

Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes

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Forward

In late summer 2010, at the request of the Chair of the Council on Environmental Quality, the United States Botanic Garden (administered by the Office of the Architect of the Capitol), coordinated a working group to prepare recommendations for Guidance on Sustainable Practices by Federal Agencies for Designed Landscapes. The working group included representatives of the Environmental Protection Agency, the General Services Administration, the Department of the Interior, the Department of Agriculture, the National Capital Planning Commission, the Advisory Council on Historic Preservation, the Department of Homeland Security, the Department of Defense, and the Department of Veterans Affairs, and benefited from technical assistance provided by the Lady Bird Johnson Wildflower Center at the University of Texas at Austin.

The United States Botanic Garden was asked to lead the effort in part because in 2009, the Sustainable Sites Initiative or SITES™, (a partnership of the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at the University of Texas, Austin, and the United States Botanic Garden) issued a document describing best practices and performance goals for the design, construction, and maintenance of sustainable landscapes. *The Sustainable Sites Initiative: Guidelines and Performance Benchmarks 2009* focuses on the area beyond the building footprint and any built landscape. A companion document, *The Case for Sustainable Landscapes*, provides economic and environmental arguments in support of sustainable landscape practices.¹ Knowledge gained in developing the Sustainable Sites Initiative served as background for many of the recommendations provided by the working group.

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¹ <http://www.sustainablesites.org/report/>.

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I. Introduction

On October 5, 2009, President Obama signed Executive Order (E.O.) 13514, “Federal Leadership in Environmental, Energy and Economic Performance.” The E.O. states that it is “the policy of the United States that Federal agencies shall increase energy efficiency; measure, report, and reduce their greenhouse gas emissions from direct and indirect activities; conserve and protect water resources through efficiency, reuse, and stormwater management; eliminate waste, recycle, and prevent pollution;...[and] strengthen the vitality and livability of the communities in which Federal facilities are located.”

To help achieve these policy goals, this document provides guidance to improve the sustainability of Federal landscape practices. This guidance should be used by Federal agencies for landscape practices when constructing new, or rehabilitating existing, owned or leased facilities or when landscaping improvements are otherwise planned.

The Federal government controls or owns more than 41 million acres of land² and 429,000 building assets, comprising 3.34 billion square feet of space in the United States.³ Consequently, landscaping practices by Federal agencies can have significant impacts on the environment. Decisions regarding the development and maintenance of Federal real property under Federal control and jurisdiction can provide an opportunity to promote the sustainable use of water and land, conserve soils and vegetation, support natural ecosystem functions, conserve materials, promote human health and well-being, and ensure accessibility for all users, including those with disabilities.⁴

II. Applicability

These guidelines apply to all Federal agencies and activities that are subject to the provisions of Executive Order 13514. They do not supersede statutes, regulations or applicable agency requirements that may be more specific and/or more stringent. These guidelines apply to agencies constructing new, or rehabilitating existing owned or leased facilities or otherwise implementing landscaping practices on agency owned or leased land or space. These guidelines are intended to support improved environmental performance of a site beyond the building footprint in agency efforts to meet the goals of E.O. 13514.

Agencies should strive to balance natural resource management priorities with development needs (energy, security, infrastructure) while considering cultural, recreational, and environmental resources inherent in the landscape. These guidelines are intended to enhance, not inhibit, planning, operations and maintenance.

² Federal Real Property Council’s FY2008 Federal Real Property Report www.gsa.gov/graphics/ogp/FY_2008_Real_Property_Report.pdf

³ Federal Real Property Council’s FY2009 Federal Real Property Report http://www.gsa.gov/graphics/ogp/FY2009_FRPR.pdf

⁴ See Architectural Barriers Act of 1968, as amended, 42 USC 4151, et seq., and Section 504 of the Rehabilitation Act of 1973, as amended, 29 USC 794.

III. Background

The best practices and performance goals for the design, construction, and maintenance of sustainable landscapes described in this document were drawn from Federal agency subject matter experts and from the *2009 Sustainable Sites Initiative or (SITES™)*. The following principles served as a foundation for the recommendations in this guidance.

- **Do no harm:** Avoid changes to the site that will degrade the natural environment and promote reuse and improvement of sites with previous disturbance or development.
- **Precautionary principle:** Do not create risk to human and environmental health. Examine a full range of alternatives—including no action.
- **Design with nature and culture:** Create and implement designs that are responsive to economic, environmental, and cultural conditions at local and regional levels.
- **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.
- **Use a systems thinking approach:** Understand and value the relationships in an ecosystem and sustain ecosystem services; strive to re-establish the integral and essential relationship between regenerative systems (natural processes) and human activity.⁵
- **Provide regenerative systems:** Provide future generations with a sustainable environment supported by regenerative systems and resources.
- **Support a living process:** Continuously re-evaluate assumptions and adapt to demographic and environmental change.
- **Use a collaborative and ethical approach:** Encourage direct and open communication among colleagues, clients, other agencies, manufacturers, and site users to link long-term sustainability with environmental stewardship.
- **Maintain integrity in leadership and research:** Implement transparent and participatory leadership, develop research with technical rigor, and communicate new findings that foster sustainable landscapes in a clear, consistent, and timely manner.
- **Foster environmental stewardship:** In all aspects of site development and maintenance, foster an ethic of environmental stewardship with the understanding that healthy ecosystems improve the quality of life for present and future generations.

The recommendations in this document describe goals and strategies to achieve sustainable outcomes rather than specifying prescriptive solutions and technology. They are intended to inspire flexibility, innovation, and a culture change. They apply equally to new construction, major renovations, and existing sites and to a lesser extent alterations to existing small scale landscaping efforts. The recommendations accommodate regional differences and can be adapted to support diverse agency missions and policies. In addition, they assume that the user is aware of and will follow other related guidance documents such as the [Instructions for Implementing Sustainable Locations for Federal Facilities](#) and [Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the](#)

⁵ 1958. "Industrial Dynamics--A Major Breakthrough for Decision Makers", in: *Harvard Business Review*, Vol. 36, No. 4, pp. 37–66. Professor Jay W. Forrester Sloan School of Management, Massachusetts Institute of Technology

[Energy Independence and Security Act \(EISA\)](#) and any related instructions or guidance issued under E.O. 13514.

The recommendations are organized into nine sections based on the process of site development and guide an integrated team through the project phases. Agencies are strongly encouraged to develop and maintain a comprehensive sustainable landscape plan that encompasses the following elements.

- Site Selection and Planning
- Soils
- Water
- Vegetation
- Materials Selection
- Human Health and Well-Being
- Existing/Historic Facilities and Cultural Landscapes
- Construction
- Operations and Management

IV. Site Selection & Planning

For guidance on the siting of facilities, agencies should refer to [Instructions for Implementing Sustainable Locations for Federal Facilities](#).⁶ The *Sustainable Locations* document includes information on how site selection can promote transit-oriented development, walkability and bikeability, and support development in existing central business districts and town centers.

The planning stage of a sustainable landscape begins with an assessment of existing site conditions, resources, and opportunities by an integrated design team with expertise in landscape design, site engineering, and sustainable construction and maintenance practices. The information gathered during this stage can be used to evaluate opportunities and to incorporate existing resources into the site design. For example, microclimate conditions may influence building orientation and existing landscape materials may be reused or recycled.

Elements of the site selection and planning stage should reflect the complexity of the proposed action and include the following recommendations.

- a. **Assess opportunities for site sustainability:** This assessment should include environmental, economic, and social equity analyses and should inform decisions on site design, construction, operations, and maintenance. The assessment should determine if the site is a designed historic landscape and identify any contributing historic elements. Moreover, opportunities should be identified to protect and improve ecosystem services and sustainable strategies to guide the design, construction, operation, and maintenance of the site.

