

6. stormwater and foundation drain water
7. Steam system condensate
8. fluid cooler discharge
9. food steamer discharge
10. combination oven discharge
11. industrial process water
12. fire pump test water
13. municipally supplied treated wastewater
14. ice machine condensate

36. Condensate and cooling tower blowdown in particular may have salinity levels precluding use for irrigation.

37. WE Credit Indoor Water Use Reduction requirements:
Further reduce fixture and fitting water use from the calculated baseline in WE Prerequisite Indoor Water Use Reduction. Additional potable water savings can be earned above the prerequisite level using alternative water sources. Include fixtures and fittings necessary to meet the needs of the occupants. Some of these fittings and fixtures may be outside the project boundary. Points are awarded according to Table 1.

38. Complete Table 1. Points for reducing water use

Table 1. Points for reducing water use

Percentage reduction	Points (NC, CS, DC, WDC)	Points (S, R, HOS, HC)
25%	1	1
30%	2	2
35%	3	3
40%	4	4
45%	5	5
50%	6	—

AND

39. Appliance and Process Water
Install equipment within the project scope that meets the minimum requirements in Table 2, 3, 4, or 5. One point is awarded for meeting all applicable requirements in any one table. All applicable equipment listed in each table must meet the standard.

Schools, Retail, and Healthcare projects can earn a second point for meeting the requirements of two tables. To use Table 2, the project must process at least 120,000 lbs (57 606 kg) of laundry per year.

40. Complete Table 2. Compliant commercial washing machines

Table 2. Compliant commercial washing machines		
Washing machine	**Requirements (IP)**	**Requirements (SI)**
On-premise, minimum capacity 2,400 lbs (1088 kg) per 8-hour shift	Maximum 1.8 gals per pound*	Maximum 7 liters per 0.45 kilograms*

* Based on equal quantities of heavy, medium, and light soil laundry.

41. To use Table 3, the project must serve at least 100 meals per day of operation. All process and appliance equipment listed in the category of kitchen equipment and present on the project must comply with the standards.

42. Complete Table 3. Standards for commercial kitchen equipment

Table 3. Standards for commercial kitchen equipment			
Kitchen equipment		**Requirement (IP units)**	**Requirements (SI units)**
Dishwasher	Undercounter	ENERGY STAR	ENERGY STAR or performance equivalent
	Stationary, single tank, door	ENERGY STAR	ENERGY STAR or performance equivalent
	Single tank, conveyor	ENERGY STAR	ENERGY STAR or performance equivalent
	Multiple tank, conveyor	ENERGY STAR	ENERGY STAR or performance equivalent
	Flight machine	ENERGY STAR	ENERGY STAR or performance equivalent
Food Steamer	Batch (no drain connection)	≤ 6 gal/hour/pan	≤ 23 liters/hour/pan
	Cook-to-order (with drain connection)	≤ 10 gal/hour/pan	≤ 38 liters/hour/pan
Combination oven	Countertop or stand	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan
	Roll-in	≤ 3.5 gal/hour/pan	≤ 13 liters/hour/pan
Food and waste Disposer	Disposer	3-8 gpm, full load condition, 10 minute automatic shutoff; or 1 gpm, no-load condition	11–30 lpm, full load condition, 10-min automatic shutoff; or 43.8 lpm, no-load condition
	Scrap collector	Maximum 2 gpm makeup water	Maximum 7.6 lpm makeup water
	Pulper	Maximum 2 gpm makeup water	Maximum 7.6 lpm makeup water
	Strainer basket	No additional water usage	No additional water usage

43. To use Table 4, the project must be a medical or laboratory facility.

44. Complete Table 4. Compliant laboratory and medical equipment

Table 4. Compliant laboratory and medical equipment		
Lab equipment	**Requirement (IP)**	**Requirements (SI)**
Reverse-osmosis water purifier	75% recovery	75% recovery
Steam sterilizer	For 60-inch sterilizer, 6.3 gal/U.S. tray For 48-inch sterilizer, 7.5 gal/U.S. tray	For 1520-mm sterilizer, 28.5 liters/DIN tray For 1220-mm sterilizer, 28.35 liters/DIN tray
Sterile process washer	0.35 gal/US tray	1.3 liters/DIN tray
X-ray processor, 150 mm or more in any dimension	Film processor water recycling unit	
Digital imager, all sizes	NO water use	

45. To use Table 5, the project must be connected to a municipal or district steam system that does not allow the return of steam condensate.

