COMPATABILITY OF URBAN EDIBLE LANDSCAPING TO THE SUSTAINABLE SITES INITIATIVE'S GOALS AND DESIGN CRITERIA

by

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ABSTRACT

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This research addresses edible landscapes through the lens of The Sustainable Sites Initiative (SITES™). The *Sustainable Sites Initiative* is a collaboration of the American Society of Landscape Architects (ASLA), The Ladybird Johnson Wildlife Center and the United States Botanic Garden. The team of professionals working on SITES has developed a manual for sustainable site development and landscaping practice that include guidelines regarding site development, installation, and maintenance practices. Various levels of certification can be obtained by accumulating points in categories that relate to new site construction or site renovation. It is the purpose of this thesis to research how urban edible landscaping may or may not fit into the SITES point criteria.

The Sustainable Sites Initiative includes criteria for sustainable site development in the areas of water conservation, fuel conservation, lessening toxic pollutants entering water, soil and air, and conservation of existing topsoil. Most of these criteria are affected to some degree

by edible landscaping in urban areas. This thesis uses three methods to evaluate the compatibility of urban edible landscaping for SITES point criteria.

First, SITES guidelines are analyzed to determine if there are any direct conflicts regarding edible urban landscapes. Secondly, interviews with design professionals who have been associated with the development of the *SITES Guidelines and Benchmarks* are compared and analyzed for common thoughts and opinions regarding compatibility of edible landscapes with SITES certification. Finally, a case study of The Olive Tree Learning Center, an edible landscape in Austin, Texas, is evaluated for compatibility and possible point accumulation using the criteria of the *Sustainable Sites Initiative Benchmarks and Guidelines, 2009*.

Evaluation of the interviews, SITES' criteria and the application of this evaluation to the Olive Tree Learning Center reveals no direct conflict with edible landscapes and the SITES prerequisites and credits; however, certain credits are more well-suited for point accumulation. Charts that rate probable point accumulations are for each section of SITES are in located in Chapter 5. These point accumulations are based on the research in this study; however, they are subjective, and will vary widely from site to site according to a particular site's variables regarding site selection, construction and maintenance.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

According to the National Gardening Association, urban agriculture is gaining in interest and popularity (Butterfield, 2009, p.6). Their 2009 report on home and community gardening details that “37 percent of all U.S. households, or an estimated 43 million households, plan to grow vegetables, fruit, berries, or herbs in 2009 compared with 31 percent, or an estimated 36 million households, in 2008. That's an increase of 7 million households or 19 percent from 2008 to 2009” (Butterfield, 2009 p.6). The report found that community involvement in gardening initiatives have arisen around the issues of community connection, food security, and accessibility to healthy food (Butterfield, 2009 p.4). Evidence that this is not just a fad or of local interest is a federal law introduced on March 25, 2010 in the House of Representatives. According to govtrack.org, the intent of H.R. 4971, the ‘Greening Food Deserts Act’, is to “To increase the emphasis on urban agricultural issues in the Department of Agriculture through the establishment of a new office to ensure that Department authorities are used to effectively encourage local agricultural production and increase the availability of fresh food in urban areas, particularly underserved communities experiencing hunger, poor nutrition, obesity, and food insecurity, and for other purposes” (H.R. 4971, 2010).

There is also a growing desire to design sites that provide ecosystem services. “Ecosystem services are goods and services of direct or indirect benefit to humans that are produced by ecosystem processes involving the interaction of living elements, such as vegetation and soil organisms, and non-living elements, such as bedrock, water, and air” (*SITES Guidelines and Performance Benchmarks 2009*, p.6). Efforts toward sustainable site development are observed in the Sustainable Sites Initiative Guidelines and Sustainability

Benchmarks (SITES Guidelines, 2009). The SITES Guidelines are the result of a collaboration of experts in the fields of landscape architecture, civil engineering, hydrology, ecology, and social science who have sought to bring together the essential elements of ecologically and environmentally sound site development in a comprehensive publication. These guidelines offer a system where an accumulation of points in the ecological subjects of site selection and planning; water, soil and vegetation conservation; and human health and well-being, as well as construction, operation and maintenance management decisions. The number of points accumulated translates into One, Two, Three and Four Star Ratings for ecological site development.

1.2 Statement of Problem

This research questions whether or not edible landscapes are compatible with the goals of the recently developed *Sustainable Sites Initiative Guidelines and Benchmarks, 2009*. In order to determine compatibility of edible landscapes to sustainable practices as outlined in the *SITES Guidelines*, the term 'Sustainability' needs to be defined.

'Sustainability' was defined at the United Nations World Commission on Environment and Development in its report to the UN General Assembly, *Our Common Future*. Sustainability is defined in this report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development (WCED), *(*1987 p. 43).

The *SITES Benchmarks and Guidelines* serves as a measure with which to gauge site development practices as they relate to sustainability issues using the above U.N. General Assembly definition. The issues surrounding the conservation of natural resources are central to the U.N. General Assembly's definition of sustainability. Site development plans that include soil, air and water conservation are all addressed in the *SITES Guidelines.* While not prohibiting development, these guidelines promote future access to natural resources through conservation

and careful handling of a particular site's soil, air and water. A review of how edible landscapes affect these natural resources, as well as the societal and communal elements associated with the site will determine the compatibility of edible landscapes with the Sustainable Sites Initiative's goals and benchmarks.