⁶ *Instructions for Implementing Sustainable Locations for Federal Facilities*
http://www.fedcenter.gov/Announcements/index.cfm?id=19448&page_id=1854

- b. **Use an integrated site development process:** A multidisciplinary team experienced in sustainable practices, historic buildings, and cultural landscapes should be included in an integrated design, planning and implementation process. The team should document the integrated site development process, develop a communications process, identify site sustainability principles and goals, create a program plan, engage stakeholders and user groups, develop and manage construction oversight strategies, and create a landscaping maintenance and monitoring plan. In addition, the team should conduct an assessment of cultural, historic, and archaeological resources and options for sustainable outcomes that minimize adverse effects to those resources.
- c. **Engage users and other stakeholders in the site design:** Stakeholders include site users, affected government agencies at the Federal, state, and local levels, and members of the affected community. Stakeholders should be engaged during the site design process to identify their needs and concerns, and local knowledge from the community should be utilized. Supplemental outreach and engagement may be required under the National Environmental Policy Act (NEPA),⁷ Section 106 of the National Historic Preservation Act (NHPA)⁸ and *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*.⁹
- d. **Avoid development of prime farmland:** Protect soils designated by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as prime farmland, unique farmland, or farmland of statewide importance.¹⁰ Additional information on the preservation of agricultural land is available in Section III, Soils, of the *Sustainable Sites Initiative Guidelines and Performance Benchmarks 2009*.
- e. **Preserve areas with permeable soils** (Hydrologic Soil Group Class A and B, as defined by the National Cooperative Soil Survey) to the extent possible, for use in storm water infiltration and groundwater recharge.
- f. **Protect floodplain functions:** Protect floodplain functions of the site by avoiding or limiting development within the 100-year floodplain.¹¹
- g. **Protect and conserve existing landscapes, forest and wilderness areas:** In urban settings, use existing buildings and building sites, and introduce trees and other vegetation on available lands. In rural and suburban settings, conserve forest and wilderness areas, and re-forest on available lands.
- h. **Preserve wetlands:** Coordinate with the Army Corps of Engineers to ensure all activities that impact wetlands are in compliance with Clean Water Act requirements. Avoid development of areas that contain wetlands, including isolated wetlands.¹² Enhance degraded wetlands to compensate for any wetland or other natural values lost as part of site development.
- i. **Preserve or restore continuous riparian buffer widths:** When feasible and appropriate, preserve or restore continuous riparian buffer widths for natural drainages including ephemeral and first order streams. When feasible and appropriate, use the most stringent recommended buffer width for the applicable stream order and ecoregion.

⁷ National Environmental Policy Act (NEPA): 42 U.S.C. § 4321 et seq. <http://ceq.hss.doe.gov/nepa/regs/nepa/nepaeqia.htm>

⁸ National Historic Preservation Act under Section 106 <http://www.nps.gov/history/local-law/nhpa1966.htm>

⁹ National Historic Preservation Act (NHPA): 16 U.S.C. § 470 et seq., and Section 106: 36 C.F.R. Part 800

¹⁰ Also see the Farmland Protection Act: http://www.nrcs.usda.gov/programs/fppa/pdf_files/FPPA_Law.pdf

¹¹ Also see Executive Order 11988 <http://water.epa.gov/lawsregs/guidance/wetlands/eo11988.cfm>

¹² Also see Executive Order 11990: <http://water.epa.gov/lawsregs/guidance/wetlands/eo11990.cfm>

Recommended buffer widths for water quality generally range from 50 feet to 175 feet, although smaller buffer widths may be applied to lower order streams. Riparian buffer widths of 300 feet or more have been recommended to maintain wildlife corridors along streams and rivers.

- j. **Minimize site disturbance:** Minimize the need to grade the site by concentrating development in areas with minimal non-engineered slopes and existing infrastructure and mitigate any construction disturbance. Avoid mass grading in favor of disturbing areas only as they are worked and stabilized before grading the next area.
- k. **Preserve historic properties, including landscapes and archaeological sites:** Protect properties and landscapes listed on, or eligible for, the National Register of Historic Places. Additional information on this type of development can be found in Section VIII of this document or in *Sustainable Strategies for Existing and Historic Facilities*.¹³ Where culturally significant buildings and landscapes exist, consider reuse of the buildings to minimize new materials use, waste, and negative effects on the landscape that can occur through construction, such as compaction and vegetation removal. Where possible, designate protection zones for areas containing archaeological sites and contributing features. Where adverse effects are unavoidable, minimize or mitigate those effects as required by law in the National Historic Preservation Act under Section 106.
- l. **Preserve threatened or endangered species and their habitats:** Avoid development of areas containing habitat for threatened or endangered plant and animal species.¹⁴
- m. **Improve linkages and connections to surrounding destinations and neighborhoods:** New development should connect to existing open space corridors, sidewalks, transit, bike lanes, trails, and street networks. It should also incorporate urban design features and elements from surrounding neighborhoods (streetscaping, wayfinding, etc) to ensure new development compliments existing community characteristics.
- n. **Develop a network of complete streets:** Where a project involves the development of a street network, the street design should support multiple modes of transportation in addition to ecosystem services.¹⁵ Streets should be designed to promote and facilitate safe pedestrian and bicycle activity.
- o. **Incorporate security design opportunities:** Thoughtful use and design of setback space can provide an opportunity to activate underutilized space, while increasing the safety of employees and integrating the building with the local community. Setback space can be used to enhance employee and community morale by preserving or enhancing open space, creating outdoor spaces for social interaction such as pedestrian plazas, gardens or amenity areas for employees and visitors. Permanent landscape security features such as tables, benches, seating walls, planters, and changes in topography may be incorporated instead of bollards or fences.

V. Soils

Soils are complex, dynamic, living systems with both biological and non-biological components. Soil provides a physical anchor for plants; a medium for water retention, infiltration, and

¹³ National Historic Preservation Act: <http://www.achp.gov/docs/nhpa%202008-final.pdf>; and Section 106 Regulations: <http://www.achp.gov/regs-rev04.pdf>

¹⁴ Endangered Species Act: 16 U.S.C. § 1531-1544: <http://water.epa.gov/lawsregs/guidance/wetlands/eo11990.cfm>

¹⁵ For additional information on the concept of complete streets, see: <http://www.completestreets.org>

availability; a site for exchange and retention of air, water and soluble nutrients; and a host for mycorrhizal association that aids water and nutrient uptake and the breakdown of plant organic matter.

Ecosystem services and environmental values associated with the soil ecosystem include water infiltration, water filtration, carbon sequestration, optimization of the vegetative biomass, and significant reductions in the use of potable irrigation water, fertilizers, and pesticides. Adverse influences such as compaction, chemical contamination, excessive slopes, and reduced organic matter and biological activity can negatively affect physical and biological conditions and thereby inhibit healthy soil processes. Where feasible, landscape practices should conserve, restore, and manage these essential processes and reflect the elements addressed below.

Soil Conservation

Existing native soils are highly valued and should be conserved. Soil physical integrity and chemical viability should be maintained over the long-term. Beyond being critical reservoirs of biological soil communities, pristine soil is usually the host for high-quality plant communities. Agencies should consider the following site design principles to address conservation of soil resources.

- a. **Identify and protect Vegetation and Soil Protection Zones (VSPZs):** As feasible, healthy soil should be conserved by mapping soils on site, performing tests of disturbed soils and reference soils,¹⁶ conserving the healthiest soils in topsoil salvage areas, and limiting work to appropriate sites for building construction. During construction, VSPZs should be protected with a fence or physical barrier that cannot be easily moved. Agencies should educate construction personnel regarding required protective measures and construction documents and specifications should explicitly state the consequences to construction personnel/contractors if boundaries are not respected and/or damage occurs. A VSPZ can encompass one plant or include groups of plants. To ensure adequate protection, boundaries for trees should extend out from the trunk, to a distance of two-foot radius (measured at ground level) per inch of diameter at breast height (DBH) or the full lateral extent of the actual root system.
- b. **Prevent Soil Compaction:** VSPZs should be considered as a method to avoid soil compaction during construction and maintenance. In addition, construction planning should be designed to preclude parking of all heavy equipment, vehicles, and materials storage within the footprint of the site to the extent possible.
- c. **Prevent/Mitigate Soil Erosion:** An erosion control plan should be implemented during construction so as to prevent damage or loss of critical soils during and after site construction. Where excessive slopes cannot be avoided, special provisions should be used to limit and mitigate soil losses.

Soil Management

The easiest method to ensure future soil health and integrity is the creation and implementation of a management plan that 1) identifies areas of highest soil quality and permeability, 2) limits damage to those soils, 3) protects salvaged topsoil, and 4) facilitates restoration of desired

¹⁶ U.S. Department of Agriculture Natural Resources Conservation Service <http://websoilsurvey.nrcs.usda.gov>

conditions for damaged soils. Agencies should consider the following site design principles to address management of soil resources.

