# Appendix 6-D

# The Sustainable Sites Initiative

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***Leadership in Energy and Environmental Design (LEED®) and the Sustainable Sites Initiative (SSI).*** The LEED® point credit system designed by the U.S. Green Building Council (USGBC) and implemented by the Green Building Certification Institute (GBCI) awards points related to site design and stormwater management. Several categories of points are potentially available for new development and redevelopment projects. The SSI point credit system was designed by the American Society of Landscape Architects (ASLA) and the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, and the National Botanic Garden (see ASLA et al., 2009a and 2009b). This Appendix provides a more thorough discussion of the site planning process and design considerations as related to SSI credits. It is anticipated that SSI credits may eventually be blended into LEED credits. However, DEQ is not affiliated with any of the creators of LEED or SSI, and any information on applicable points suggested here is based only on perceived compatibility. **Designers should research and verify scoring criteria and applicability of points as related to the specific project being considered through LEED or SSI resources.**

## 6-D.1.0. THE SUSTAINABLE SITES INITIATIVE™ (SSI)

Environmental site design is intrinsically associated with the concept of sustainability and the emerging *sustainable site design* movement, reflected in the 2009 release of the Sustainable Sites Initiative™ (SSI), an interdisciplinary partnership of the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, and the National Botanic Garden (see ASLA et al., 2009a and 2009b).

The Sustainable Sites Initiative has spent several years developing guidelines for sustainable land practices that are grounded in rigorous science and can be applied on a site-by-site basis nationwide. These voluntary guidelines – *The Sustainable Sites Initiative: Guidelines and Performance Benchmarks 2009* – acknowledge that different regions of the country will have different requirements and therefore include performance levels appropriate to each region as needed. The benchmarks are meant to guide, measure and recognize sustainable landscape design practices on a site-by-site basis. They may also inform larger scale projects or planning efforts, although they are not intended to be a tool for regional planning.

By aligning land development and management practices with the functions of healthy ecosystems, the SSI believes that developers, property owners, site managers, and others can restore or enhance the ecosystem services provided by their built landscapes. Moreover, adopting such sustainable practices not only helps the environment but also enhances human health and well-being and is economically cost-effective.

For the Initiative's purposes, "sustainability" is defined as *design, construction, operations, and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs*. This definition embraces the definition of sustainable development first put forward in a 1987 report of the United Nations World Commission on Environment and Development entitled *Our Common Future*. As Dr. Gro Harlem Brundtland, former Prime Minister of Norway once said, "The environment is where we all live; and development is what we all do in attempting to improve our lot within that abode. The two are inseparable." Also, as a Native American proverb states, "We do not inherit the earth from our ancestors, we borrow it from our grandchildren."

The impetus for creating the guidelines came from the recognition that although buildings have national standards for "green" construction, little existed for the space beyond the building envelope. Modeled after the LEED® (Leadership in Energy and Environmental Design) Green Building Rating System® of the U.S. Green Building Council, the Initiative's rating system gives credits for the sustainable use of water, the conservation of soils, wise choices of vegetation and materials, and design that supports human health and well-being. The U.S. Green Building Council anticipates incorporating the Sustainable Sites benchmarks into future revisions of its LEED rating system.

The term "ecosystem services" describes the goods and services provided by healthy ecosystems – the pollination of crops by bees, bats, or birds, for example, or the flood protection provided by wetlands, or the filtration of air and water by vegetation and soils. Ecosystem services provide benefits to humankind and other organisms but are not generally reflected in our current economic accounting (see **Figure 6-D.1**). Nature doesn't submit an invoice for them, so humans often underestimate or ignore their value when making land-use decisions. However, efforts to determine the monetary value of ecosystem services have placed that figure at an estimated global average of $33 trillion annually– nearly twice the value of the global gross national product of $18 trillion, both figures in 1997 dollars (Costanza et al., 1997).