1.3 Literature Review and Research Methods

The literature review in Chapter 2 looks at each prerequisite and credit within the *Sustainable Sites Initiative* for possible conflict or compatibility with individual prerequisites and credits. Not all of the prerequisites and credits are specific to edible landscapes. Relevant prerequisites and credits will be covered in depth in the literature review, along with examples of edible landscape projects and studies regarding these projects. Prerequisites and credits which are not considered to be relevant to edible landscapes are included at the end of this report in Appendix 'A'.

Research for this study beyond the literature review is from a series of interviews with creators of the *SITES Guidelines*. The interview respondents answered a series of questions designed to be open enough to allow elaboration in the answers about the compatibility of edible landscapes with *SITES Guidelines*. The final question asks the respondents to rate overall compatibility and complexity of incorporation of edible plants for sustainability goals. The interviews are recorded and transcribed for inclusion in this report.

1.4 Findings

A thorough analysis of the *SITES Guidelines* and the interviews with its designers reveal specific compatibility issues, positive and negative, relating to edible landscapes. While edible landscapes can potentially utilize any of the credits, there are some credits that may not be achievable, especially for sites which are planted entirely in edible plants. For example, edible landscapes require soil preparation practice and specific plant selections that are not

common to the SITES design criteria. These credits can be used with edible landscapes; however, it would be very unlikely with typical edible landscape practice.

Some examples of the incompatible credits are found in the 'Site Design – Soils and Vegetation' section of SITES. These are credits that promote undisturbed areas of soil and vegetation. Leaving areas of natural soils and vegetation will not be conducive to edible landscapes. Natural soils will most likely need to be amended and natural vegetation will need to be removed for edible landscapes. A practice called "no-till" gardening, where a planting hole is dug for the plant and the surrounding soil is undisturbed, can be used to achieve this credit. "No-till" bed preparation involves layering newspapers and compost on top of the ground to smoother vegetation. Soil horizons are only disturbed during planting with this method. Because this bed preparation method does not disturb the soil, there is less of a problem with soil erosion and the existing air pockets in the soil are not compacted.

Another example of incompatibility is found in the 'Site Design – Water' section of the *SITES Guidelines*. Credit 3.2, which promotes the reduction of potable water usage, may be in conflict. Points for this credit may be claimed if harvested rain water is used for irrigation; however edible plants are not usually drought tolerant, and will require consistent water supply, which may not be available year-round from rain water harvesting.

Examples of highly compatible credits are found in the 'Human Health and Well-Being' section of the *SITES Guidelines*. These credits are very well-suited to edible landscapes, especially those which incorporate community gardens. This section is more concerned with psychological and physiological well-being than with ecological factors relating to a site. Community gardens are a good way to claim credit points under this section of SITES.

Some of the credits in SITES are neutral in compatibility with edible landscapes. These credits are primarily in the "Construction', 'Materials' and 'Operation and Maintenance' sections. These credits are considered to be neutral in that they can be claimed; however, are not directly

related to edible landscapes. The points associated with these credits can be claimed if the requirements are met.

Research analysis confirms that edible plants have special cultivation requirements which will require knowledgeable caretakers. Maintenance issues are of great concern to interview respondents in this study. Although the credits in the 'Maintenance and Operations' section are not in direct conflict with edible landscapes, an analysis of these credits and interview results indicate that maintenance requirements for edible landscapes will be important considerations for sustainable site development.

A compatibility chart of the prerequisites and credits outlined in the SITES Guidelines with edible landscapes is included in Chapter 5 'Conclusion', and a case study of The Olive Tree Learning Center in Austin, Texas, that provide examples of how an actual edible landscape project fits into the sustainability guidelines in the SITES manual is included in Chapter 4.

SITES is a comprehensive manual for sustainable site development, which will be a valuable resource to facilitate ecological health in the built environment. This study finds no direct conflict between edible landscapes and the *SITES Guidelines*; however, the compatibility of the individual credits varies. This research is limited to the direct compatibility of edible landscapes with the *SITES Guidelines*, not exploring the compatibility of non-edible landscapes or conventional agricultural practices with SITES criteria. This more involved research is beyond the scope of this work. More thorough research in these areas should be explored in future studies. The findings in this report will aid designers to make informed choices when weighing the potential societal, economic and psychological benefits of edible landscapes with their potential impact on ecology and the environment.

1.5 Definition of Key Terms

These definitions are taken from the *Sustainable Sites Initiative Guidelines and Performance Benchmarks, 2009*, pages 223-229, unless otherwise noted. Additional sources are cited following the definitions.

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.

Basic services include, but are not limited to: bank, child care facility (licensed), community/civic center, convenience store, hair care, hardware store, health club or outdoor recreation facility, laundry/dry cleaner, library, medical/dental office, pharmacy (stand-alone), place of worship, police/fire station, post office, restaurant, school, senior-care facility, supermarket, museum, and theater.

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 E1903-97 Phase II Environmental Site Assessment or a local Voluntary Cleanup Program; a site defined as a Brownfield by a local, state, or federal government agency.

Community benefits agreement is an agreement made between the developer and coalition(s) of community organizations, addressing a broad range of community need to ensure that affected residents share in the benefits of major developments. The agreement allows community groups to have a voice in shaping a project, to press for community benefits that are tailored to their particular needs, and to enforce developer's promises.

