

LEED Building Operations and Maintenance

Activity #3 – Sustainable Sites (SS)

Before completing this Activity Read Reference Guide: Building Operations and Maintenance v4 – Pages 61-138

Note the following abbreviations are used in this activity:

EB	LEED O+M: Existing Building
S	LEED O+M: Schools
R	LEED O+M: Retail
DC	LEED O+M: Data Centers
WDC	LEED O+M: Warehouses and Distribution Centers
HOS	LEED O+M: Hospitality
MF	LEED O+M: Multifamily

Although the LEED O+M 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 Sustainable Sites (SS) credit category and match the intent shown below to the prerequisite or credit:

LEED O+M: EB, S, R, DC, WDC, HOS, MF		
Credit	Intent	Name
P1		
C1		
C2		
C3		
C4		
C5		
C6		
LEED O+M: Schools		
C7		

	INTENT
A	To minimize effects on microclimates and human and wildlife habitats by reducing heat islands.
B	To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.
C	To integrate the school with the community by sharing the building and its playing fields for nonschool events and functions.
D	To increase night sky access, improve nighttime visibility, and reduce the consequences of development for wildlife and people.
E	To preserve ecological integrity and encourage environmentally sensitive site management practices that provide a clean, well-maintained, and safe building exterior while supporting high-performance building operations and integration into the surrounding landscape.
F	To preserve and improve ecological integrity while supporting high-performance building operations.
G	To reduce runoff volume and improve water quality by replicating the natural hydrology and water balance of the site, based on historical conditions and undeveloped ecosystems in the region.

2. Rainwater runoff carries such pollutants as _____, _____, _____, and lawn _____ directly to streams and rivers, where they contribute to _____ and harm aquatic ecosystems and species.

3. SS Prerequisite Site Management Policy requirements:

ESTABLISHMENT

Create and implement a site management policy that employs best management practices to reduce harmful _____ use, _____ waste, _____ waste, air _____, _____ waste, and/or chemical _____ for all of the following operational elements on the _____ and _____:

•	
•	
•	
•	
•	
•	
•	
•	
•	

PERFORMANCE

None.

4. Site management best practices not only protect _____, _____, and _____ resources but also yield _____ benefits.

5. SS Credit Site Development - Protect and Restore Habitat requirements:

OPTION 1. ON-SITE RESTORATION (2 POINTS)

ESTABLISHMENT

Have in place _____ or _____ vegetation on _____ of the total site area (_____ the building footprint), a minimum of _____ square feet (465 square meters), to provide habitat and promote _____.

PERFORMANCE

None.

OR

OPTION 2. FINANCIAL SUPPORT (1 POINT)

ESTABLISHMENT

Provide financial support equivalent to at least \$ _____ per square foot (US\$0.50 per square meter) for the _____ site area (_____ the building footprint).

Financial support must be provided _____ to a nationally or locally recognized land trust or conservation organization within the same _____ ecoregion or the project's state (or within 100 miles [160 kilometers] for projects outside the U.S.). For U.S. projects, the land trust must be accredited by the _____.

PERFORMANCE

Provide the specified financial support _____.

6. A small office building project has a total site area of 475,200 ft². The project team is increasing the site's vegetated area to earn SS Credit Site Development - Protect and Restore Habitat using Option 1. On-Site Restoration. The project has 88,000 ft² of vegetated area meeting the credit requirements. What is the total required area for native and adapted vegetation under Option 1?
- A. 118,800 ft²
 - B. 95,040 ft²
 - C. 7040 ft²
 - D. 30.800 ft²

7. SS Credit Site Development - Protect and Restore Habitat: EXEMPLARY PERFORMANCE

Option 1. Double the _____ restoration requirement (restore at least _____).

Option 2. Double the annual financial requirement by donating at least \$ _____ per square foot (\$1.00 per square meter).

8. SS Credit Rainwater Management requirements:

ESTABLISHMENT

Use low-impact development (LID) practices to capture and treat water from _____ of the _____ surfaces for the _____ percentile storm event.