- a. **Create a soil management plan:** A soil management plan protects on-site soil from contamination and compaction and establishes soil management and conservation priorities. It consists of a site plan including a soils map and grading plan, and indicates designated soil conservation areas. The soils management plan should be communicated to all construction contractors prior to construction in order to limit disturbance, assist soil restoration efforts, and define VSPZ locations and boundaries. Actions/techniques required for soil restoration should be included in site drawings and written into contract specifications.
- b. **Minimize soil disturbance in design and construction:** Identify and protect areas designated as VSPZs and other off-limit areas to construction and enforce construction limits with fences and on-site monitoring.
- c. **Salvage healthy top soil:** The term topsoil refers to the uppermost soil horizon and includes decayed organic and other materials capable of supporting vegetation. In order to conserve topsoil from site construction and excavation areas, topsoil should be completely removed prior to all construction. All topsoil removal should be done at the same time if possible to minimize compaction. In small areas where topsoil cannot be removed mechanically, removal should be performed manually. Topsoil containing hard soil, or large rock should be considered unsuitable and should be buried as fill. Topsoil should not be mixed with subsoil.
- d. **Topsoil contaminated with toxic substances:** Identify any contaminated soils prior to excavation through a Phase I or Phase II type of environmental assessment. Topsoil contaminated with toxic substances should be segregated from non-contaminated soils at all times. If regulated levels of toxic substances are present, determine if a regulatory response is required and if an assessment is warranted to identify the source and extent of the contamination. Remediation of contaminated soils may be required prior to or concurrent with site development.
- e. **Restore soils disturbed during construction and/or previous development:** Restoration techniques that improve disturbed soil conditions include amendment with organic matter (e.g., compost), reduction of compaction (by aerating, tilling or ripping) and restoration of nutrient profile. These techniques will positively affect infiltration rates, soil biology, and soil chemistry.¹⁷ Prior to construction, restoration goals should be established by using a reference site and soil testing should be completed for nutrient and textural characteristics. Techniques that preserve the functional and biological characteristics of the soil including soil salvage, soil amendment, and replacement topsoil should be considered as well as actions and techniques required for soil restoration in construction specifications.
- f. **Amend topsoil or provide topsoil as needed:** Compost is the best source of organic matter, because of its stability, biological activity, and soil structure building qualities. Organic compost materials should be selected from sustainable and renewable sources to amend topsoil on-site. A qualified horticultural or soil professional should be considered when selecting and balancing amendments for healthy plant growth. Quality guidelines for compost are a carbon-to-nitrogen ratio below 25:1, pollutant concentration limits

¹⁷ For additional information see SITES prerequisite 7.2

below U.S. EPA¹⁸ or applicable local regulations, and no viable weed seeds or invasive plant propagules.

- g. **Prepare areas for topsoil placement:** When preparing areas for topsoil placement, the area should be clear of construction debris. If severe compaction exists, where aerating or tilling the soil is not possible, then 6-18 inches of compacted soil should be removed. Soil composition, percolation testing, auguring, and other soil indicators will help determine the need for tilling or ripping.
- h. **Salvage on-site soil:** Site design should include plans for on-site soil salvage prior to construction. Wherever possible, balance cut and fill, and reuse existing soils in design instead of importing new materials to the site. Always protect stockpiled soils during construction by either covering over or seeding stockpiles to prevent erosion.

VI. Water

Conserving and protecting water resources through water efficiency, reuse, and stormwater management are vital to the goals of sustainable landscape practices. Integrating facility design with landscape design can conserve water, reuse properly treated wastewater and greywater (in accordance with local codes and regulations), harvest and use rainwater and snowmelt, reduce energy use, and protect and restore surface and ground water resources. Agencies should consider the following site design principles to address protection and conservation of water resources.

- Reduce or eliminate use of potable water for landscape irrigation and water features.
- Manage stormwater on-site to the extent practicable while protecting ground and surface receiving waters and ecosystems.
- Design water features to use harvested runoff or snowmelt and avoid use of potable water.
- Design structures with dual plumbing and backflow protection to allow for the use of harvested rainwater, greywater, or reclaimed wastewater for non-potable water use (e.g., toilet flushing).
- Protect and enhance on-site water resources such as streams, lakes, and wetlands.
- Protect riparian and shoreline buffers.
- Rehabilitate on-site aquatic resources to restore ecosystem functions.
- Where feasible, use drip irrigation and soil amendments to conserve water.
- Choose plant species which are native to the area and therefore likely to require less irrigation water.

Water Resource Goals

- a. **Reduce, with aim to eliminate, the use of potable water, natural surface water (such as lakes, rivers, and streams), and groundwater withdrawals for landscape irrigation:** Agencies should set significant goals for reduction of water use and take measures to ensure they are using amounts of supplemental irrigation appropriate to the facility's local climate. To ensure the designed landscape's water requirement meets a

¹⁸ US EPA 40 CFR Part 503 Biosolids Rule, section 503.13 table 3 "Pollutant Concentrations
water.epa.gov/scitech/wastetech/biosolids/503pe_index.cfm

basic measure of water efficiency, use the U.S. EPA's WaterSense Water Budget Tool.¹⁹ Although generally employed for residential landscapes, the EPA's WaterSense Water Budget Tool can be used as a guide for these purposes.

- b. **Manage stormwater on-site:** Strive to replicate the hydrologic condition of the undeveloped site using historic data and undeveloped ecosystems within the region. The design process should consider all components of the hydrologic cycle (evapotranspiration, runoff, and infiltration), minimize impervious cover, and maximize use of soil- and vegetation-based methods.²⁰
- c. **Design rainwater/stormwater features to provide a landscape amenity:** The design, construction and location of rainwater/stormwater management features should consider amenities so they are visible and/or accessible from high-use portions of the site to maximize interaction, educational and human health and well-being opportunities. Where appropriate, use rainwater capture features that allow future use of the water for irrigation.
- d. **Maintain water features to conserve water and other resources:** Design and maintain water features created in the landscape with minimal or no make-up water from potable sources or other natural surface or subsurface water resources. Design systems to use gravity for water movement and recirculation where possible. Consider use of cisterns to capture roof runoff as a source for irrigation and water features.
- e. **Protect and enhance on-site water resources and receiving water quality:** Implement Low-Impact Development (LID) technologies, and to treat discharge from developed areas using soil and vegetative systems as a watershed pollution prevention strategy, such as silt and pollution barriers. When necessary, provide appropriate stormwater treatment for common stormwater pollutants. For best practices, see EPA's LID website <http://www.epa.gov/owow/NPS/lid/>.
- f. **Protect and restore riparian, wetland, and shoreline buffers:** Existing riparian, wetland, or shoreline buffers should be preserved or disturbed buffer areas should be restored in order to improve flood control, water quality, stabilize soils, control erosion, and provide wildlife corridors and habitat.²¹ Where practical, buffer widths of 300 feet or greater should be established with intent to provide protection of wildlife migration corridors and habitat for threatened, endangered, and sensitive species.
- g. **Rehabilitate streams, wetlands, and shorelines:** Rehabilitate lost or degraded stream channels and shorelines to stable geomorphological conditions. Where practicable, rehabilitate native plant communities, aquatic habitat, floodplain connections, and existing degraded wetlands.

¹⁹ EPA's WaterSense is a partnership program that seeks to protect the future of the nation's water supply by promoting water efficiency and enhancing water-efficient products, programs, and practices. WaterSense helps consumers identify water-efficient products and programs that meet efficiency and performance criteria. WaterSense also partners with irrigation professionals and irrigation certification programs to promote water-efficient landscape irrigation practices. www.epa.gov/WaterSense/about_us/index.html

²⁰ For additional information about managing stormwater on-site, please see the Section X, Additional References and [Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act \(EISA\)](#) as well as any subsequent related instructions or guidance issued under E.O. 13514.

²¹ Buffer widths can be based on literature review of current sources from local, state, and federal agencies, as well as resources from the Center for Watershed Protection. www.cwp.org/

VII. Vegetation

Appropriate vegetation provides ecosystem services such as pollutant interception and water management as well as habitat for desirable pollinator species. Plants that are adapted to regional conditions and climate, and that meet design intent ultimately require fewer resources and less maintenance. The use of native and appropriate non-native plants can enhance biodiversity, reduce pesticide use, conserve water, and reduce energy costs. Vegetation can have a positive impact on response to local climate stress, such as providing heat energy savings when used as windbreak and cooling benefits through shading and evapotranspiration and mitigating the effects of urban heat islands. In addition, native plants can provide habitats for wildlife that support recreational and ecotourism activities, such as fishing and birdwatching, and opportunities for environmental education. Native and appropriate non-native plants also support important pollinator species that are necessary for plant reproduction, including cultivation of crops. Up to 80% of the world's food plant species are dependent on pollination by animals. A healthy vegetation cover will also inhibit the establishment of invasive plants. Invasive species compete with and harm plant and animal communities. Approximately 5,000 plant species (approximately 60% from horticulture) have escaped into natural ecosystems, resulting in billions of dollars in damage, loss of productivity and control costs.

Correct management of plants and plant products reduces risks to local ecosystems, property, and human life. In wildfire prone areas for example, designing a defensible space around structures protects facilities from damage by reducing flame heights and making fires easier to extinguish.

When addressing vegetation issues as part of sustainable landscape practices agencies should consider the following actions.