Created water features are features with water made visible for aesthetic purposes. These features can include ponds, streams, pools, fountains, water gardens, created wetlands (ornamental or for water cleansing), and any other water element in the landscape with permanent or seasonal, occasional, or otherwise intermittent water. Created water features can include those intended for limited human contact or for full human contact. Note that water intended for human contact must meet local and/or state health requirements. In some situations, this may require additional treatment methods such as ozonation or thermal treatment.

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.

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. For guidance, see the ISA website, *http://www.isa-arbor.com/publications/treeord/measuringdbh.aspx*.

Food Security - The World Food Summit of 1996 defined food security as existing "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (Report of the World Food Summit. 1996, Plan of Action, Item #1).

Farmland of statewide importance refers to soils designated by each state Natural Resources Conservation Service as "farmland of statewide importance." Farmland of statewide importance is farmland which 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.

Full-Time Equivalent (FTE) *occupants* are the occupants of a site during a standard 8-hour period. An 8-hour period has an FTE value of 1.0, while a part-time occupant has a FTE value based on his/her hours per day divided by 8. (FTE Occupants = Occupant Hours/8 hours). If there are multiple shifts, use only the highest volume shift in the FTE calculation but consider shift overlap when determining peak site users. Note that FTE calculations must be consistently used throughout documentation.

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 streambanks and provide habitat; and the reshaping or replacement of unstable stream reaches into appropriately designed functional streams and associated floodplains.

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

Healthy soils are all areas of soils that have not been significantly disturbed by previous human development activities. Indicators of healthy soils may include one or more of the following:

- soil horizons that are similar to the *reference soil*
- bulk densities that do not exceed the Maximum Allowable Bulk Densities.
- *organic matter* content that is equal to or exceeds that of the reference soil
- soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) similar to that of the reference soil
- absence of compounds toxic to the intended plants
- presence of vegetation that is representative of native plant communities.

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 will be excluded from the calculation.

Integrated design team includes the owner and/or client and professionals knowledgeable in landscape design, construction, and maintenance. Team members should be selected to meet the unique constraints and opportunities of the 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.

Isolated wetlands are wetlands with no surface water connections to other aquatic resources.

Landscape coefficient is a constant used to modify the reference evapotranspiration. It takes into account the species factor, density factor, and microclimate factor. For the purposes of the Irrigation Calculator, the density factor and microclimate factor are both assumed to approximately equal one, to reduce the complexity of the calculations. In general, a high

landscape coefficient value is used for plants that need a lot of water, and a low value is used for plants that need little water.

Light pollution is any adverse effect of artificial light, including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste. (International Dark-Sky Association, 2008).

Mature, stable compost is compost that tests at 6.0 or higher on the Solvita Compost Maturity Index Rating, which is a combination of Carbon Dioxide and Ammonia Maturity Tests.

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 shown in Figure 7.2-A, 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 or is partly removed and/or not present, and in which subsoils are compacted or mixed with topsoil. Examples of soils that are moderately disturbed include previously developed or graded areas that are not covered with buildings or paved surfaces, such as unpaved ranch roads.

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 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, varieties, and cultivars of species native to the ecoregion are acceptable.

Natural surveillance is the placement of physical features, activities, and people in a way that maximizes visibility.

On-going consumables are materials that are regularly used and replaced through the course of business. These materials can include, but are not limited to, paper, glass, plastics, cardboard, and metals.

Open-grid pavement is pavement that is less than 50 percent impervious and contains vegetation in the open cells.

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.

Peak watering month is the month with the highest evapotranspiration rate. This is the month when the plants in the site’s region require the most water. For most regions in the United States, the peak watering month is July.

Permaculture “Consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre, and energy for provision of local needs” (Holmgren, 2006, p.3).

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. *Primary contact recreation* includes activities in which there is prolonged and intimate body contact with the water (Secondary contact recreation includes activities with incidental water contact in which the probability of ingesting appreciable quantities of water is minimal).

Prime farmland refers to soils designated by the Natural Resources Conservation Service as "prime farmland."5 This does *not* include soils that would be prime farmland if drained, irrigated, protected from flooding, etc. 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). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

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 stormdrains.

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.

Reference soils are defined as:

- 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 have 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 support appropriate *native plants* or *appropriate.*

Rehabilitate is defined as 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.

Salvaged materials are construction materials recovered from existing buildings or sites and *reused* on-site.

Schematic design is the concept and basic framework for the design of the project.

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 shown in Figure 7.2-A; 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.

Shared Lane Markings (SLMs) are markings on streets (typically with a speed limit below 35 mph) that help bicyclists position themselves to travel side by side within the same traffic lane in lanes too narrow for a motor vehicle and a bicycle. They encourage safe passing of bicyclists by motorists, reduce the chance of a bicyclist's impacting the open door of a parked vehicle in a shared lane with on-street parallel parking, alert road users of the lateral location bicyclists may occupy, and reduce the incidence of wrong-way bicycling.

Soils disturbed by previous development are all areas of soils disturbed by previous human development activities. Indicators of disturbed soils may include one or more of the following:

1. soil horizons that differ significantly in depth, texture, or physical or chemical properties from the *reference soil*
2. bulk densities that exceed the Maximum Allowable Bulk Densities.
3. *organic matter* content lower than that of the reference soil
4. soil chemical characteristics (parameters such as pH, salinity, cation exchange capacity, and nutrient profiles) different from that of the reference soil
5. presence of compounds toxic to the intended plants
6. 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. To calculate the SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980-01. Reflectance is measured according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E

408 or ASTM C 1371. Default values for some materials will be available in the LEED 2009 Reference Guide. For more information on ASTM standards, see *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.