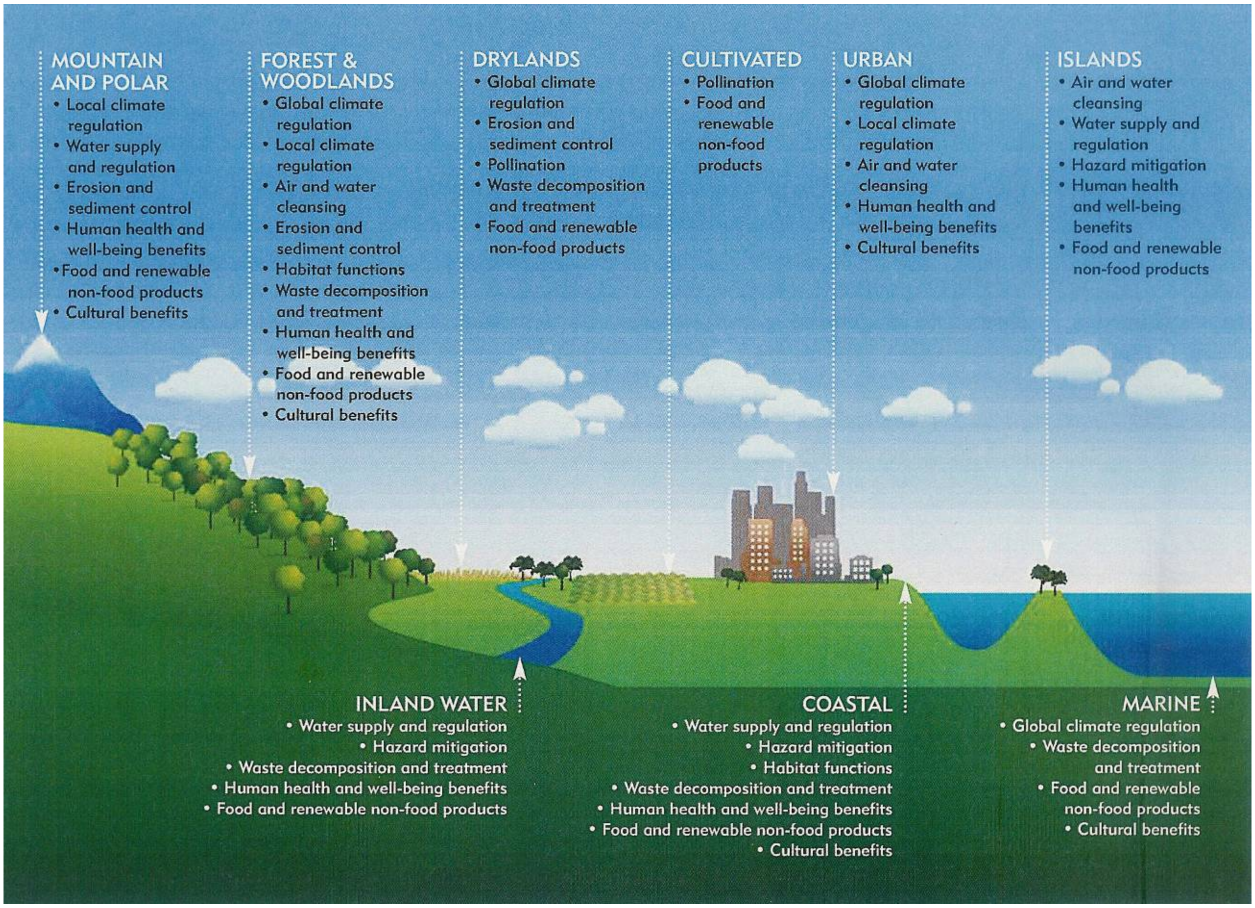


***Figure 6-D.1. Various Ecosystem Services.*** *No type of ecosystem has a monopoly on the goods and services it can provide. The services shown here represent only a few of the many services available from each source type. With sustainable practices, built landscapes can provide many of these same natural services.* Source: ASLA et al. (2009a)

The SSI's committees and staff have distilled the potential ecosystem services that a sustainable site can strive to protect or regenerate to the following list:

- ***Global Climate Regulation.*** Maintaining balance of atmospheric gases at historic levels, creating breathable air, and sequestering greenhouse gases.
- ***Local Climate Regulation.*** Regulating local temperature, precipitation, and humidity through shading, evapotranspiration, and windbreaks.
- ***Air and Water Cleansing.*** Removing and reducing pollutants in air and water.
- ***Water Supply and Regulation.*** Storing and providing water within watersheds and aquifers.
- ***Erosion and Sediment Control.*** Retaining soil within an ecosystem, preventing damage from erosion and siltation.
- ***Hazard Mitigation.*** Reducing vulnerability to damage from flooding, storm surge, wildfire, and drought.
- ***Pollination.*** Providing pollinator species for reproduction of crops or other plants.
- ***Habitat Functions.*** Providing refuge and reproduction habitat to plants and animals, thereby contributing to conservation of biological and genetic diversity and evolutionary processes.
- ***Waste Decomposition and Treatment.*** Breaking down waste and cycling nutrients.
- ***Human Health and Well-Being Benefits.*** Enhancing physical, mental, and social well-being as a result of interaction with nature.
- ***Food and Renewable Non-Food Products.*** Producing food, fuel, energy, medicine, or other products for human use.
- ***Cultural Benefits.*** Enhancing cultural, educational, aesthetic, and spiritual experiences as a result of interaction with nature.

Increased understanding of the value of these services has led to acknowledgment of the way current land practices can imperil such essential benefits as air purification, water retention, climate regulation, and erosion control. Careless land practices, such as excessive reduction of vegetative cover, can start a cascade of negative effects that destroy ecosystems and degrade air and water quality. As many communities have found, it is difficult, expensive, and sometimes impossible to duplicate these natural services once they are destroyed.

However, as **Figure 6-D.2** illustrates, sustainable practices of stewardship, such as improving soil conditions, can reverse the effects, preserving and restoring healthy ecosystems and thereby increase the ecosystem services they provide after development – whether that development is a backyard garden, a housing development, or a state park. Water on the site can be managed to imitate natural water cycling, vegetation can be used strategically to cool the area and filter water, and soils can be restored to support healthy vegetation and filter pollutants.


***Figure 6-D.2. Degradation versus Stewardship Progressions***

The Initiative's development of site-specific performance benchmarks is grounded in an understanding of healthy systems and natural processes. Achieving these benchmarks will help to maintain or support those natural processes and the services that they provide to humans. The SSI's overview document, *The Case for Sustainable Landscapes* (ASLA et al., 2009a), is intended to provide readers with more background on the science underlying the guidelines for sustainable practices – to explain the connection, for example, between excessive use of nitrogen fertilizers and the increase in "dead zones" in coastal waters downstream, or between an increase in impervious cover and reduced base flow to creeks, streams, and rivers.

*The Case for Sustainable Landscapes* also offers evidence for the economic benefits that can accrue from adopting sustainable practices. For example, as a number of developers have found, bioswales, rain gardens and other low-impact development strategies to reduce runoff not only help recharge groundwater but also can save developers anywhere from 15 to 80 percent in total capital costs. And as New York City has found, a long-term investment in protecting its watershed can save billions in avoided costs for a new water treatment plant—a cost saving passed on to rate payers.

The science demonstrates that humans are an integral part of the environment. As people acknowledge this link, they recognize that human decisions and behavior are in fact components of a global feedback loop: what people do affects the health and well-being of the rest of the natural world, which in turn affects human health and well-being – physical, mental, economic, and social. According to the SSI, the guiding principles of a sustainable site are as follows:

- ***Do no harm.*** Make no changes to the site that will degrade the surrounding environment. Promote projects on sites where previous disturbance or development presents an opportunity to regenerate ecosystem services through sustainable design.

- ***Precautionary principle.*** Be cautious in making decisions that could create risk to human and environmental health. Some actions can cause irreversible damage. Examine a full range of alternatives – including no action – and be open to contributions from all affected parties.
- ***Design with nature and culture.*** Create and implement designs that are responsive to economic, environmental, and cultural conditions with respect to the local, regional, and global context.
- ***Use a decision-making hierarchy of preservation, conservation, and regeneration.*** Maximize and mimic the benefits of ecosystem services by preserving existing environmental features, conserving resources in a sustainable manner, and regenerating lost or damaged ecosystem services.
- ***Provide regenerative systems as intergenerational equity.*** Provide future generations with a sustainable environment supported by regenerative systems and endowed with regenerative resources.
- ***Support a living process.*** Continuously re-evaluate assumptions and values and adapt to demographic and environmental change.
- ***Use a systems thinking approach.*** Understand and value the relationships in an ecosystem and use an approach that reflects and sustains ecosystem services; re-establish the integral and essential relationship between natural processes and human activity.
- ***Use a collaborative and ethical approach.*** Encourage direct and open communication among colleagues, clients, manufacturers, and users to link long-term sustainability with ethical responsibility.
- ***Maintain integrity in leadership and research.*** Implement transparent and participatory leadership, develop research with technical rigor, and communicate new findings in a clear, consistent, and timely manner.
- ***Foster environmental stewardship.*** In all aspects of land development and management, foster an ethic of environmental stewardship – an understanding that responsible management of healthy ecosystems improves the quality of life for present and future generations.