_____ and _____ an annual inspection program of all rainwater management facilities to confirm continued performance.

PERFORMANCE

Document the annual inspections, including identification of areas of _____, _____ needs, and _____.

Perform necessary maintenance, repairs, or stabilization within _____ of inspection.

9. Conventional site development disrupts natural _____ systems and watersheds through _____ surfaces, soil _____, loss of _____, and loss of _____ drainage patterns.
10. Obtain at least _____ years of historical rainfall data, or as much historical data as possible, representative of the project climate conditions based on proximity to site, elevation, region, etc.

11. A project site has a total impervious area of 5,000 ft². What is the total impervious area that must be managed to meet the requirements for SS Credit Rainwater Management?
- 5,000 ft²
 - 1,250 ft²
 - 1,500 ft²
 - 1,000 ft²
12. Which of these is used to test compliance for the total volume of runoff for SS Credit Rainwater Management?
- One-year storm events
 - Two-year storm events
 - 75th percentile of regional storm events
 - 95th percentile of regional storm events
13. To comply with the performance requirements for SS Credit Rainwater Management projects must perform necessary maintenance, repairs, or stabilization within how many days of inspection?
- 15 days
 - 30 days
 - 60 days
 - 90 days
14. SS Credit Rainwater Management: Exemplary Performance
Use GI and LID practices to capture and treat water from _____ of the impervious surfaces for the _____ percentile storm event.
15. List low-impact development (LID) design practices used to manage rainwater runoff:
- -
 -
 -
 -
16. SS Credit Heat Island Effect requirements:
Choose one of the following options.

OPTION 1. NONROOF (1 POINT)

ESTABLISHMENT

Use any combination of the following strategies for a minimum of _____ of the site paving.

- Use the existing plant material or install plants that provide _____ over paving areas (including playgrounds) on the site within _____ of planting. Plants must be in place at the time of certification application.
- Install vegetated planters. Plants must be in place at the time of occupancy permit and cannot include _____ turf.
- Provide shade with structures covered by _____ generation systems, such as solar _____ collectors, _____, and _____ turbines.

- Provide shade with architectural devices or structures that have a three-year aged solar reflectance (SR) value of at least _____. If three-year aged value information is not available, use materials with an initial SR of at least _____ at installation.
- Provide shade with vegetated _____.
- Use _____ materials with a three-year aged solar reflectance (SR) value of at least _____. If three-year aged value information is not available, use materials with an initial SR of at least _____ at installation.
- Use an _____ pavement system (at least _____% unbound).

PERFORMANCE

Implement a maintenance program that ensures all high-reflectance paving surfaces are _____ at least every _____ years to maintain good reflectance.

OR

OPTION 2. ROOF (1 POINT)

ESTABLISHMENT

Use either roofing materials with a SRI equal to or greater than the values in Table 1 for a minimum of _____ of the roof area, or a vegetated roof for a minimum of _____ of the roof area, or both. If using both high-reflectance and vegetated roof surfaces, meet the following criterion:

(Complete the equation)

$$\frac{\text{Area of high-reflectance roof}}{\text{_____}} + \frac{\text{Area of vegetated roof}}{\text{_____}} \geq \text{Total roof area}$$

Alternatively, an SRI and SR _____ average approach may be used to calculate compliance.

PERFORMANCE

Implement a maintenance program that ensures all high-reflectance roof surfaces are _____ at least every _____ years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

OR

OPTION 3. NONROOF AND ROOF (2 POINTS)

ESTABLISHMENT

Meet the following criterion:

(Complete the equation)

$$\frac{\text{Area of nonroof measures}}{\text{_____}} + \frac{\text{Area of high-reflectance roof}}{\text{_____}} + \frac{\text{Area of vegetated roof}}{\text{_____}} \geq \frac{\text{Total site paving area}}{\text{_____}} + \frac{\text{Total roof area}}{\text{_____}}$$

Alternatively, an SRI and SR weighted average approach may be used to calculate compliance.

Use any combination of the following strategies.

Nonroof Measures

Use the measures listed in Option 1. Plant material must be in place at time of certification application.

High-Reflectance Roof

Use roofing materials that have an SRI equal to or greater than the values in Table 1. Meet the three-year aged SRI value. If three-year aged value information is not available, use materials that meet the initial SRI value.