- a. **Preserve existing native vegetation:** especially mature trees, to the extent possible. The functions of mature trees are difficult to replace with new plantings that will not reach maturity for several years.
- b. **Use appropriate, non-invasive plants²²:** Plants that are non-invasive and appropriate for local site conditions, climate, and design intent should be used to improve landscape performance and reduce resource use. Plants/seeds that are appropriate for site conditions, climate, and design intent and are nursery grown, legally harvested, or salvaged for reuse should be used.
- c. **Prevent, detect, control, and manage invasive plants:** As feasible, identify and remove all invasive species on-site and develop and implement an active management plan to prevent new introductions. Develop a comprehensive invasive plant management plan (either as a separate plan or as part of a larger natural resources or operations management plan) that addresses early detection, removal, prevention, and long-term management. This plan should also incorporate Integrated Pest Management Plan (IPM) practices and guidelines including treatments, long-term control (including monitoring), and best management practices for disposal of invasive plant materials to prevent spread. Invasive and/or non-invasive plants may be a character-defining part of

²² Executive Order 13112 requires each Federal agency to the extent practicable and permitted by law to identify such actions and not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species.

a historic landscape or planting. If invasive non-native plants are to be maintained for historic reasons, they should be actively managed so that they do not spread or cause harm to the region.

- d. **Maintain existing historic landscapes and plantings:** Existing plantings and landscapes should be maintained if they are historic in their existing form and/or protect historic properties, extend the life cycle of existing stock, conserve resources, or reduce waste. In some cases invasive plants may have cultural or historic value and are appropriate to be used in a new design, but should be actively managed to prevent spread. During construction protect using VSPZ methods.
- e. **Use native plants:** Where practicable, use vegetation native to the ecoregion.
- f. **Protect and preserve all vegetation designated as special status:** Identify, protect, and preserve all vegetation designated as special status by local, state, or Federal entities, including historic designation and protect using VSPZ methods.²³
- g. **Conserve plant communities native to the ecoregion:** Plant communities native to the ecoregion of the site that contribute to regional diversity of flora and provide habitat for native wildlife should be conserved. As feasible, the area containing native plant communities within VSPZ should be protected and habitat corridors connecting to off-site natural areas or buffers adjacent to off-site natural areas for migrating wildlife should also be protected.
- h. **Restore plant communities native to the ecoregion:** As feasible, restoration of the vegetated area should be pursued. Restoration of plants and plant communities native to the ecoregion of the site contributes to regional diversity of flora and provides habitat for native wildlife.
- i. **Use vegetation to minimize building heating and cooling requirements:** Vegetation and/or vegetated structures should be placed in strategic locations to shade buildings during the cooling season, thereby reducing energy consumption associated with indoor climate control. Windbreaks for buildings should be established to effectively block wind, but also not result in winter shading. Staggered rows of trees and dense shrubs that extend for the full length of the building's walls facing the prevailing winter wind should be considered. Strategically placed vegetation can lower energy use associated with indoor climate control. Deciduous vegetation or vegetated structures can shade surface areas of the west, southwest, southeast, and east walls and the roof area during summer months.
- j. **Use trees and other vegetation to offset emissions of greenhouse gases from operations:** Trees and other vegetation should be planted to promote long-term storage of carbon.
- k. **Reduce urban heat island effects:** Use vegetation to reduce heat island effect, minimizing effects on microclimate. Design options in addition to vegetative shade include covering structures with solar photovoltaic panels, installing vegetated roofs and/or surfaces with a solar reflectance index (SRI) of at least 29, using paving materials with an SRI of at least 29, and using an open-grid pavement system (e.g. concrete-grass lattice).

²³ For more information on Vegetation and Soil Protection Zones (VSPZ) see glossary and the *Sustainable Sites Initiative Guidelines and Performance Benchmarks 2009* Credit 4.3

- l. **Reuse salvaged materials and plants:** Salvaged materials and appropriate plants (where feasible) should be reused to conserve resources. Recycle useful materials to divert waste from landfills.
- m. **Support sustainable practices in plant production:** Where practicable, plants and materials should be purchased from businesses and providers that reduce resource consumption and waste and employ sustainable practices including, but not limited to, use of sustainable soil amendments, reduced irrigation runoff, reduced greenhouse gas emissions, reduced energy consumption, use of Integrated Pest Management (IPM) practices, reduced water consumption, reduced waste, and recycling of all organic matter.
- n. **Use regional materials:** When acquiring and using materials, plants, soils, select those that are grown or produced locally or within the geographic region of the project in order to reduce energy use for transportation and increase demand for local goods. Source materials, plants, and soils within distances specified (soils – 50 miles, aggregate – 50 miles, plants – 250 miles, all other materials – 500 miles) should be considered.
- o. **Reduce the risk of catastrophic wildfire:** To reduce the risk of catastrophic wildfire both on-site and in adjacent landscapes, the management of potential fuels should be considered in the design, building, and maintenance of site landscaping. Design, build, and maintain sites to manage fuels to reduce the risk of catastrophic wildfire both on site and in adjacent landscapes. Although used for residential landscapes, the Firewise™²⁴ Guide to Landscape and Construction can be used as a guide for these purposes.
- p. **Use vegetation to promote community/employee morale and well-being activities:** Rooftop gardens, community gardens, and vertical gardens inside or outside of buildings, adjacent or connecting to the landscape should be considered in order to promote educational programs, food access, and gardening activities for morale and community engagement.
- q. **Allow space for proper growth:** When placement of landscaping is determined, allow for full mature growth of the species to permit the natural beauty of the plant and diminish the possibility of disease.

VIII. Materials Selection

*Sustainable materials management*²⁵ promotes the use of material resources in a manner that protects economic growth, environmental quality, and social development throughout the life-cycle of the product. This means ensuring materials are sourced and managed sustainably and used efficiently throughout their life-cycle, including considering wastes as potential resources that can be used as inputs for new products. Sustainable materials management helps reduce the negative environmental impacts associated with the production, consumption, and end-of-life management of material resources.

²⁴ [Firewise Guide to Landscape and Construction](#)

²⁵ www.epa.gov/osw/inforesources/pubs/vision2.pdf

While the following recommendations aim to increase the use and management of sustainable materials, Federal agencies must work within Federal and agency procurement specifications, criteria and regulations (see <http://www.fedcenter.gov/programs/buygreen/>). When addressing materials management issues as part of sustainable landscape practices agencies should consider the following actions.

- a. **Reuse salvaged materials:** Where feasible, a minimum of 20% of all materials (including plants) used on-site for landscaping should be salvaged materials. Check within your own facility, installation, or agency for materials that may already be available and/or excess. For modernization or renovation projects, it may be feasible to reuse many of the existing materials on-site for landscaping, which reduces the project cost by cutting down on the amount of waste being trucked off-site. Contact the General Services Administration (GSA) or the Defense Reutilization and Marketing Service (DRMS)²⁶ to determine if excess Federal materials are available for transfer or purchase.
- b. **Use regional materials:** Where feasible, materials, plants, and soils should be sourced within the distances specified in the following list. Soils – 50 miles, aggregate – 50 miles, plants – 250 miles, all other materials – 500 miles.
- c. **Use sustainably harvested, certified wood:** Do not use wood species listed as threatened or endangered by the Convention on International Trade in Endangered Species (CITES)²⁷ and the International Union for Conservation of Nature (IUCN).²⁸ Use wood that is harvested in a sustainable manner.
- d. **Maintain existing structures:** Where feasible, maintain or reuse in their existing form existing structures, hardscapes, and landscape amenities on-site.
- e. **Design for deconstruction:** Design material assemblies, products, and/or product components used for construction to facilitate reuse and deconstruction.
- f. **Use recycled content materials:** The Comprehensive Procurement Guideline (CPG)²⁹ requires Federal agencies to buy products containing recovered materials. For non-CPG designated items, materials with recycled content should be used. While compost and fertilizer made from recovered organic materials are included in this element, plants and soils are not.
- g. **Develop and implement a materials waste management plan:**³⁰ Encourage the salvage and recycling of all construction, demolition, land clearing, and operational waste. For example, existing vegetation that is removed from a site can be mulched and added back as a soil amendment.

IX. Human Health and Well-Being

In addition to environmental functions, sustainable landscapes provide restorative value and health benefits to the user. Outdoor physical activity contributes to overall health and can help people control obesity and associated chronic diseases such as diabetes, cardiovascular issues,

²⁶ For more information on the Defense Reutilization and Marketing Service program, see www.drms.dla.mil/

²⁷ Convention on International Trade in Endangered Species (CITES) www.cites.org

²⁸ International Union for Conservation of Nature (IUCN) www.iucn.org

²⁹ www.epa.gov/epawaste/conservetools/cpg/index.htm

³⁰ www.epa.gov/wastes/nonhaz/municipal/pubs/ghg/f02026.pdf

and high blood pressure. Outdoor spaces that encourage social interaction can promote social connection among site users, which is important for human health, while providing quiet outdoor spaces for site users to enjoy. Moreover, such features can enhance employee morale and retention.

Incorporating natural systems and garden settings should be a goal for integrated site design. Single sites in a built setting can serve both social and environmental functions. Knowledge about the microclimates of a space (where and when the sun hits, amount of rainfall, the natural water levels, soil types, wind, and exposure to sound and light pollution) can be used to achieve ecological design goals, enhance human comfort, and provide a restorative setting. For instance, rain gardens for stormwater management can be designed to create a social space, or a roof garden can serve as a break room. Other human health considerations should include access to transit and affordable housing as well as promotion of the ability to walk and bike to and around the site.