The *Millenium Ecosystem Assessment*, a United Nations study completed in 2005, highlighted the need for all development to address considerations in three key arenas: social, environmental, and economic (MEA, 2003). Unless all three aspects are equally vibrant, true sustainability is not possible. A sustainable site also needs to take into account the challenges on all three fronts. An environmentally sustainable site that does not engage its users on multiple levels – physical, aesthetic, cultural, spiritual – will lose crucial human stewardship. By the same token, creation and maintenance of the site must be economically feasible for the site to exist at all.

In view of the pressing need for an economy less reliant on fossil fuels and more attuned to potential climate change, the SSI hopes to encourage land design, development, and management professional to engage in a re-evaluation of conventional practices – a new valuation of ecosystem services – so that built landscapes will support natural ecological functions throughout the life cycle of each site, adopting the philosophy of low impact development.

Beginning in April 2010, a number of pilot projects will help test and refine the *Guidelines and Performance Benchmarks 2009* and its rating system over the course of two years. For more information on the pilot program, visit http://www.sustainablesites.org/pilot/ .

## 6-D.2.0. THE ECONOMICS OF SUSTAINABLE DESIGN

The central message of the Sustainable Sites Initiative is that any landscape – whether the site of a large subdivision, a shopping mall, a park, an office building, or even an individual home – holds the potential both to improve and to regenerate the natural benefits and services provided by ecosystems in their undeveloped state. These benefits – such as the supply and regulation of clean air and water, the provision of food and renewable resources, and the decomposition of waste, to name only a few – are essential to the health and well-being of humans and all other life on the planet. President Theodore Roosevelt stated a similar notion: "The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased, not impaired, in value" (ASLA et al., 2009a).

In reality, most people often underestimate or simply ignore these benefits and services when making land use decisions, only to realize later how expensive and sometimes impossible it is to replicate them once they are lost. Yet efforts to build landscapes that preserve and restore healthy ecosystems face a significant challenge – namely, persuading decision-makers that the cost of changing conventional methods of landscape design, development, and maintenance is money well spent.

Persuasion must begin with an accurate accounting of what the benefits of ecosystems are worth to the economies of our cities and towns, to developers and individuals. As noted in **Section 6-D.1.0** above, one estimate of the monetary value of the collective ecosystems services is $33 trillion annually– nearly twice the value of the global gross national product of $18 trillion, both figures in 1997 dollars (Costanza et al., 1997). An accurate accounting must take into consideration how the adoption of sustainable practices can not only be cost-effective for both public and private entities, but also can leverage additional costs and multiple benefits.

In fact, the elements in a functioning ecosystem are so highly interconnected that unsustainable approaches to land development and associated management practices can have a devastating ripple effect throughout the system. Specific to stormwater management, the following examples of sustainable approaches demonstrate how thoughtful design, construction, operations and maintenance can reduce construction and life-cycle costs while enhancing an restoring ecosystem services that would otherwise be lost.

### 6-D.2.1. Treating Water as a Resource

As discussed in **Chapter 4**, freshwater resources are under duress all over the world, and Virginia is no exception. Demand for water has tripled in the United States in the last 30 years, even though the population has grown only 50 percent. Globally, demand for water is doubling every 20 years. As water rates rise, the imbalance between supply and demand has become so striking that investment bank Goldman Sachs has dubbed water "*the petroleum of the next century*" (Cooper, 2008). Yet two practices, both traditionally accepted among land design, development, and management professionals, not only contribute to the imbalance but also ignore the looming crisis.

- ***Undervaluing rain.*** In most cities and towns around the country, rainfall is treated as waste, to be funneled directly from roof gutters to sewers or streams. In older cities, this stormwater flows into combined sewer/stormwater systems that flow to sewage treatment plants, thus raising the cost of purifying waste water. In heavy storms, these combined sewer systems can overflow, dumping raw sewage into fresh water. Rather than getting rid of stormwater runoff as quickly as possible, a sustainable approach to stormwater management would find ways to harvest it on site (using cisterns or surface ponds) and use it for groundwater recharge, irrigation, ornamental water features, drinking water (treated), and other domestic uses, potentially lowering water and sewer utility costs.

- ***Wasteful Irrigation.*** Irrigation of unsustainable landscapes accounts for more than a third of residential water use – more than 7 billion gallons of potable water *per day* nationwide (EPA, 2008). With the compaction of soils a common condition in developed areas (see **Section 6-D.2.2** below, *Valuing Soils*), the infiltration rates of water are significantly reduced, causing much of the water used to irrigate lawns to end up as runoff or evaporation, instead of filtering down to recharge the water table. A sustainable approach to landscape design would minimize or eliminate the use of potable water or the drawing off of natural surface water or groundwater for landscape irrigation once plants are established. An effective alternative would be to employ rainwater harvesting techniques to supply water for irrigation systems at residences, commercial office parks, golf courses, etc., potentially lowering water utility costs.

### 6-D.2.2. Valuing Soils

The undervaluation of soils is one of the most significant failings of the conventional development approach. For example, a frequent consequence of standard construction practices is compaction of the soil, which seriously damages soil structure by shrinking the spaces between soil particles available to hold air and water. If not restored, compacted soil can start a spiral of degradation.

- ***Damage to Vegetation.*** Compacted soil particles restrict a plant’s root growth and its access to nutrients. If soil compaction continues, vegetation becomes unhealthy and unsightly and eventually dies or, making the soils vulnerable to erosion.
- ***Reduced Infiltration.*** Compacted soils are less able to absorb water, which reduces the recharge of groundwater and aquifers.
- ***Excess Runoff.*** Reduced infiltration leads to increases in the volume of runoff and the probability of flooding. On developed sites where there is widespread use of impervious material such as concrete and asphalt, even more runoff is likely, as reflected in changing *runoff curve numbers* (see **Figure 6-D.3**).
- ***Water Pollution.*** Without a sustainable approach to managing water on-site, excess runoff damages soils and vegetation in one area, and also creates further hazards downstream – exponentially so during heavy rains or storm events. As noted in **Chapter 4**, water leaving developed sites can contain a host of pollutants, depending on the type of development or other land use. These pollutants may range from excessive nutrients, oil, grease, and heavy metals to contaminants such as E. coli, hepatitis A, and persistent bioaccumulative toxic (PBT) chemicals. Stormwater runoff is one of the leading sources of pollution for all water body types in the United States, with impacts that escalate with increased development and urbanization (EPA, 2007a). Furthermore, as noted elsewhere in this Handbook, stormwater runoff is the only steadily increasing source of pollution in the Chesapeake Bay watershed of Virginia. Around the country, polluted and contaminated stormwater runoff accounts for 70 percent of

water pollution in urban areas and is the leading cause of poor water quality and the degradation of aquatic habitat (Loizeaux-Bennet, 1999).