Specific pollutants of concern include those listed for the site's receiving water on the Clean Water Act Section 303(d) impairment lists by the state water-quality agency.

Stakeholders may include, but are not limited to, the following: neighbors (e.g., residential, commercial, industrial, institutional-education, religious, government, non-profit), interest groups (e.g., growth management, environmental, transportation), 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.

Urban farm is considered to be one or more sites within the boundaries of a city, where the soil is cultivated for edible plants, and where the food produced is shared (whether for-profit or not, by sales or donation) with individuals other than the farmers themselves. The existing sites currently known as urban farms usually occupy a total of at least 1/4 acre (or 10,890 ft2) and have established a formal food distribution system, often selling through Community Supported Agriculture (CSA), at farmers markets, and to local restaurants (Myers, 2008.)

Unique farmland refers to soils designated by the Natural Resources Conservation Service as "unique farmland." Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce

sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods.

Vegetation and soil protection zones (VSPZ) must meet the following requirements:

1. Construction impacts from overall site development shall not decrease the capacity of the VSPZ to support the desired vegetation. For example, construction activities outside of the VSPZ should not change drainage patterns and microclimate effects within the VSPZ.

2. VSPZ shall be protected with a fence or other physical barrier that cannot be easily moved (wildlife-permeable barrier, if appropriate) that protects the zone during construction from equipment parking and traffic, storage of materials, and other construction activities.

3. All construction and maintenance personnel are to be educated about the locations and protective measures of the VSPZ. In construction documents, outline consequences to contractor if VSPZ boundaries are not respected.

4. VSPZ can encompass one plant or can include several plants in a group. VSPZ boundaries for trees shall extend out from the trunk, to a distance of 2 feet radius (measured at ground level) per inch of diameter at breast height (DBH) or the full lateral extent of the actual root system as determined by ground-penetrating radar. VSPZ boundaries for shrubs shall extend out from the stem to twice the radius of the shrub. VSPZ boundaries for herbaceous vegetation shall extend to encompass the diameter of the plant.

5. No more than 10 percent of the total area of the VSPZ can contain development. Only minimal impact site development is allowed within the VSPZ.

6. Incorporate into the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*) on-going management activities to protect the integrity of the VSPZ.

Volatile organic compounds (VOCs) are a variety of organic compounds that vaporize at room temperature, including benzene, chloroform, p-Dichlorobenzene, formaldehyde, and tetrachloroethylene. 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 must have a 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 defined by the Clean Water Act (U.S. Code of Federal Regulations 40 CFR 230.3) as "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."

1. The definition of "control" is modified from Executive Order 13112. http://www.invasivespeciesinfo.gov/laws/execorder.shtml. (April 12, 2010))
2. USDA Natural Resources Conservation Service, "Identification of Important Farmlands," Part 657.5 of Chapter VI of Title 7 of the Code of Federal Regulations (1-1-00 Edition), http://frwebgate.access.gpo.gov/cgi-bin/getcfr.cgi?TITLE=7&PART=657&SECTION=5&YEAR=2000&TYPE=PDF (April 12, 2010).
3. KG Beck, K Zimmerman, JD Schardt, J Stone, RR Lukens, et al. (2008),"Invasive Species Defined in a Policy Context: Recommendations from the Federal Invasive Species Advisory Committee," *Invasive Plant Science and Management* 1 (2008): pp. 414–421. This is an expansion of the federally adopted definition under Executive Order 13112. http://wssa.net/Meetings/WSSAAnnual/2009/CommitteeReports/IPSMJournal.pdf. (April 12, 2010)
4. USDA Natural Resources Conservation Service, "Identification of Important Farmlands," Part 657.5 of Chapter VI of Title 7 of the Code of Federal Regulations (1-1-00 Edition), http://frwebgate.access.gpo.gov/cgi-bin/getcfr.cgi?TITLE=7&PART=657&SECTION=5&YEAR=2000&TYPE=PDF (accessed April 12, 2010).

CHAPTER 2

LITERATURE REVIEW

2.1 SITES Introduction

This Literature Review is based on the *Sustainable Sites Initiative Guidelines and Performance Benchmarks, 2009.* Relevant prerequisites and credits are analyzed individually as they relate to edible landscapes in urban areas. The prerequisites and credits are also analyzed under their various sections for potential point accumulation possibilities within the SITES™ criteria. The following are the nine SITES sections:

1. Site Selection
2. Pre-Design Assessment and Planning
3. Site Design – Water
4. Site Design – Soil and Vegetation
5. Site Design – Materials Selection
6. Site Design – Human Health and Well-Being
7. Construction
8. Operations and Maintenance
9. Monitoring and Innovation

2.2 SITES Goals and Design Criteria for Sustainability

The Sustainable Sites Initiative (SITES™) is a collaboration between the American Society of Landscape Architects (ASLA), The Ladybird Johnson Wildflower Center (LBJWC) and The United States Botanic Garden (USBG). These groups have united to produce a set of guidelines that promote ecological principals and sustainability for site design. Sustainability was defined in a Report to the United Nations as "Design, construction, operations, and maintenance practices that meet the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development (WCED). (*Our common future,* 1987 p. 43).