When addressing human health issues as part of sustainable landscape practices agencies should consider the following actions.

- a. **Promote equitable site development and use:** Where appropriate, agencies should engage with the local communities and stakeholders (e.g., residents, users, agency employees) to identify and develop options for sharing economic and social benefits of the site's landscape development. Select options that allow development of the site to benefit a wide range of users, beyond the primary user groups.
- b. **Enhance community development:** Quality landscape design that enables positive effects for local residents can promote the long-term economic stability of local families and businesses. Providing community accessibility and on-site facilities that address the needs of local residents is recommended when feasible (e.g., farmer's markets, community gardens). The development of a community benefits agreement for post-construction site use can be a helpful way to engage with the local community. Community events should not interfere with agency mission or public safety or lead to damage of the landscape. Rooftop gardens, community gardens, and vertical gardens inside or outside of buildings, adjacent or connecting to the landscape should be considered in order to promote educational programs, food access, and gardening activities for morale and community engagement.
- c. **Review parking and design:** Where feasible, locate parking areas in underground parking structures in order to reduce impervious surface stormwater runoff. Moreover, underground parking provides opportunities for green space, gardens, park space, or a facility on top of the structure, providing good urban design and efficient use of the land and built environment. Alternative parking structures, such as above grade parking garages should blend aesthetically with the built environment and as feasible, incorporate green roofs and/or solar panels. If surface parking must be built, trees and grass or other types of vegetation and sustainable materials should be incorporated to mitigate impervious surface stormwater runoff.
- d. **Promote sustainability education:** Consider developing interpretation programs and activities to educate site users and the public about the sustainability of the landscaping and site. Programs could include talks, demonstrations, web sites, on-site descriptive

signage etc. Consider partnerships to extend sustainability education to local community groups or schools.

- e. **Increase user ability to understand and safely access outdoor spaces:** Optimum site accessibility, safety, and wayfinding should be provided for all users, including those with disabilities, without compromising sensitive site features such as wetlands, archaeological sites, or heritage trees. Wayfinding should be implemented to create an environment that makes it easy and intuitive for all users to orient themselves and navigate from place to place. Where feasible, incorporate accessibility into site selection, planning, design, and development so that all elements and features, including paths, trails, facilities, and signage, are equally usable by people with physical, sensory, cognitive, or developmental disabilities.
- f. **Encourage outdoor activities:** On-site amenities such as community gardens, bike trails, playgrounds, and workout stations should be provided to encourage outdoor activities. Appropriate support services, such as drinking fountains, emergency call boxes, and safety lighting should also be included. To the extent possible, on-site systems, such as trails and paths, should be connected to local and regional systems and access to parks and open space within 0.25 mile.
- g. **Create quiet outdoor spaces for relaxation and restoration, small group interaction, and views:** Creating visual and physical connections to the outdoors optimizes the well-being of site users. Plantings that use rich species diversity should be utilized in the landscape design. Where possible, seating areas with unique or beautiful views and minimal noise should be provided, while taking into consideration an understanding of the microclimate and other site-specific conditions (e.g., sun, shade, wind, etc.). In addition, outdoor gathering spaces should accommodate groups for the purpose of education, building community and improving social ties.
- h. **Reduce light pollution:** “Light trespass” from landscaping on Federal sites should be minimized to reduce sky-glow, increase nighttime visibility, minimize negative effects on nocturnal animals, and improve human health and functioning. Site lighting criteria should be formulated to minimize energy use and to avoid off-site lighting and sky pollution, while maintaining safe light levels. The direction and spread of light can be controlled by choosing appropriate light fixtures.
- i. **Create a safe environment:** Gardens and landscaping located around the perimeter of a Federal facility can double as a security measure to help protect workers and visitors inside the building. Incorporate permanent hardscape features such as benches and raised planters to help deter unwanted access to the building. Agencies should consider principles and strategies developed from Crime Prevention Through Environmental Design (CPTED).³¹

X. Existing Historic Facilities and Cultural Landscapes

When working with historic or cultural landscapes it is critical to understand the characteristics that make the site historic or give it cultural significance.³² Changes to the characteristics and features of the site should only occur after careful consideration of whether the change will affect

³¹ Crime Prevention Through Environmental Design (CPTED). <http://www.cpted.net/>

³² For an overview of working with historic and cultural landscapes, see *Preservation Briefs 36 - Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes*, National Park Service, 1994 www.nps.gov/history/hps/tps/briefs/brief36.htm.

the site's cultural and historic integrity. This may require a Cultural Landscape Report (CLR)³³ with analysis of characteristics such as spatial organization, vegetation, circulation, water features, structures, site furnishings, and objects.³⁴ CLR direction on site significance and treatment will inform all aspects of management, operations, and maintenance. For example, a CLR will include a list of features that are historically significant and denote which landscape features are not contributing to the historic significance. Where appropriate, a landscape architect specializing in historic preservation should be consulted in order to assist in meeting sustainability goals while protecting the integrity of the cultural landscape. For more information on landscape preservation, see the *Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*.³⁵ When evaluating existing and historic facilities as part of sustainable landscape practices, agencies should consider the following recommendations.

Water

For cultural landscapes, it is important to reduce water usage by focusing irrigation on significant vegetation features, using native plants for replacement plantings as necessary and appropriate, and upgrading irrigation systems. When preserving or restoring riparian, wetland, and shoreline buffers, it is necessary to work with preservation specialists to determine whether and how this goal can be implemented without adversely effecting site integrity. Water features should be maintained in cultural landscapes using sustainable non-potable water forces for required make-up water.

Vegetation

In the cultural or historic setting, plants often provide a historic connection indicating a sense of place or regional identity. Maintaining cultural integrity through cultural landscapes, including historic properties, is an important consideration when designing sustainable landscapes. While the recommendations included in the Vegetation section are generally applicable, additional recommendations are required when dealing with a cultural landscape. Plant materials in cultural landscapes and designed historic sites may be non-native, naturalized and in some cases managed invasive species. Plants that are character-defining features of a cultural landscape should be preserved. On tribal lands, special consideration should be given to culturally significant species. When replacement of character-defining vegetation is necessary, a historical landscape architect should be involved in order to determine whether a change to native species is appropriate. Additionally, potential changes should be communicated to the public to allow for stakeholder input. Any existing plants and plantings that have been determined to have special status should be maintained, such as state champion trees, rare species (i.e. American chestnut), threatened and endangered species, trees with other special status or especially desirable characteristics (e.g., National Park Service's "witness trees" and disease-resistant elms on the National Mall), and all vegetation that contributes to a cultural landscape, including controllable invasive plants.

³³ *A Guide to Cultural Landscape Reports: Contents, Process, and Techniques*, National Park Service, 2005.

http://openlibrary.org/books/OL344308M/A_guide_to_cultural_landscape_reports or www.nps.gov/oclp/clar_main.htm

³⁴ Cultural Landscape Inventories are also used within the National Park Service. Unlike a CLR, this document does not include treatment recommendations on how to preserve the landscape.

³⁵ Available at www.nps.gov/history/hps/hli/landscape_guidelines/index.htm

XI. Construction

Construction practices at Federal facilities should reflect the goals outlined below and other goals outlined in this document. An Integrated Design Team, made up of architects, landscape architects, horticulturalists, designers, specification writers, and contracting officers, should use the following recommendations during the design process and apply them through construction specifications and contractor bidding requirements process.

- a. **Control and retain construction pollutants:** The discharge of construction site pollutants and materials should be prevented to protect receiving waters (including surface water, groundwater, and combined sewers or stormwater systems), air quality, and public safety. A Stormwater Pollution Prevention Plan (SWPPP)³⁶ and Erosion and Sedimentation Control Plan (ESC)³⁷ should be developed for all construction activities and implemented per applicable EPA and/or location regulations. The project should conform at a minimum to erosion and sedimentation requirements of the most current EPA Construction General Permit or local erosion and sedimentation control standards and codes, whichever is more stringent. In addition, agency policy should encourage designers to incorporate long-term, post-construction stormwater pollution and sedimentation control measures into site designs to both enhance this goal and assist in meeting goals for water and vegetation.
- b. **Restore soils disturbed during construction:** Soils disturbed during construction should be restored to pre-development conditions for organic matter, compaction, infiltration rates, soil biological function, and soil chemical characteristics to ensure the ability to support healthy plants, biological communities, and water storage and infiltration.
- c. **Restore soils disturbed by previous development:** Where possible, soil function in areas of previously disturbed topsoil and subsoil should be restored to support healthy plants, biological communities, and water storage and infiltration. For areas to be re-vegetated, consider a benchmark of at least 90% restoration of the total surface area of soil disturbed by previous development or use.
- d. **Divert construction and demolition materials from waste stream:** Divert construction and demolition (C&D) materials generated by site development from disposal in landfills and/or combustion in non-energy producing incinerators. As feasible, all non-hazardous structural materials and infrastructure/road materials should be recycled, reused, and/or salvaged and coordinated between designers and contractors. Designers should be aware of this goal during initial design phases of a project, to support the objective of a zero-waste site.
- e. **Reuse or recycle vegetation, rocks, and soil generated during construction:** Reuse or recycle vegetation, soils, and mineral/rock waste generated during construction to achieve a zero-waste site. To the extent practicable, materials from on-site land clearing activities with the exception of contaminated soils and diseased and/or invasive plant materials, should be retained and reused on-site. Site design should encourage balance of cut and fill wherever possible. All excess vegetation and recyclable materials shall be taken to composting and/or recycling sites.