In a sustainable approach to construction, a soil management plan communicated to contractors prior to construction would limit disturbance of healthy soil, assist soil restoration efforts, and define the location and boundaries of all vegetation and soil protection zones.

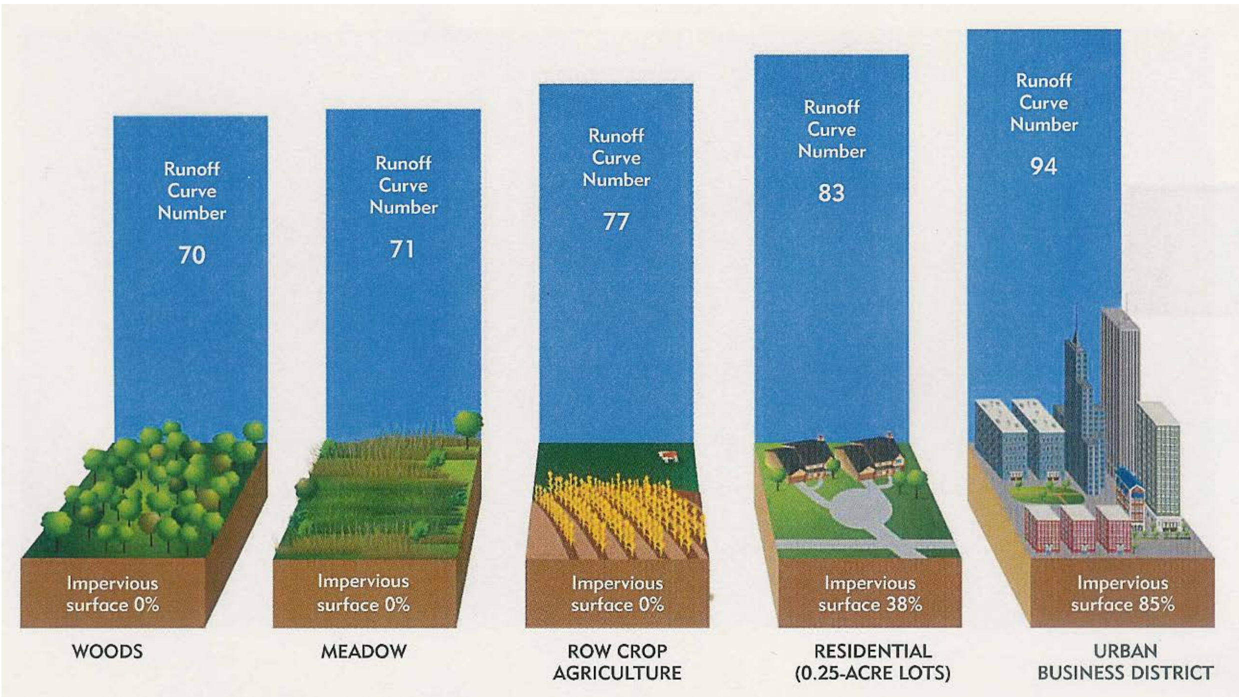


***Figure 6-D.3. Runoff Curve Numbers for Different Site Types.*** *The runoff curve number is a product of empirical data from many sites across the country. It takes into account the amount of rainfall that is intercepted by vegetation, stored in surface depressions, and infiltrated. Any rainfall not retained on site becomes runoff. All sites in this Figure are assumed to have similar slopes and similar soils. However, as development increases – from woods to row crop agriculture to residential and urban landscapes – so does soil compaction. Compaction and increasing amounts of impervious area result in less water retained on-site and more of it running off, thus raising a site's curve number. A higher curve number, in turn, corresponds to a greater predicted runoff volume (see* ***Figure 6-D.4,*** *next page).* Source: Source: ASLA et al. (2009a)