The Sustainable Sites Initiative: Guidelines and Performance Benchmarks 2009 is a compilation of voluntary guidelines and performance benchmarks, including 15 prerequisites and 51 credits, which cover all phases of site development and preservation. The stated goals from the Sustainable Sites Initiative website are to develop "criteria for sustainable land practices that will enable built landscapes to support natural ecological functions by protecting existing ecosystems and regenerating ecological capacity where it has been lost" (*The Case for Sustainable Landscapes*, 2009, p.8). The guidelines are site specific and are not meant as a regional planning tool. As of October, 2010, 150 projects from 34 states, as well as Canada, Iceland and Spain have been selected for pilot projects to determine how the guidelines may need to be altered. It is expected that the *SITES Guidelines and Performance Benchmarks* will be incorporated into the U.S. Green Building Council's LEED® (Leadership in Energy and Environmental Design) rating system (*The Case for Sustainable Landscapes*, 2009, p.9). LEED, developed by the United States Green Building Council (USGBC), has produced a design manual that aids designers and property owners in "identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions… providing a definitive standard for what constitutes a green building in design, construction, and operation" (USGBC, *LEED 2009 for New Construction and Major Renovations*, p.xi). The

LEED rating system accrues points or credits for a particular project and then awards the site with platinum, gold, silver or certified status depending on the number of sustainability credits satisfied.

There are not specific design criteria in the SITES Guidelines for edible landscaping. A provision is made in the "How to Use the Guidelines and Performance Benchmarks" introductory section. Below the "Site Types" heading, it is written that although the Guidelines "…do not address large-scale agricultural practices…the benchmarks do encourage food production, community gardening, and edible landscapes as potential components of the site" (*SITES Guidelines*, 2009, p. 9). There is no specific credit for edible landscaping in the *SITES Guidelines and Performance Benchmarks*. This section will outline the existing design credits that are relevant to edible landscaping, and explore how edible landscape might fit into SITES goals.

2.3 SITES Prerequisites and Credits for Edible Landscapes

Not all of the SITES credits discussed are specific to edible landscapes. The credits in this Literature Review deal with SITES design criteria that most directly apply to edible landscapes. Table 2.1 lists the pertinent prerequisites and credits. The development of sustainable sites is the concern of the SITES guidelines, and the credits are divided into categories regarding the conservation of natural resources and human health and well-being.

The prerequisites in the SITES guidelines are required for all landscapes seeking SITES certification. In addition to the required prerequisites, there are numerous credits which are optional. The points associated with these optimal credits are accrued to determine the level of SITES certification. The following are the specific categories and credits which are related to edible landscapes in urban areas:

Table 2.1 Relevant Prerequisites and Credits from the *SITES Guidelines and Performance Benchmarks*

Site Selection	Pre-Design Assessment and Planning	Site Design-Water	Site Design - Soil and Vegetation	Site Design - Human Health and Well-Being	Construction	Operation and Maintenance	Monitoring and Innovation
Credit 1.5 - Select Brownfields or Greyfields for Development	Perequisite 2.1 - Pre-Design Site Assessment for Opportunities for Sustainability	Prerequisite 3.1 - Reduce Potable Water Use By 50 Percent of Baseline - Water Harvesting Only	Prerequisite 4.1 and Prerequisite 4.2 - Control Invasive and Use Appropriate Non-Invasive Species	Credit 6.1 - Promote Equitable Site Development	Prerequisite 7.1 - Control and Retain Construction Pollutants	Prerequisite 8.1 - Plan for Sustainable Site Maintenance	Credit 9.1 - Monitor Performance of Sustainable Design Practices
Credit 1.6 - Select Sites Within Existing Communities	Prerequisite 2.2 - Use and Integrated Site Development Proces	Credit 3.2 - Reduce Potable Water Use by 75 Percent from Baseline - Water Harvesting Only	Prerequisite 4.3 - Create a Soil Management Plan	Credit 6.2 - Promote Equitable Site Use	Prerequisite 7.2 and Credit 7.3 - Restore Soils Disturbed During Construction and by Previous Development	Credit 8.3 - Recycle Organic Matter Generated During Site Operation	Credit 9.2 – Innovation in Site Design
Credit 1.7 - Select Sites that Encourage Non-Motorized Transport	Credit 2.3 - Engage Users and Other Stakeholders	Credit 3.5 - Manage Stormwater on Site	Credit 4.4 - Minimize Soil Disturbance in Design and Construction - No-till only.	Credit 6.3 - Promote Sustainability Awareness and Education		Credit 8.7 - Minimize Greenhouse Gas Generation and Exposure to Air Pollutants During Maintenance	
		Credit 3.6 - Protect and Enhance On-Site Water Resources and Receiving Water Quality	Credit 4.6 - Preserve or Restore Plant Biomass	Credit 6.4 - Protect and Maintain Unique Cultural and Historical Places	Credit 7.4 - Divert Construction and Demolition Materials from Disposal		
			Credit 4.7 - Use Native Species	Credit 6.5 - Provide for Optimum Site Accessibility, Safety and Wayfinding	Credit 7.5 - Reuse and Recycle Vegetation, Rocks and Soils		
			Credit 4.11 - Use Vegetation to Minimize Building Cooling Requirements	Credit 6.6 - Provide Opportunities for Outdoor Physical Activity	Credit 7.6 - Mimimize Greenhouse Gas Emissions and Air Pollutants during Construction		
			Credit 4.12 - Reduce Urban Heat Island Effects	Credit 6.7 - Provide Quiet Outdoor Spaces for Mental Restoration			
			Credit 4.13 - Reduce the Risk of Catastrophic Wildfire	Credit 6.8 - Provide Outdoor Space for Social Interaction			

Hatched Cells are Less Compatible

Each of these prerequisites and credits will be discussed as they relate to edible landscapes. The credits that are not related to edible landscapes are included in Appendix A for review.