³⁶ For more information on Stormwater Pollution Prevention Plans <http://cfpub.epa.gov/npdes/stormwater/swppp.cfm>

³⁷ For more information on Erosion and Sedimentation Control Plans www.epa.gov/owow/NPS/ordinance/erosion.htm

XII. Operations and Maintenance

Ongoing landscape maintenance can have a significant impact on the environment. Federal agencies should work to reduce intensive landscape maintenance operations with the goal of having a self-sustaining landscape where possible. Federal agencies should implement sustainable landscape practices both contractually and in-house when performing facility operations and maintenance. When addressing operations and maintenance as part of sustainable landscape practices, agencies should consider the following actions.

- a. **Plan for ongoing sustainable landscape improvements:** A development strategy for the site to meet the goals listed in this Guidance document should be prepared with an outline and identification of the long-term strategies (10-year desired outcome) and short-term actions to achieve sustainable design goals.
- b. **Monitor performance of sustainable design practices:** Sustainable design practices should be monitored and documented in order to evaluate performance over time and improve the body of knowledge on long-term site sustainability. The design team should monitor and evaluate results such as water consumption, chemical usage, and fossil fuel-intensive maintenance. Overall plant vigor should be monitored on at least an annual basis to provide a measure of sustainable landscape planting success. The review and research of new practices in the landscape industry can assist Federal agencies in maintaining cost effectiveness and becoming leaders in sustainability.
- c. **Implement sustainable site maintenance:** Prepare a site maintenance plan and ensure that site managers and any maintenance contracts commit to educating maintenance personnel on the goals and implementation of the plan. Examples of plan actions include, but are not limited to, mandating an Integrated Pest Management (IPM) approach and use of organic fertilizer (consider using BioPreferred fertilizer and pesticides), seasonal performance-based mowing (spring 3", summer 4-5", fall 4"), and annual pruning practices as opposed to regular shearing. IPM plans should be put in place for maintenance, so that risks from both pests and pesticides are minimized. In addition, maintenance staff should consider and address excessive and/or poorly timed watering and frequent mowing. When maintaining historic or cultural landscapes, the maintenance plan should also address managing historic resources to prevent loss of integrity. Staff and contractors should be required to attend annual training on sustainable practices.
- d. **Recycle organic matter generated during site operations and maintenance:** The site maintenance plan should incorporate composting and/or recycling 100% of vegetation trimmings and appropriate compostable organics on-site, where feasible. Proper composting of materials from the recycling of vegetation trimmings and, where appropriate, food waste supports nutrient cycling, improves soil health, and reduces transportation costs and materials going to landfills.
- e. **Reduce outdoor energy consumption for all landscape operations:** In new construction, energy-efficient outdoor fixtures, vehicles, and equipment should be selected to reduce environmental impacts and costs associated with site operations. The following actions can help Federal agencies reduce petroleum use associated with landscaping operations.
 - Increase fuel economy through acquisition of smaller vehicles, hybrid-electric vehicles, and alternative fuels vehicles and landscape equipment.

- Employ efficiency strategies in landscape equipment, such as low-rolling resistance tires, synthetic oil, and other technologies.
 - Conduct annual evaluation of vehicle and equipment practices. Continue to improve program by keeping abreast of new technology advances.
 - Utilize energy-efficient light bulbs (including LEDs), lighting fixtures, and other means to minimize electricity use.
- f. **Use renewable and energy efficient sources for landscape electricity and power needs:** As feasible, agency operations and outside contractors should use on-site renewable energy sources and greenhouse gas emission reduction strategies to minimize air pollution, habitat destruction, and pollution from fossil fuel-based energy production from landscape operations. Agencies can use:
- Energy Star and Federal Energy Management Program (FEMP)-designated energy-efficient products;³⁸
 - Water-efficient products, including those meeting EPA’s WaterSense standards;
 - Bio-based products designated by the U.S. Department of Agriculture in the BioPreferred³⁹ program;
 - Environmentally preferable products and services, including Electronic Product Environmental Assessment Tool (EPEAT) registered electronic products and Energy Star energy efficient electronic products;
 - Alternative fuel vehicles and alternative fuels required by the Energy Policy Act of 1992 (EPAAct);
 - Products with low or no toxic or hazardous components;
 - Sustainable products for plant production and lawn care;
 - Alternative fuel vehicles and alternative fuels required by the Energy Policy Act of 1992 (EPAAct); and
 - Products with low or no toxic or hazardous constituents.
- g. **Minimize generation of greenhouse gases and exposure to localized air pollutants during landscape maintenance activities:** Maintenance activities should minimize localized air pollutants and greenhouse gas by specifying in the site maintenance plan that power maintenance equipment is powered without the use of gasoline and/or meets emission levels in the U.S. EPA’s *Emission Standards for New Nonroad Spark-Ignition Engines*.⁴⁰ Work periods should be specified for use of power equipment to reflect impact on human health and if possible, maintenance equipment such as mowers, leaf blower, trimmers, should operate during hours that have the least impact on building occupants and neighboring communities.

XIII. Additional References

General:

- The Sustainable Sites Initiative (SITES): www.sustainablesites.org
- Executive Order 13514 www.fedcenter.gov/programs/eo13514/

³⁸ For more information on Energy Star, a collaboration of the U.S. Department of Energy and the U.S. Environmental Protection Agency www.energystar.gov and on Federal Energy Management Program www1.eere.energy.gov/femp/

³⁹ For more information on the U.S. Department of Agriculture’s BioPreferred program www.biopreferred.gov

⁴⁰ www.epa.gov/OMS/regs/nonroad/marinesi-equiuld/420f08013.htm

- Instructions for Implementing Sustainable Locations for Federal Facilities, http://www.fedcenter.gov/kd/Items/actions.cfm?action=Show&item_id=19447&destination=ShowItem
- LEED for Neighborhood Development (LEED-ND): www.usgbc.org/leed/nd
- American Society of Landscape Architects: www.asla.org/sustainablelandscapes/
- Landscape Architecture Foundation: <http://lafoundation.org/research/landscape-performance-series/>
- Biobased products information: www.BioPreferred.gov

Water

- [Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act of 2007 and Section 438](#)
- www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf
- Stormwater Guidance for Federal Facilities: www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf
- Guidance for Federal Land Management in the Chesapeake Bay Watershed www.epa.gov/owow_keep/NPS/chesbay502/
- Unified Facility Criteria (UFC) Low Impact Development Manual www.wbdg.org/ccb/DOD/UFC/ufc_3_210_10.pdf
- www.bae.ncsu.edu/stormwater/
- Center for Watershed Protection, www.cwp.org/

Materials and Energy

- U.S. Department of Agriculture's BioPreferred program www.biopreferred.gov
- Energy Star www.energystar.gov
- Federal Energy Management Program www.eere.energy.gov/femp/
- www.epa.gov/OMS/regis/nonroad/marinesi-equipid/420f08013.htm
- <http://www.resource-solutions.org/index.php>

Soils and Vegetation

- www.epa.gov/wed/pages/ecoregions.htm

Green Infrastructure Community of Practice Collaborative Network

- <http://greeninfrastructure.ning.com>
- www.nps.gov/history/local-law/arch_stnds_8_2.htm
- www.nps.gov/history/hps/tps/standguide/
- www.nps.gov/history/history/online_books/hps/contents.htm
- www.fs.fed.us/sustainableoperations

Human Health

- www.fs.fed.us/ccrc/topics/urban-forests/ctcc/
- www.cdc.gov/healthyplaces/
- www.completestreets.org/
- www.greenhealth.washington.edu

Cultural Landscapes

- *Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes* www.nps.gov/history/hps/tps/briefs/brief36.htm

- *A Guide to Cultural Landscape Reports: Contents, Process, and Techniques*
http://openlibrary.org/books/OL344308M/A_guide_to_cultural_landscape_reports or
www.nps.gov/oclp/clar_main.htm
- *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*
- *National Historic Preservation Act (NHPA): 16 U.S.C. § 470 et seq., and Section 106: 36 C.F.R. Part 800* Also see the National Historic Preservation Act:
<http://www.achp.gov/docs/nhpa%202008-final.pdf>; and Section 106 Regulations:
<http://www.achp.gov/regs-rev04.pdf>