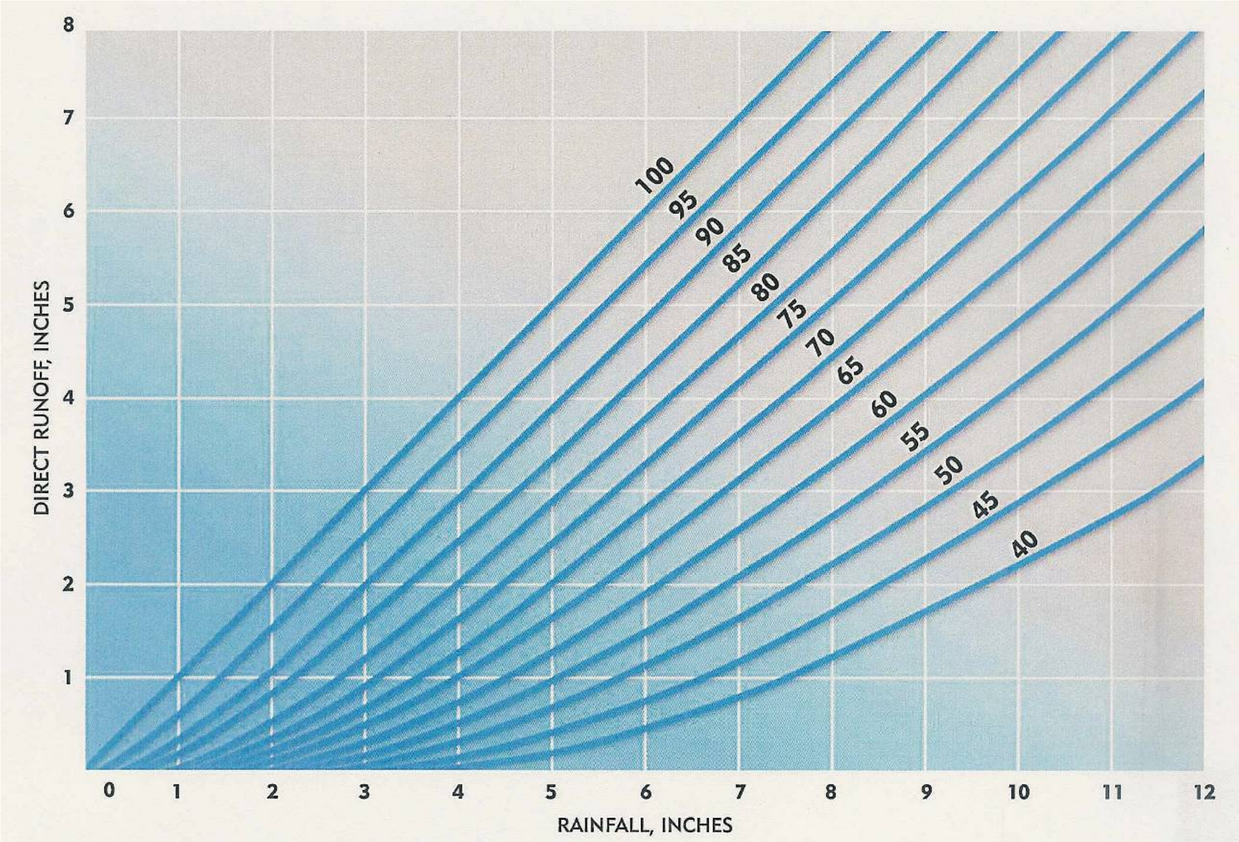


***Figure 6-D.4. Predicting Stormwater Runoff.*** The runoff potential of sites varies with their runoff curve numbers, which characterize a site's response to long-term patterns of precipitation. Sites with higher curve numbers will produce more runoff than sites with lower curve numbers for the same amount of rainfall. For example, with 6 inches of rain, a site with a curve number of 40 yields just over 1/2-inch of runoff, while a site with a curve number of 90 yields produces nearly 5 inches of runoff.

### 6-D.2.3. Preserving Vegetative Cover

Removing existing vegetation disturbs soils and has other consequences as well. Without vegetation, a site loses its natural capacity for stormwater management, filtration, and groundwater recharge. Reduced vegetative cover also affects soil health, because vegetation maintains soil structure, contributes to soil organic matter, and prevents erosion.

- ***Excess Sedimentation.*** Removing vegetation increases the likelihood of erosion, which contributes to increased sediment runoff. Sedimentation is a major cause of polluted rivers and streams in the United States, second only to pathogens. Sediment runoff rates from construction sites can be up to 20 times greater than agricultural sediment loss rates and 1,000 to 2,000 times greater than those of forested lands (EPA, 2005)
- ***Increased Greenhouse Gases.*** Because so much organic carbon is stored in soils, significant amounts of carbon dioxide can be emitted when soils are disturbed. Disturbed soils also release substantial amounts of methane and nitrous oxide, both gases that trap heat even more effectively than carbon dioxide (Flannery, 2005; Smith, 2003). Although all of these

greenhouse gases are emitted as part of natural nutrient cycling, the natural balance is upset by increased soil erosion and by activities such as tillage and fertilizer application, all of which increase the natural emission rates.

By adopting a plan with defined vegetation protection zones, a sustainable approach to site design and construction would preserve or restore appropriate plant biomass on the site as well as preserve native plant communities and mature trees.

### 6-D.2.4. Conserving Material Resources

Materials are natural resources that have been extracted, processed, and/or manufactured for human use. One way of evaluating a product's sustainability is to look at the energy and resource consumption involved, from the extraction of raw materials through processing and manufacturing, to the product's use and disposal or recycling. However, conventional attitudes toward materials in society as a whole have not been focused on conserving either resources or energy. The land development and management industries are no exception.

- ***Yard Waste.*** Yard and landscape trimmings are a significant contributor to landfills. In 2007, approximately 33 million tons of yard waste entered the municipal waste stream, representing 13 percent of total municipal waste in the United States (EPA, 2007b).
- ***Construction Waste.*** An estimated 170 million tons of building-related construction and demolition wood waste are generated each year in the United States (EPA, 2003). Recoverable wood from construction and demolition could be reused in new applications, thereby reducing the need for virgin timber.

A sustainable approach to materials use in landscapes begins with an assessment of the existing site – both built and non-built features – and a design that seeks to incorporate and reuse as much of the existing site materials as practicable. For example, composting vegetation trimmings on-site would provide an excellent source of soil nourishment. Careful materials selection can also reduce the energy used in both the production and the transport of the materials, thereby decreasing greenhouse gas emissions and the impact on the global climate. For example, fly ash (a by-product of coal combustion) could be a substitute for energy-intensive portland cement in the production of concrete. Each ton of fly ash used to replace portland cement reduces greenhouse gas emissions by approximately one ton – equivalent to the emissions released by driving about 2,500 miles in an average car (Mehta, 2001). Selecting locally produced materials reduces the amount of energy used for transport, which also reduces greenhouse gas emissions.

The concept of the *waste hierarchy*, depicted in **Figure 6-D.5**, is that the more sustainable the practice, the more efficient the use of resources. Prevention consumes the least energy and produces the least volume of waste, while disposal is the most wasteful practice. Sustainable practices have the added benefits of reducing greenhouse gas emissions, protecting public health through safe management of potentially hazardous substances, and protecting soils and groundwater.