2.4 Site Selection

For this section of the SITES Guidelines there are three credits which pertain to site selection: 'Brownfield and Greyfield Site Development', 'Select Sites Within the Communities' and 'Select Sites that Encourage Non-Motorized Transport'. These credits focus on the importance of site location in urban areas that reduce pollution and the problems created by unsightly brownfield and greyfield areas.

Credit 1.5 Select Brownfields or Greyfields for Redevelopment

> Intent - Channel development to urban areas to reduce pressure on undeveloped land, reduce resource consumption and restore ecosystem services to damaged sites (*SITES Guidelines and Benchmarks*, 2009, p.26).

This credit is adapted from the US Green Building Council LEED Certification Manual based on the following two credits:

> Credit 3 – Brownfield Redevelopment - Rehabilitate damaged sites where development is complicated by real or perceived environmental contamination, reducing pressure on undeveloped land (2009 LEED Manual, p.5).
>
> Credit 2 – Development Density, Option 1 -The intent of this credit is "to channel development to urban areas with existing infrastructure, protect greenfields, and preserve habitat and natural resources. Development Density: Construct or renovate a building on a previously developed site and in a community with a minimum density of 60,000 square feet per acre. The density calculation is based on a typical two-story downtown development and must include the square footage of the proposed building of the project being built" (2009 LEED Manual, p.3). In other words, the density of the existing buildings within the

site's one acre proximity are added to the proposed building's density to achieve the final density of at least 60,000 square feet per acre.

There could be a conflict with the above 'Credit 2 - Development Density, Option 1' and edible landscapes, because it encourages greater building density, leaving less of the site for planting, as greater density translates into more building square footage per acre. An acre is 43,560 sq.ft. If a 60,000 sq. ft. two-story building is planned, attributing 30,000 sq. ft. per floor, that would be over 2/3rds of a one acre site that would be occupied in building footprint. An edible landscape can still be planned in this example; however, the proposed planting area will be limited by such a large building footprint. A rooftop garden would be a good method for edible plantings in this instance.

Brownfields are further defined in the *SITES Guidelines* as "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 E1903-97 Phase II Environmental Site Assessment or a local Voluntary Cleanup Program; a site defined as a Brownfield by a local, state, or federal government agency" (*SITES Guidelines and Benchmarks*, 2009, p.27). The purpose of the American Society of Testing and Materials (ASTM) E 1903-97 Phase II Site Assessment is to evaluate the physical conditions of a property, based on the needs of the report's end user. "The guide covers a framework for employing good commercial and customary practices in conducting a Phase II environmental site assessment of a parcel of commercial property." Locations for brownfields can be found at the following:

1. U.S. Environmental Protection Agency's Brownfields and Land Revitalization, *http://www.epa.gov/brownfields/.*
2. Sanborn maps, *http://sanborn.umi.com/.*
3. Local (city or county) assessor records.
4. Smart Growth Online, *http://www.smartgrowth.org.*
5. Urban Land Institute, *http://www.uli.org/.*

An example is given by the Environmental Protection Agency (EPA) of a site in Somerville, Massachusetts where the City used an EPA Brownfields Cleanup grant in 2007 to clean up a brownfield site for the construction of Allen Street Community Garden (US EPA, *How Does Your Garden Grow?* 2009). The site had been used as an illegal dumping ground and became vacant in the 1950's. The City took over the responsibility for the site, and held community meetings on potential uses. After deciding that the site should be used for a community garden, the top 3 feet of soil was removed and raised beds were put in for use as individual garden plots. The site includes 15 garden plots, one of which is handicapped accessible (US EPA, *How Does Your Garden Grow?* 2009).

Illustration 2.1 - Allen Street Community Garden

This EPA publication lays out a step by step approach for remediating brownfields for edible landscapes which references the Sustainable Sites Initiative:

1. Apply for Brownfield grant funds if help is needed to assess and clean a site.
2. Talk with local municipalities about gardens for information regarding the use of a site as an interim or permanent use for vacant land.
3. Assess sites before buying, leasing or borrowing to ensure the site is safe for food.
4. Learn how to use greener materials when establishing gardens. This information is available from the Sustainable Sites Initiative at: www.sustainablesites.org/.
5. Bring clean fill or mulch from certified sources for raised beds and cover.
6. Work with nature to save time and money (US EPA, *How Does Your Garden Grow?* 2009).