AGENCIES REPRESENTED IN WORKING GROUP AND ADVISORS

- Advisory Council on Historic Preservation
- General Services Administration, National Capitol Region Fire Protection, Life Safety and Environment Branch
- General Services Administration, Office of Design and Construction, Public Buildings Service, Urban Development/Good Neighbor Program
- General Services Administration, Office of Design and Construction, Public Buildings Service
- General Services Administration, Office of the Chief Architect
- National Capital Planning Commission
- Smithsonian Institution, Office of Facilities Management & Reliability, Smithsonian Gardens
- U.S. Army Corps of Engineers, Institute for Water Resources, Risk Management Center
- U.S. Botanic Garden, Architect of the Capitol, United States Congress
- U.S. Department of Agriculture, Forest Service, Urban and Community Forestry
- U.S. Department of Agriculture, Natural Resources Conservation Service, Conservation Engineering Division
- U.S. Department of Agriculture, Office of Operations
- U.S. Department of Agriculture, Office of the Secretary
- U.S. Department of Agriculture, U.S. Forest Service Green Cities Research Alliance
- U.S. Department of Agriculture, U.S. Forest Service, Northern Research Station of the Research and Development
- U.S. Department of Defense, U.S. Army Corps of Engineers, Civil Section, Design Branch Omaha District
- U.S. Department of Defense, U.S. Air Force Center for Engineering and the Environment, Technical Support Division, Build Infrastructure Branch
- U.S. Department of Defense, Naval Facilities Engineering Command
- U.S. Department of Homeland Security, Federal Law Enforcement Training Center
- U.S. Department of Interior, National Invasive Species Council
- U.S. Department of Interior, National Park Service, Denver Service Center
- U.S. Department of Interior, National Park Service, Denver Service Center at National Mall and Memorial Parks

- U.S. Department of Interior, National Park Service, National Capital Region, Liaison to the White House
- U.S. Department of Veteran’s Affairs
- U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics Environmentally, Preferable Purchasing Program
- U.S. Environmental Protection Agency, Office of Resource Conservation and Recovery
- U.S. Environmental Protection Agency, Office of Sustainable Communities
- U.S. Environmental Protection Agency, Office of Water
- U.S. Environmental Protection Agency, Office of Water, Nonpoint Source Control Branch
- U.S. Environmental Protection Agency, Office of Water, Water Sense Program
- White House, Council on Environmental, Quality, Office of Federal Environmental Executive

ADVISORS REPRESENTING LOCAL AND REGIONAL CONSTITUENTS

- Arizona State University, Department of Applied Sciences and Mathematics
- City of Albuquerque, Park Management Division
- City of Portland, Bureau of Environmental Services, Sustainable Stormwater Program
- City of Seattle, Resource Conservation Planning, Seattle Public Utilities
- Cornell University, Department of Crop and Soil Sciences
- Cornell University, Department of Horticulture
- Hennepin County, Housing, Community Works and Transit Department
- Lady Bird Johnson Wildflower Center of the University of Texas at Austin
- New Castle County Delaware, Department of Land Use Planning and Design Standards Section
- University of Illinois at Urbana-Champaign, Department of Natural Resources and Environmental Sciences and Department of Psychology
- University of Massachusetts, Amherst Department of Landscape Architecture and Regional Planning
- University of Washington, College of the Environment, Human Dimensions of Urban Greening
- Virginia Tech, Department of Forest Resources & Environmental Conservation and Department of Horticulture

GLOSSARY⁴¹

100-year floodplain includes all areas below the 100-year flood elevation of waterways of all sizes, including depressional areas, wetlands, areas behind levees, ephemeral and intermittent streams, rivers, lakes, and shoreline and coastal areas. These areas are generally depicted on the current FEMA Flood Insurance Rate Map as Zones A, AE, A1-A30, AH, AO, AR, A99,

⁴¹ Glossary adapted from *The Sustainable Sites Initiative Guidelines and Performance Benchmarks 2009* www.sustainablesits.org

V, and VE. However, in some areas they may need to be calculated by the site development team.

Appropriate plant species are plants adapted to site conditions, climate, and design intent. The following attributes should be considered in determining whether plants are appropriate for the site: cold hardiness, heat tolerance, salt tolerance, soil moisture range, plant water use requirements, soil volume requirements, soil pH requirements, sun/shade requirements, pest susceptibility, and maintenance requirements. Native and non-native plants are appropriate if they meet the above criteria.

Average buffer width can be calculated using perpendicular transects every 50 feet along a water body for at least 90 percent of the stream or shoreline length within the boundaries of the site. For final average buffer widths, a minimum buffer width of at least 10 feet must be maintained at all points along the buffer. Buffer widths for rivers, streams, and tributaries are measured on each side of the stream from the top of bank.

Bicycle network is a continuous bicycle or multi-use facility that is separate from the vehicular right-of-way but can be shared with pedestrians. The standard bicycle network has pavement that is at least 8 feet wide with a 2-foot unpaved clear zone on each side.

Biomass is the total amount of living material or formerly living material in a given habitat, population, or sample. Specific measures of biomass are generally expressed in dry weight per unit area of land.

Brownfield is an abandoned, idled, or underused industrial and commercial facility/site where expansion or redevelopment is complicated by real or perceived environmental contamination; a site documented as contaminated by means of an ASTM E1903-11 Standard Practice for Environmental Site Assessments: Phase II Environmental Site Assessment or a local Voluntary Cleanup Program; or a site defined as a brownfield by a local, state, or Federal Government agency.

Common stormwater pollutants can adversely impact receiving waters and include, but are not limited to: Landscape chemicals – pesticides, fertilizers, herbicides, detergents, oil, grease; Metals – copper, zinc, lead; Nutrients – nitrogen, phosphorus; Pathogens - bacteria, viruses, protozoa; Regional pollutants – salts, alcohol, temperature; and Solids – soil, tire particles, road abrasion material, etc.

Control of invasives is the appropriate eradication, suppression, reduction, or management of invasive species populations, the prevention of the spread of invasive species from areas where they are present and taking steps such as the restoration of native or appropriate species and habitats to reduce the effects of invasive species and to prevent further invasion.

Cultural landscape is a geographic area including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

Deconstruction is a process of carefully taking apart constructed elements with the intention of either reusing or recycling the materials and is accomplished during redevelopment, adaptation, or at the end of use on a site.

Design for deconstruction, also called Design for Disassembly, is the design of buildings or products to facilitate future change and the eventual dismantlement (in part or whole) for recovery of systems, components, and materials. This design process includes developing the assemblies, components, materials, construction techniques, and information and management systems to accomplish this goal.

Diameter at breast height (DBH) is a standard method for determining the trunk diameter of a standing tree. In the U.S., DBH is typically measured in inches at 4.5 feet (137 centimeters) off the ground on the uphill side. Wounds, branches, multiple stems, and defects may change how diameter is measured. www.isa-arbor.com/publications/tree-ord/measuringdbh.aspx

Ecoregion refers to areas within which ecosystems (and the type, quality, and quantity of environmental resources) are generally similar. Developed by Omernick (1987) to serve as a spatial framework for the research, assessment, and monitoring of ecosystems and ecosystem components.

Ecosystem services describe the goods and services provided by healthy ecosystems—for example, the pollination of crops by bees, bats, or birds; the flood protection provided by wetlands; or the filtration of air and water by vegetation and soils.

Farmland of statewide importance refers to soils designated by each state's Natural Resources Conservation Service as "farmland of statewide importance." Farmland of statewide importance is farmland that does not meet all of the prime farmland criteria, but is still able to economically produce high yields of crops when treated and managed according to acceptable farming methods.

Geomorphological and vegetative methods focus on the creation of a stable dimension, pattern, and profile for a stream type and channel morphology appropriate to its landform and valley, designed such that over time, the stream is self maintaining (able to transport the flow and sediment of its watershed without aggrading or degrading). This can include a broad range of measures, including the removal of the watershed disturbances that are causing stream instability; installation of structures and planting of vegetation to protect stream banks and provide habitat; and reshaping or replacement of unstable stream reaches into appropriately designed functional streams and associated floodplains.

Greenfield is a site that has not been previously developed or graded, including previous agricultural fields.

Greyfield is a site that has been previously developed or graded and may have existing infrastructure that can be utilized.

Greywater is domestic wastewater composed of wash water from kitchen, bathroom, and laundry sinks, tubs, and washers.

Impervious surfaces do not allow stormwater to drain into the soil below. Some examples include concrete sidewalks, driveways and heavily compacted urban soils. Because these surfaces cover the soil, they increase stormwater runoff and should be replaced with more permeable surfaces such as porous pavers, porous asphalt or turf.

Infill site is a site that must have at least 75 percent of its perimeter bordering sites that consist of at least 75 percent previously developed land. Any fraction of the perimeter that borders waterfront is excluded from the calculation.