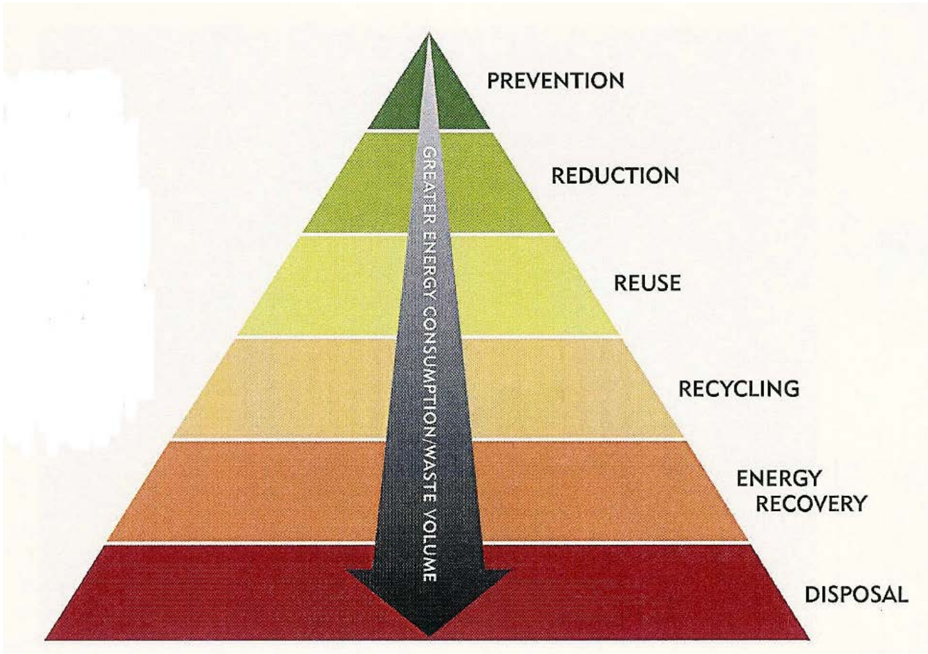


***Figure 6-D.5. The Waste Hierarchy***

## 6-D.2.5. Accounting for Direct and Indirect Benefits

Given the environmental cost of unsustainable land and development practices, a more sustainable approach is certainly desirable, but at what price? Those who make spending decisions in any field are accustomed to considering the trade-offs needed among economic, environmental, and social needs and constraints. However, often these trade-offs are evaluated based on incomplete information. That is, the full direct and indirect economic value of the goods and services produced by a healthy environment – and the economic consequences of an impaired ecosystem – are not fully understood and not taken into account.

The economic value of benefits for which markets currently exist is relatively easy to quantify, as is the case with the commercial harvest of fish or timer, for example. However, even these relatively straightforward market prices do not usually include such external effects as the artificial price elevation for timber and agricultural products that results from government subsidies or the cost of cleaning up resulting pollution, no matter who pays for it.

Measuring the economic significance of benefits for which markets do not exist is even more challenging. For example, what is the economic value of an aesthetic or cultural or educational experience of nature, or the value of an endangered species? However, in recent decades, economists have developed and tested techniques that can approximate the economic values of some of these benefits, with methods and results subjected to peer review in academic journals and presentations at scholarly conferences (e.g., see NRC, 2004). The following are some examples:

- ***Energy Savings.*** Many ecosystem services have values that take the form of cost savings, which a number of studies have begun to quantify. For example, the local climate regulation provided by shade trees results in an avoided cost for summertime electricity usage for the residence or commercial building cooled by that shade. Trees also block wind, potentially reducing demand for heating during the winter months. Studies conducted by American Forests found that tree canopy reduces residential home cooling costs, saving an average of between $11 per household per year in Portland, Oregon, and $28 per household per year in Atlanta, Georgia (American Forests, 2001). Multiplied across the region, this household benefit can add up. In the Atlanta region, savings in home cooling costs could amount to $2.8 million per year with adequate tree canopy.

- ***Water Treatment Savings.*** Similarly, when an urban forest prevents thousands of gallons of stormwater runoff from flowing into a municipal sewer system, that municipality saves money in water treatment. For example, a study by the U.S. EPA found that a 2,500-acre wetland in Georgia saves $1 million in water pollution abatement costs each year (EPA 2007c). In New York City, urban trees intercept almost 890 million gallons of rainwater each year, preventing that much runoff from entering storm sewers and saving the city an estimated $35 million annually in stormwater management costs alone (Peper et al., 2007).
- ***Air Cleansing.*** Trees also provide an air-cleansing benefit. In the Chicago area, urban trees filter an estimated 6,000 tons of air pollutants each year, providing air cleansing valued at $9.2 million (McPherson et al., 2994).
- ***Habitat and Species Preservation.*** Along with habitat loss, exotic invasive species are a major cause of loss of biodiversity and species. Increasing the use of native plants in landscape design reduces the risk from invasive species and helps bolster the wild native plant populations. This practice can also save considerable money. In the United States, exotic invasive species have been responsible for $38 billion of annual damage (Pimentel et al., 2000).
- ***Water Supply.*** On a broader scale, New York City took a long-term ecosystem view of protecting its drinking water supply. Starting in 1992, the city began acquiring thousands of acres of watershed lands and working with communities in the watershed on the need for environmentally sensitive development. The city's planned investment – approximately $1.5 billion over the course of ten years – saved it anywhere from $4 billion to $6 billion in construction costs and an estimated $300 million in annual operations costs for a new water filtration plant that it no longer had to build. The new treatment plant would have doubled or tripled rate payers' bills; by contrast the provisions of the watershed protection plan increased the average residential customer's water bill by only $7 per year (Archives of the Mayor's Press Office, 1996).

In addition, according to a study by the U.S. EPA (2007a), in the vast majority of cases, implementing thoughtfully selected LID/ESD practices saves money – for developers, property owners, and communities alike, as demonstrated by the following examples and **Table 6-D.1** below:

- ***Preserving Forested or Natural Areas.*** This can save up to $10 per square foot or $435,000 per acre over conventional landscape solutions.
- ***Balancing Cut and Fill on a Site.*** This can save up to $100 per cubic yard in haul costs.
- ***Using On-Lot Rain Gardens and Bioretention Areas.*** This can save up to $4,800 per residential lot over conventional engineered solutions, such as standard stormwater pond costs, and up to 75% of stormwater utility fees per residential lot. (Gap Creek, 2000; Somerset, MD, 2005; Kensington Estates, WA, 2001)

- ***Creating Narrow Streets (24 feet wide) versus Wide Streets (32 feet wide).*** This can save up to $30 per linear foot in street costs.
- ***Shade trees on the South Side of Buildings.*** This can save up to $47 per tree per year in energy costs. (Peper, 2007)
- ***Vegetated Roofs.*** These can retain more than 75% of rainfall annually, reducing downstream stormwater management costs. (ASLA Green Roof, 2007)
- ***Recycling Construction Waste.*** This can save tens of thousands of dollars in haul costs, dump fees, and material costs. (Stapleton, 2006).