Greyfields are defined in the *SITES Guidelines* as "a site that has been previously developed or graded" (*SITES Guidelines and Benchmarks, 2009,* p.27). Edible landscapes may be located on either brownfields or greyfields, however, site contamination may prevent these sites from being used for food production. Heavy metals are a concern in previously industrialized sites. A study in West Midlands, United Kingdom which measured uptake of cadmium, copper, nickel, lead, and zinc for a selection of commonly grown vegetables in allotment gardens found that the uptake was based on a number of factors, including soil pH, soil carbon, water amounts and amount of base contamination (Hough et al., 2004, pp.215-221). **"**Generalized linear cross-validation showed that final predictions of Cd, Cu, Ni, and Zn (Cadmium, Copper, Nickel and Zinc) content of food crops were satisfactory, whereas the Pb (Lead) uptake models were less robust" (Hough et al., 2004, p.215). The largest contribution to HI (Hazard Index) was from Pb (about 40% of HI) and Cd (about 30% of HI). Ni and Cu provided the lowest contribution to HI at about 10 and 14%, respectively." (p.220) The study also found that the "highest levels of contamination were found at junctions of major roads, railways, and canals" (Hough et al., 2004, p.221).

Government agencies can be very supportive in brownfield and greyfield site remediation. Sites that are listed on the EPA Cleanup List provide funding to aid in clean-up efforts. Brownfield site remediation can be very costly, as the polluted soil must be trucked to a

special landfill that will accept toxic material. It would be important to locate an approved landfill to determine fuel costs to haul the soils away when considering brownfield remediation.

When considering brownfield or greyfield sites for edible landscapes, it is important to consider how existing pollutants, planned density requirements and the cost of remediation involved in developing the site.

Credit 1.6 – Select Sites Within Existing Communities

> Intent – Encourage site development within existing communities to reduce pollution and development impacts, support local economy and improve human health (*SITES Guidelines and Benchmarks*, 2009, p.28).

This SITES credit requires that the site be an infill construction or be located within a ½ mile walk from at least five basic services or within a ¾ mile walk from seven basic services. An infill site is defined as "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 will be excluded from the calculation" (*SITES Guidelines and Benchmarks*, 2009, p.29). A basic service includes but is not limited to "bank, child-care facility (licensed), community/civic centers, convenience store, hair care, hardware store, health club or outdoor recreation facility, laundry/dry cleaners, library, medical/dental office, pharmacy (stand-alone), place of worship, police/fire station, post office, restaurant, school, senior-care facility, supermarket, museum and theater (*SITES Guidelines, 2009,* p. 28).

This credit is based on the LEED SS Credit 2: Development Density and Community Connectivity, Option 2 - Community Connectivity, which states that sites should:

Construct or renovate a building on a site that meets the following criteria:

1. Is located on a previously developed site
2. Is within 1/2 mile of a residential area or neighborhood with an average density of 10 units per acre net
3. Is within 1/2 mile of at least 10 basic services
4. Has pedestrian access between the building and the services
5. For mixed-use projects, no more than 1 service within the project boundary may be counted as 1 of the 10 basic services, provided it is open to the public. No more

than 2 of the 10 services required may be anticipated (i.e., at least 8 must be existing and operational). In addition, the anticipated services must demonstrate that they will be operational in the locations indicated within 1 year of occupation of the applicant project.

Urban community gardens or urban infill gardens on commercial or residential sites would qualify for this credit if they are within required distances.

Credit 1.7 – Select Sites That Encourage Non-Motorized Transportation and the Use of Public Transit

Intent – Encourage site development that is accessible by pedestrians and bicyclists and near public transit to reduce pollution and improve human health (*SITES Guidelines and Benchmarks*, 2009, p. 30). This credit has two possible options to earn credit points:

Option 1

1. Locate the project on a site that is accessible to pedestrians and bicyclists by one or a combination of the following features.
2. Continuous sidewalks or trails that span 8 blocks (approximately 1 mile) in each direction (must directly connect to project entrance)
3. A street with bicycle lanes or Shared Lane Markings (SLMs) on both sides of the street (must directly connect to project entrance)
4. A bicycle network of at least 5 continuous miles in length (must be located within 0.25 mile bicycling distance from project entrance)
5. In the case of a planned sidewalk, street with bicycle lanes or SLM, or bicycle network, show that the relevant agency has committed in a legally binding warrant to provide the designated feature and has identified all funding necessary to do so within the time period of project certification.
6. If a project connects to a street with bicycle lanes or SLMs and/or a bicycle network, the project must also provide secure bicycle racks and/or storage within 200 yards of an entrance to a regularly occupied building (if applicable) or at a convenient and accessible location for 5 percent or more of total site users (Full-Time Equivalent (FTE) occupants and Temporary occupants).

OR

Option 2

1. Locate the project on a site with existing transit service so that at least one project entrance is within 0.25 mile walk distance of bus or streetcar stops or within 0.5 mile walk distance of bus rapid transit stops, light or heavy passenger rail stations or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in the following table (both weekday and weekend trip minimums must be met (*SITES Guidelines and Benchmarks*, 2009, p. 30).

Table 2.2 Minimum Requirements for Transit Service (*SITES Guidelines*, 2009, p.30).

Minimum Requirements for Transit Service		
	Weekday Minimum Daily Trips	Weekend Minimum Daily Trips
Projects with a Combination of Transit Service Types (Bus, Rail or Ferry)	72	40
Projects with Only Commuter Rail or Ferry Service	24	6

These credit options are adapted from the USGBC LEED Manual's Sustainable Site Credits 4.1 and 4.2.