(Complete the table)

TABLE 1. Minimum solar reflectance index value, by roof slope			
	Slope	Initial SRI	3-year aged SRI
Low-sloped roof	≤ 2:12		
Steep-sloped roof	> 2:12		

Vegetated Roof

Install a _____ roof.

PERFORMANCE

Implement a maintenance program that ensures all high-reflectance surfaces are _____ at least every _____ years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

OR

OPTION 4. PARKING UNDER COVER (1 POINT)

ESTABLISHMENT

Place at least _____ of parking spaces under cover. Any roof used to shade or cover parking must (1) have a three-year aged SRI of at least _____ (if three-year aged value information is not available, use materials with an initial SRI of at least _____ at installation), (2) be a _____ roof, or (3) be covered by _____ generation systems, such as _____, _____, and _____ turbines.

PERFORMANCE

Implement a maintenance program that ensures all SRI surfaces are _____ at least every _____ years to maintain good reflectance, and all vegetated roofs are maintained for plant health and good structural condition.

- 17. Dark, nonreflective surfaces used for _____, _____, _____, _____, and other _____ absorb the sun's warmth and radiate heat, creating heat islands.
- 18. Urban areas can have temperatures _____ warmer than surrounding suburban and undeveloped areas, and as much as _____ warmer in evenings.

19. Heat islands _____ cooling loads in the summer, necessitating larger, more powerful air-conditioners that use more _____, in turn increasing cooling costs, producing more _____, and generating pollution.
20. According to a study of the metropolitan areas of Baton Rouge, Chicago, Houston, Sacramento, and Salt Lake City by the Department of Energy's Lawrence Berkeley National Laboratory, the energy savings potential of heat island reduction measures ranges from
- A. \$1 million to \$2 million per year
 - B. \$2 million to \$4 million per year
 - C. \$4 million to \$15 million per year
 - D. \$30 million to \$50 million per year
21. Which of these is the most effective measure of a roofing materials ability to reject solar heat?
- A. ET_0
 - B. SR
 - C. VOC
 - D. SRI
22. Which of these is used by LEED to measure the solar heat rejection of components that are not roofing materials, or "nonroof"—for example, vegetation, shading devices, and other less reflective components?
- A. ET_0
 - B. SR
 - C. VOC
 - D. SRI
23. List examples of hardscape areas:
- 1.
 - 2.
 - 3.
 - 4.
24. Applicable roof area excludes roof area covered by:
- 1.
 - 2.
 - 3.
 - 4.
25. For SS Credit Heat Island Effect Option 4. Parking under cover which of these parking spaces can be excluded?
- A. Handicap parking
 - B. Motorcycle parking
 - C. Bicycle parking
 - D. Structured parking

26. SS Credit Heat Island Effect: Exemplary Performance

Option 1. Install SR-compliant materials and/or open-grid paving, or provide shading within _____ years, for at least _____ of nonroof impervious surfaces.

Option 2. Install a vegetated roof system for at least _____ of the project's roof area (excluding any mechanical equipment, photovoltaic panels, and skylights).

Option 3. Achieve exemplary performance for both Option 1 and Option 2: install SR-compliant materials and/or open-grid paving, or provide shading within _____ years, for at least _____ of nonroof impervious surfaces AND install a vegetated roof system for at least _____ of the project's roof area (excluding any mechanical equipment, photovoltaic panels, and skylights).

Option 4. Locate at least _____ of parking under cover.

27. Black paint has a solar reflectance of _____; white paint (titanium dioxide) has a solar reflectance of _____.

28. SS Credit Light Pollution Reduction requirements:

ESTABLISHMENT

Meet the requirements of one of the options below:

OPTION 1. _____

Shield all _____ fixtures (where the sum of the mean lamp lumens for that fixture exceeds _____) such that the installed fixtures do not directly emit any light at a vertical angle more than _____ degrees from straight down.