***Table 6-D.1. Summary of Cost Comparisons Between Conventional and LID/ESD Approaches***

| Project | Conventional Development Cost ($) | LID/ESD Cost ($) | Cost Difference ($) | Percent Difference (%) |
|---|---|---|---|---|
| **2nd Avenue SEA Street** | 868,803 | 651,548 | 217,255 | 25 |
| **Auburn Hills** | 2,360,385 | 1,598,989 | 761,396 | 32 |
| **Bellingham City Hall** | 27,600 | 5,600 | 22,000 | 80 |
| **Bellingham Bloedel Donovan Park** | 52,800 | 12,800 | 40,000 | 76 |
| **Gap Creek** | 4,620,600 | 3,942,100 | 678,500 | 15 |
| **Garden Valley** | 324,400 | 260,700 | 63,700 | 20 |
| **Kensington Estates** | 765,700 | 1,502,900 | -737,200 | -96 |
| **Laurel Springs** | 1,654,021 | 1,149,552 | 504,469 | 30 |
| **Mill Creek** | 12,510 | 9,099 | 3,411 | 27 |
| **Praire Glen** | 1,004,848 | 599,536 | 405,312 | 40 |
| **Somerset** | 2,456,843 | 1,671,461 | 785,382 | 32 |
| **Tellabs Corporate Campus** | 3,162,160 | 2,700,650 | 461,510 | 15 |
| *Conventional Development Cost* refers to costs incurred or estimated for a traditional stormwater management approach, where *LID/ESD Cost* refers to costs incurred or estimated for using LID or ESD practices. *Cost Difference* is the difference between the conventional development cost and the LID/ESD cost. *Percent Difference* is the cost savings relative to the conventional development cost. Negative values denote increased cost for the LID/ESD design over conventional development costs. *NOTE:* The *Mill Creek* costs are reported on a per-lot basis. | | | | |

Beyond cost reductions and savings, the communities subject to the EPA study also experienced a number of associated amenities and economic benefits, including aesthetic amenities, improved quality of life, improved habitat, and enhanced property values. Although the EPA study did not attempt to monetize these additional benefits or consider them in its calculations of each project's costs, it found the additional economic benefits to be "real and significant" (EPA, 2007a). Studies like this offer on-going evidence of the satisfying return on investment to developers, communities, and individuals from adopting sustainable practices of land development and management.

### 6-D.2.6. Development Costs versus Life Cycle Costs

Many communities around the nation are recognizing the need to begin developing in a sustainable manner. To set the example for other developers, these communities have adopted requirements to follow LEED® guidelines in the design and construction of public buildings within their jurisdictions. However, one key to the willingness of local governments to make such a commitment is that they will continue to own and operate these properties, once developed.

In contrast, many private development projects, especially those involving construction of residential neighborhoods, are constructed with the intent that they will be sold to others upon completion. Therefore, the only costs these developers are concerned with are those involving design and construction, and they are typically motivated to keep their costs as low as possible to achieve a quality development and, thus, maximize their profit margin. However, this motivation can be a deterrent to achieving sustainable designs, because many of the economies that result from sustainable design are reflected in long-term, "life-cycle" costs, such as lower utility costs, lower maintenance costs, and intangible values pertaining to aesthetics, wildlife habitat, etc. The temptation is to ignore the cost to achieve such long-term economies because the developer himself will not benefit directly from those project enhancements.

Of course, some sustainable design objectives *will* result in initial project construction savings as well as achieve sustainable results (e.g., using stormwater management practices that result in lower overall drainage system costs, minimizing imperviousness, using narrower streets and smaller parking rations or parking bay dimensions). However, there are really only two strategies that are likely to achieve the full range of sustainable design outcomes. The first is to rely on the good will of project developers and designers, depending on their recognition of the need for and wisdom of sustainable design and understand that our culture must start to build in ways that protect our ecosystem services and reduce energy consumption – even if costs more initially and reduces their profits somewhat. History and economic stress argue against this strategy achieving much success on its own.

The second strategy is reflected in communities who decide, as a matter of public policy, that they want to achieve greater sustainability within their own small sphere of influence. Such communities may follow up such a policy decision with green infrastructure planning, appropriate regulations, and/or zoning or comprehensive plan amendments that translate the policy into local requirements for the building industry to employ sustainable design. This is a big step, and it would typically require a strong measure of citizen support, because it could place a community at a disadvantage in competing with its neighbors for economic growth and development.

In the long run, to achieve truly sustainable development on a consistent and widespread basis, the public will have to be made more aware of how important sustainable design and development is for future generations and even, in the long term, national security (energy security, water availability, etc.). Only then is there likely to be sufficient public support and pressure on the development industry to adopt sustainable practices.

## 6-D.3.0. SUSTAINABLE SITES INITIATIVE SCORING CATEGORIES

In the course of identifying the specific and measurable criteria for site sustainability, members of the SSI's committees recognized the need to acknowledge that different regions of the country have distinct requirements and conditions. The committees therefore worked to develop performance benchmarks that would shift the market toward sustainability while remaining practical and achievable on a regional basis. The *Guidelines and Performance Benchmarks 2009* (ASLA et al., 2009b) encompass a series of prerequisites and credits for measuring site sustainability. The document explains the credit point system and rating scale. Benchmarks outlined under *prerequisites* are *required* and must be met in order for a site to participate in this voluntary program. Benchmarks outlined under *credits* are *optional*, but a certain number of them must be attained for a project to achieve eventual recognition as a Sustainable Site. The following is the list of prerequisites and credits:

***1.*** ***Site Selection*** (21possible points)
***Select locations to preserve existing resources and repair damaged systems***
***Prerequisite 1.1:*** Limit development of soils designated as prime farmland, unique farmland, and farmland of statewide importance
***Prerequisite 1.2:*** Protect floodplain functions
***Prerequisite 1.3:*** Preserve wetlands
***Prerequisite 1.4:*** Preserve threatened or endangered species and their habitats
*Credit 1.5:* Select brownfields or greyfields for redevelopment (5–10 points)
*Credit 1.6:* Select sites within existing communities (6 points)
*Credit 1.7:* Select sites that encourage non-motorized transportation and use of public transit (5 points)

***2.*** ***Pre-Design Assessment and Planning*** (4 possible points)
***Plan for sustainability from the onset of the project***
***Prerequisite 2.1:*** Conduct a pre-design site assessment and explore opportunities for site sustainability
***Prerequisite 2.2:*** Use an integrated site development process
*Credit 2.3:* Engage users and other stakeholders in site design (4 points)

**3.** ***Site Design – Water*** (44 possible points)
***Protect and restore processes and systems associated with a site's hydrology***
***Prerequisite 3.1:*** Reduce potable water use for landscape irrigation by 50 percent from established baseline
*Credit 3.2:* Reduce potable water use for landscape irrigation by 75 percent or more from established baseline (2–5 points)
*Credit 3.3:* Protect and restore riparian, wetland, and shoreline buffers (3–8 points)
*Credit 3.4:* Rehabilitate lost streams, wetlands, and shorelines (2–5 points)
*Credit 3.5:* Manage stormwater on site (5–10 points)
*Credit 3.6:* Protect and enhance on-site water resources and receiving water quality (3–9 points)
*Credit 3.7:* Design rainwater/stormwater features to provide a landscape amenity (1–3 points)
*Credit 3.8:* Maintain water features to conserve water and other resources (1–4 points)