Integrated design team consists of the “owner” and/or client along with professionals knowledgeable in landscape design, architecture, engineering, construction, and maintenance of a site. Team members should meet the unique constraints and opportunities of the specific site.

Integrated pest management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. IPM is site specific in nature, with individual tactics determined by the particular crop/pest/environment scenario. The IPM approach places an emphasis on the reduction of pesticide use and the implementation of preventative and alternative control measures.

Invasive species are alien species, with respect to a particular ecosystem, that are not native to that ecosystem and whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Low Impact Development (LID) is a more sustainable land development approach that begins with a site planning process that first identifies critical natural resource areas for preservation. Federal agencies can learn more about LID at:
<http://www.epa.gov/owow/NPS/lid/>

Management of invasives is the implementation of control measures to prevent the spread of invasive species or lessen their impacts when they appear to be permanently established. Control and management of invasive species encompasses diverse objectives such as eradication within an area, population suppression, limiting spread, and reducing effects. Complete eradication is not generally feasible for widespread invasive species or where adequate control methods are not available. Integrated pest management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. Consideration of cumulative environmental impacts requires that environmentally sound methods be deployed, especially in vulnerable areas.

Minimal impact site development is development that does not significantly alter the existing vegetation and hydrology of the vegetation and soil protection zone, such as trails, picnic areas, or boardwalks.

Minimal soil disturbance describes soils that are minimally graded and/or compacted, such that compaction levels exceed the Maximum Allowable Bulk Densities, but not covered with impervious surfaces. Examples of soils that are minimally disturbed include areas with minor modifications or very limited development but not covered with buildings or paved surfaces, such as areas that have been compacted by livestock or heavy foot traffic.

Moderate soil disturbance describes soils in which topsoil is compacted such that compaction levels exceed the Maximum Allowable Bulk Densities, but not covered with impervious surface.

Native plant communities are plant species, composition, and structure typical of communities native to the EPA Level III ecoregion or known to naturally occur within 200 miles of the site. At least two references (or local reference sites) are needed to determine the dominant plant species, relative species abundances, and other characteristic elements of the plant community/communities to be preserved or restored. Native plant communities include (but are not limited to) wetlands, grasslands, riparian buffers, and habitat for wildlife species of concern within the region.

Native plants are plants native to the EPA Level III ecoregion of the site or known to naturally occur within 200 miles of the site. Naturally occurring hybrids and varieties of species native to the ecoregion are acceptable.

Organic matter in soil is carbon-containing material composed of both living organisms and formerly living decomposing plant and animal matter. Soil organic matter (SOM) content can be supplemented with compost or other partially decomposed plant and animal material. Soil organic matter content is commonly measured using “loss on ignition” tests that measure the amount of the element carbon, a key constituent of all organic matter.

Potable water is municipally treated water or well water that is suitable for drinking.

Post-consumer material is waste material generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose.

Pre-consumer material is material diverted from the waste stream during the manufacturing process that could be used in a separate and different manufacturing process (e.g., reuse of flue gas desulfurization gypsum in drywall production). Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

Previously developed site consists of at least 75 percent of the site area that has preexisting paving, construction, or altered landscapes. This does not apply to a street, roadway, or altered landscapes resulting from current agricultural use, forestry use, or use as preserved natural area.

Prime farmland refers to soils designated by the Natural Resources Conservation Service as “prime farmland.” Prime farmland is land that has the best combination of physical and

chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forestland, or other land, but not urban built-up land or water).

Program plan is a narrative or written design that provides a mechanism for clearly stating the vision and desired outcomes of the project and setting the direction of the design team.

Rainwater/stormwater features use rainwater and stormwater as their sole source and function as stormwater management elements. Examples include pools, fountains, stormwater BMPs, water gardens, channels/runnels for local conveyance, raingardens, and water art. Features can include those intended for limited human contact, or for full human contact.

Receiving waters include groundwater, creeks, streams, rivers, lakes, or other water bodies that receive treated or untreated wastewater or stormwater. This also includes water from combined sewer systems and storm drains.

Reclaimed water is effluent derived in any part from sewage from a wastewater-treatment system that has been adequately and reliably treated, so that as a result of that treatment, it is suitable for a beneficial use, or a controlled use that would not otherwise occur, and is no longer considered wastewater.

Recycled content is defined in accordance with the International Organization of Standards document, ISO 14021—Environmental labels and declarations—Self-declared environmental claims (Type II environmental labeling). www.iso.org

Reference soils are soils native to a site as described in Natural Resources Conservation Service Soil Surveys (refer to soils within the region if the site soils are not mapped). OR undisturbed native soils within the site's region that has native vegetation, topography, and soil textures similar to the site. OR for sites that have no existing soil, undisturbed native soils within the site's region that supports appropriate native plants or appropriate plant species similar to those intended for the new site.

Regularly occupied building(s) are buildings where occupants (workers, students, etc.) are seated or standing inside for extended periods of time.

Rehabilitate is the action of performing ecological restoration that strives to alter the biota and physical conditions at a site, with an emphasis on the reparation of ecosystem processes, productivity, and services.

Reuse is a process of utilizing a used product or material in a manner that generally retains its original form and identity with minor refurbishments. Materials reusable in whole form might include sand-set pavers, segmental retaining walls, or mechanical fasteners, connections, and/or joinery (e.g., avoidance of adhesives and mortar).

Salvage is the recovery of materials from existing sites for reuse on other sites.

Severe soil disturbance describes soils in which topsoil is removed and/or is not present; subsoils are compacted such that compaction levels exceed the Maximum Allowable Bulk Densities; and/or topsoil or subsoil is covered with impervious cover or is chemically contaminated. Examples of soils that are severely disturbed include areas that are covered with buildings or paved surfaces, or areas that are defined as brownfields by local, state, or Federal agencies.

Soils disturbed by previous development are all areas of soils disturbed by previous human development activities. Indicators of disturbed soils may include soil horizons that differ significantly in depth, texture, or physical or chemical properties from the reference soil; bulk densities that exceed the Maximum Allowable Bulk Densities; organic matter content lower than that of the reference soil; soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil; presence of compounds toxic to the intended plants; and presence of weedy, opportunistic, or invasive plant species.

Solar reflectance index (SRI) is a measure of the constructed surface's ability to reflect solar heat, as shown by a small temperature rise. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100.

www.astm.org

Special status plants refers to vegetation designated as important by local, state, or Federal entities. Designations may be for size, species, age, rare or special collections; ecological and environmental value; unique genetic resources; aesthetics; location; or other unique characteristics. Groves/clusters may also be designated special status.

Stakeholders may include, but are not limited to, neighbors (e.g., residential, commercial, industrial, institutional-education, religious, government, non-profit), interest groups (e.g., growth management, environmental, transportation), and public officials from local jurisdictions, regulators, community leaders, business organizations, etc.

Sustainable water sources are non-potable sources and can include harvested rainwater, surplus water from building or site operations that has been appropriately cleansed and cooled, and surplus site water that is not needed to maintain existing or restored site ecology. Potable water or other natural surface or subsurface water resources are not sustainable water sources.

Temporary occupants are occupants such as students, visitors, and customers that are on a site intermittently.

Unique farmland refers to soils designated by the Natural Resources Conservation Service is land other than prime farmland and used for the production of specific high-value food and fiber crops.

Urban Heat Island Effect describes urban areas that are hotter than nearby rural areas due to being highly developed with buildings, roads, and other infrastructure that replaces open land

and vegetation. Surfaces that were once permeable and moist become impermeable and dry. These changes cause urban regions to become warmer than their rural surroundings, forming an "island" of higher temperatures in the landscape.

Vegetated area describes all portions of the site that will support vegetation.

Vegetation and soil protection zones (VSPZs) are areas of soil or vegetation to be protected from construction impacts from overall site development shall not decrease the capacity support the desired vegetation.

Volatile organic compounds (VOCs) are a variety of organic compounds that vaporize at room temperature. VOCs are the principal component in atmospheric reactions that form ozone and other photochemical oxidants, causing a variety of negative health effects from dizziness, eye and respiratory tract irritation, nervous system damage, developmental effects, and cancer.

Walk distance is the distance that a pedestrian must travel between destinations without obstruction, in a safe and comfortable environment such as on sidewalks, footpaths, or other pedestrian facilities. Sidewalks adjacent to urban roads of 40 mph or higher should at least have a 5' buffer zone between the road and sidewalk.

Waste audit is a systematic review of a site and its operations to quantify the types and amounts of waste generated, and the management practices that impact that waste generation. It includes an assessment of purchasing practices and identifies the areas and materials in which waste reduction efforts will be most effective. A waste audit also sets a baseline for measuring future progress of waste reduction efforts.

Wetlands are "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Clean Water Act (U.S. Code of Federal Regulations 40 CFR 230.3) www.epa.gov/lawsregs/laws/cwa.html