46. Complete Table 5. Compliant municipal steam systems

Table 5. Compliant municipal steam systems	
Steam system	**Standard**
Steam condensate disposal	Cool municipally supplied steam condensate (no return) to drainage system with heat recovery system or reclaimed water
OR	
Reclaim and use steam condensate	100% recovery and reuse

47. WE Credit Indoor Water Use Reduction exemplary performance is earned if the project achieves a 55% water use reduction.

48. WE Credit Cooling Tower Water Use requirements:
For cooling towers and evaporative condensers, conduct a one-time potable water analysis, measuring at least the five control parameters listed in Table 1.

49. Complete Table 1. Maximum concentrations for parameters in condenser water

Table 1. Maximum concentrations for parameters in condenser water	
Parameter	**Maximum level**
Ca (as $CaCO_3$)	1000 ppm
Total Alkalinity	1000 ppm
SiO_2	100 ppm
Cl	250 ppm
Conductivity	2000 µs/cm

ppm = parts per million
µS/cm = micro siemens per centimeter

50. Calculate the number of cooling tower cycles by dividing the maximum allowed concentration level of each parameter by the actual concentration level of each parameter found in the potable makeup water. Limit cooling tower cycles to avoid exceeding maximum values for any of these parameters.

51. Complete Table 2. Points for cooling tower cycles

Table 2. Points for cooling tower cycles	
Parameter	**Points**
Maximum number of cycles achieved without exceeding any filtration levels or affecting operation of condenser water system (up to maximum of 10 cycles)	1
Achieve a minimum 10 cycles by increasing the level of treatment in condenser or make-up water OR Meet the minimum number of cycles to earn 1 point and use a minimum 20% recycled nonpotable water	2

52. Cooling tower or evaporative condenser water efficiency is measured in the number of recirculation cycles before water must be removed by blowdown.

53. List examples of good nonpotable water sources:
    1. Air-conditioning condensate
    2. Rainwater
    3. Steam system condensate
    4. Food Steamer discharge water
    5. Fire pump test water
    6. Ice machine condensate

54. WE Credit Water Metering requirements:
Install permanent water meters for two or more of the following water subsystems, as applicable to the project:

Irrigation. Meter water systems serving at least 80% of the irrigated landscaped area. Calculate the percentage of irrigated landscape area served as the total metered irrigated landscape area

divided by the total irrigated landscape area. Landscape areas fully covered with Xeriscaping or native vegetation that requires no routine irrigation may be excluded from the calculation.

Indoor plumbing fixtures and fittings. Meter water systems serving at least 80% of the indoor fixtures and fitting described in WE Prerequisite Indoor Water Use Reduction, either directly or by deducting all other measured water use from the measured total water consumption of the building and grounds.

Domestic Hot water. Meter water use of at least 80% of the installed domestic hot water heating capacity (including both tanks and on-demand heaters).

Boiler with aggregate projected annual water use of 100,000 gallons (378 500 liters) or more, or boiler of more than 500,000 BtuH (150 kW). A single makeup meter may record flows for multiple boilers.

Reclaimed water. Meter reclaimed water, regardless of rate. A reclaimed water system with a makeup water connection must also be metered so that the true reclaimed water component can be determined.

Other process water. Meter at least 80% of expected daily water consumption for process end uses, such as humidification systems, dishwashers, clothes washers, pools, and other subsystems using process water.

Healthcare Projects only
In addition to the requirements above, install water meters in any five of the following:
purified water systems (reverse-osmosis, de-ionized);
filter backwash water;
water use in dietary department;
water use in laundry;
water use in laboratory;
water use in central Sterile and processing department;
water use in physiotherapy and hydrotherapy and treatment areas;
water use in Surgical suite;
closed-loop hydronic system makeup water; and
cold-water makeup for domestic hot water systems.

55. Submetering the major building water systems provides a way to formulate independent system baselines, track usage against those baselines, isolate and identify potential sources of waste, and take corrective action.