OR

OPTION 2. _____

Measure the night illumination levels at regularly spaced points on the project boundary, taking the measurements with the building's _____ and _____ lights both on and off. At least _____ measurements are required, at a maximum spacing of _____ feet (30 meters) apart. The illumination level measured with the lights on must not be more than _____ above the level measured with the lights off.

PERFORMANCE

None.

29. _____ is the misdirection or misuse of light, generally resulting from an inappropriate application of exterior lighting.

30. _____ creates light trespass onto adjacent sites by directing light in the opposite direction of the area intended to be lighted.

31. _____ causes artificial sky glow.

32. _____ is caused by high-angle front light.

33. SS Credit Site Management requirements:

ESTABLISHMENT

None.

PERFORMANCE

Demonstrate that the following performance criteria were met:

- Use no calcium chloride or sodium chloride deicers, and/or establish reduced treatment areas equal to _____ of applicable paving area.
- Prevent _____ and sedimentation, and _____ any eroded soils.
- Prevent _____ from construction materials and activities.
- Divert from landfills _____ of plant material waste via low-impact means.
- Prevent the overapplication of nutrients. Use no _____-based fertilizers, biosolid-based fertilizers (for continuous application), synthetic quick-release fertilizers, or “weed and feed” formulations. _____ applications of herbicides are prohibited; turf weeds may be controlled by _____ spraying only.
- Monitor irrigation systems manually or with automated systems at least every _____ weeks during the operating season and correct any leaks, breaks, inappropriate water usage, or incorrect timing.
- Store _____ and _____ to prevent air and site contamination.

AND

Meet one of the following options:

OPTION 1. _____

Limit turf to _____ or less of the vegetated area.

Playgrounds and athletic fields in schools or parks are _____ from this option.

OR

OPTION 2. _____

Use all _____ or _____ powered equipment in all site management operations.

OR

OPTION 3. _____

Show and maintain a _____ reduction in hydrocarbon (HC) and nitrogen oxide (NOx) emissions, and a _____ reduction in carbon monoxide (CO) emissions from baseline conditions.

34. Which of these gasoline-powered maintenance equipment are exempt from the requirements for SS Credit Site Management Option 3. Reduction in Emissions from Site Management Equipment?

- A. Walk-behind mowers
- B. Trucks for snow removal
- C. Leaf blowers
- D. Line trimmer-edgers

35. SS Credit Site Improvement Plan requirements:

ESTABLISHMENT

Develop a _____-year site improvement plan that includes the following:

- documentation of _____ site conditions;
- site _____ objectives;
- performance _____ to evaluate ongoing progress; and
- _____ protocols.

The improvement plan must address the following topics.

- _____. Protection and improvement of water bodies on-site, rainwater management and reuse opportunities, potable water-use reduction.
- _____. Documentation of existing vegetation on-site, turf area reduction, management of native and invasive plants, protection of threatened, endangered or unique species.
- _____. Documentation of general soil structure, preservation of healthy soils, remediation of compacted soils, identification of previously disturbed area.

The plan must be developed with professionals trained and experienced in the above disciplines.

PERFORMANCE

Show that at least _____ of the site is vegetated. Implement all no-cost and low-cost measures.

Develop a new improvement plan and implement all new no-cost and low-cost measures every _____ years.

36. SS Credit Joint Use of Facilities requirements:

ESTABLISHMENT

OPTION 1. _____ (1 POINT)

In collaboration with the school _____, establish at least _____ of the following types of spaces as accessible to and available for shared use by the general public:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Provide access to _____ in joint-use areas after normal school hours.

OR

OPTION 2. _____ (1 POINT)

In collaboration with the school authorities, contract with community or other organizations to provide at least _____ types of dedicated-use spaces in the building, such as the following:

- 1.
- 2.
- 3.

- 4.
- 5.
- 6.
- 7.

Provide access to _____ in joint-use areas after normal school hours.

OR

OPTION 3. _____ (1 POINT)

In collaboration with the school authorities, establish at least _____ of the following six types of spaces (owned by other organizations/agencies) are accessible to students:

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Provide direct _____ access to these spaces from the school. In addition, provide _____ joint-use agreements with the other organizations or agencies that stipulate how these spaces will be shared.

PERFORMANCE

None.