***4.*** ***Site Design – Soil and Vegetation*** (51 possible points)
***Protect and restore processes and systems associated with a site's soil and vegetation***

***Prerequisite 4.1:*** Control and manage known invasive plants found on site
***Prerequisite 4.2:*** Use appropriate, non-invasive plants
***Prerequisite 4.3:*** Create a soil management plan
*Credit 4.4:* Minimize soil disturbance in design and construction (6 points)
*Credit 4.5:* Preserve all vegetation designated as special status (5 points)
*Credit 4.6:* Preserve or restore appropriate plant biomass on site (3–8 points)
*Credit 4.7:* Use native plants (1–4 points)
*Credit 4.8:* Preserve plant communities native to the ecoregion (2–6 points)
*Credit 4.9:* Restore plant communities native to the ecoregion (1–5 points)
*Credit 4.10:* Use vegetation to minimize building heating requirements (2–4 points)
*Credit 4.11:* Use vegetation to minimize building cooling requirements (2–5 points)
*Credit 4.12:* Reduce urban heat island effects (3–5 points)
*Credit 4.13:* Reduce the risk of catastrophic wildfire (3 points)

5. ***Site Design—Materials Selection*** (36 possible points)
   ***Reuse/recycle existing materials and support sustainable production practices***
   *Prerequisite 5.1:* Eliminate the use of wood from threatened tree species
   *Credit 5.2:* Maintain on-site structures, hardscape, and landscape amenities (1–4 points)
   *Credit 5.3:* Design for deconstruction and disassembly (1–3 points)
   *Credit 5.4:* Reuse salvaged materials and plants (2–4 points)
   *Credit 5.5:* Use recycled content materials (2–4 points)
   *Credit 5.6:* Use certified wood (1–4 points)
   *Credit 5.7:* Use regional materials (2–6 points)
   *Credit 5.8:* Use adhesives, sealants, paints, and coatings with reduced VOC emissions (2 points)
   *Credit 5.9:* Support sustainable practices in plant production (3 points)
   *Credit 5.10:* Support sustainable practices in materials manufacturing (3–6 points)

6. ***Site Design—Human Health and Well-Being*** (32 possible points)
   ***Build strong communities and a sense of stewardship***
   *Credit 6.1:* Promote equitable site development (1–3 points)
   *Credit 6.2:* Promote equitable site use (1–4 points)
   *Credit 6.3:* Promote sustainability awareness and education (2–4 points)
   *Credit 6.4:* Protect and maintain unique cultural and historical places (2–4 points)
   *Credit 6.5:* Provide for optimum site accessibility, safety, and wayfinding (3 points)
   *Credit 6.6:* Provide opportunities for outdoor physical activity (4–5 points)
   *Credit 6.7:* Provide views of vegetation and quiet outdoor spaces for mental restoration (3–4 points)
   *Credit 6.8:* Provide outdoor spaces for social interaction (3 points)
   *Credit 6.9:* Reduce light pollution (2 points)

7. **Construction** (21 possible points)
   ***Minimize effects of construction-related activities***
   ***Prerequisite 7.1:*** Control and retain construction pollutants
   ***Prerequisite 7.2:*** Restore soils disturbed during construction
   *Credit 7.3:* Restore soils disturbed by previous development (2–8 points)
   *Credit 7.4:* Divert construction and demolition materials from disposal (3–5 points)
   *Credit 7.5:* Reuse or recycle vegetation, rocks, and soil generated during construction (3–5 points)
   *Credit 7.6:* Minimize generation of greenhouse gas emissions and exposure to localized air pollutants during construction (1–3 points)

8. ***Operations and Maintenance*** (23 possible points)
   ***Maintain the site for long-term sustainability***
   ***Prerequisite 8.1:*** Plan for sustainable site maintenance
   ***Prerequisite 8.2:*** Provide for storage and collection of recyclables
   *Credit 8.3:* Recycle organic matter generated during site operations and maintenance (2–6 points)
   *Credit 8.4:* Reduce outdoor energy consumption for all landscape and exterior operations (1–4 points)
   *Credit 8.5:* Use renewable sources for landscape electricity needs (2–3 points)
   *Credit 8.6:* Minimize exposure to environmental tobacco smoke (1–2 points)
   *Credit 8.7:* Minimize generation of greenhouse gases and exposure to localized air pollutants during landscape maintenance activities (1–4 points)
   *Credit 8.8:* Reduce emissions and promote the use of fuel-efficient vehicles (4 points)

9. ***Monitoring and Innovation*** (18 possible points)
   ***Reward exceptional performance and improve the body of knowledge on long-term sustainability***
   *Credit 9.1:* Monitor performance of sustainable design practices (10 points)
   *Credit 9.2:* Innovation in site design (8 points)

The SSI has developed a 250-point rating system providing designers the opportunity to achieve certification of a site as a *Sustainable Site*. Remember that the prerequisites of each category are *required* and therefore are not assigned a point value. Credited activities are assigned a point value and, in many cases, offer a range of points, providing projects additional flexibility in selecting the level (or benchmark) that is appropriate and achievable for them. The certification rating system is shown in **Table 6-D.2**.

***Table 6-D.2. Sustainable Sites Initiative Rating Scale***

| Award Level | Total Points (250 max.) |
|---|---|
| One Star | 100 points (40% of total available points) |
| Two Stars | 125 points (50% of total available points) |
| Three Stars | 150 points (60% of total available points) |
| Four Stars | 200 points (80% of total available points) |

Many of the SSI's guidelines and performance benchmarks integrate or overlap with the Environmental Site Design practices described in this chapter, aimed at more effective management of stormwater runoff. Other benchmarks – such as those relating to site selection and pre-design, choices of construction materials, design for human health and well-being, construction, operation and maintenance, and monitoring – are aimed more at general site sustainability and have little or nothing to do with stormwater management. Those guidelines and benchmarks will not be referenced herein.

The benchmarks that relate most to Environmental Site Design are benchmark categories 3 (Site Design – Water) and 4 (Site Design – Soil and Vegetation). Specific benchmarks will be referenced, where applicable, so designers will understand what SSI certification credits may apply to the use of particular ESD practices. However, it is important to understand that in order to achieve the number of points constituting eligibility for a certification level, an applicant will need points from the other categories as well.