This credit may be fulfilled by urban edible landscaping in a method that was not originally intended by the *SITES Guidelines and Benchmarks*. The original intent of this credit is concerned with transport of humans to and from the site. From another perspective, the credit might be satisfied with reduced miles traveled by the trucks that bring produce to market.

Much of the produce Americans buy has traveled a great distance before arriving in their grocery stores, resulting excessive use of fossil fuel for transportation. Supermarkets are increasing their importation of fresh fruit and vegetables. Produce imports from supermarket distributors increased at a rate of 8% per year between the years of 1992 and 2002 (Cuellar, 2002, p.276).

Pfeiffer describes the growth in agricultural trade in his book *Eating Fossil Fuel: Oil, Food and the Coming Crisis in Agriculture*. "In the three decades from 1968 to 1998, world food production increased 84 percent, world population increased 91 percent, but food trade increased 184 percent… The increase in food miles is, of course, made possible by an increase in fossil fuel consumption. So the globalization of food production and the atrophying of localized food infrastructure are subsidized by cheap and abundant fossil fuels. As fossil fuels become less abundant and more expensive, this system will become increasingly strained…" (Pfeiffer, 2006, pp.24-25). Rich Pirog defines food miles as "the distance food travels from where it is grown or raised to where it is ultimately purchased by the consumer or end-user"

(Pirog, *Food, Fuel and Freeway*, 2001, p.1). In this paper, he gives a comparison of the average number of food miles traveled for local as compared to non-local food that was delivered to various institutional markets in Iowa. His research found that the non-local deliveries averaged 1,546 miles (Pirog, *Food, Fuel and Freeway*, 2001, p.1). Food that is grown on site would, of course, have lower associated food miles. Future studies are needed to determine economies of scale regarding individual crop types and quantities of food produced in relation to food miles for farm production.

Sevag Pogharian is the principal and founder of a Montréal-based architectural and general contracting firm that specializes in sustainable design. In his article *Getting to Net Zero Energy Food,* Pogharian suggests a holistic approach to sustainable food production which includes urban gardens, both community and residential. “A sustainable food system would entail a return to…urban and community gardens, co-operatives and community supported agriculture (CSAs) along with homescale agriculture.” He defines sustainability in food production as including “1) a localized, as opposed to a globalized, system of food production and consumption, 2) reduced levels of food processing, and 3) sustainable agricultural practices” (Pogharian, 2008).

The original intent of this credit could be satisfied, and the points claimed, if the site was located near rail or bus stations and bicycle storage and changing rooms are provided on site. Although it is not explicitly covered in this credit, the use of hand tools rather than power tools for garden maintenance is another option for reducing the use of fossil fuels.

2.4.4 Summary of Edible Landscape Compatibility for the ‘Site Selection’ Section of SITES

Likely point accumulations for edible landscapes under the ‘Site Selection’ section of the Sustainable Sites Initiative are found in the areas of brownfield and greyfield development (Credit 1.5), site selection within existing communities (Credit 1.6) and possibly in the

encouragement of non-motorized transport (Credit 1.7), especially if the reduction of food miles can be allowed to aid in the achievement of the points associated with this credit.

Particular concerns for edible landscapes in this section have to do with the quality of the existing site, especially as it relates to soil contamination and affordability of reclamation.

2.5 Pre-Design Assessment and Planning

For this section of the SITES Guidelines there are two prerequisites and one credit which pertain to the design process. 'Pre-Design Site Assessment', 'Integrated Site Design Process', and 'Engage Users and Other Stakeholders in Design Process.' This section addresses the importance of looking at all of the sustainability issues surrounding the development of a site before construction. The recommended process involves design professionals associated with the site as well as potential users. Planning for community involvement can be very important for edible landscapes, especially when community gardens are a part of the site plan. Future maintenance issues are also addressed. This is the recommended point in the design process to weigh specific maintenance requirements for edible plants.

Prerequisite 2.1 – Conduct a Pre-Design Site Assessment and Explore Opportunities for Site Sustainability

> Intent - Conduct an accurate and detailed assessment of site conditions and explore options for sustainable outcomes prior to design to inform decisions about site design, construction, operation, and maintenance (*SITES Guidelines and Benchmarks*, 2009, p.33).

This Prerequisite requires that the integrated design team "collect and assess information to help identify opportunities to protect and improve ecosystem services and use sustainable strategies to guide the design, construction, operation, and maintenance of the site" (*SITES Guidelines and Benchmarks*, 2009, p.33). Integrated design team is defined as "includes the owner and/or client and professionals knowledgeable in landscape design,

construction, and maintenance" (*SITES Guidelines and Benchmarks*, 2009, p.41). The assessment provides an ecological baseline of the site. In order to satisfy this prerequisite, plans for proposed edible landscape sites would have to be subject to a pre-design site assessment.

Prerequisite 2.2 - Use an Integrated Site Development Process

> Intent - Use a multidisciplinary team of professionals experienced in sustainable practices to collaborate on the design, construction and maintenance of the site in an integrated design and implementation process (*SITES Guidelines and Benchmarks*, 2009, p.44).

This Prerequisite requires the following 3 components:

1. Team formation: At a minimum, the integrated design team should include the following roles: owner and/or client, and professionals knowledgeable in site design, construction, and maintenance. The integrated design team should have expertise in vegetation, water/hydrology, soil, landscape ecology, materials, and human health and well-being. Team members are selected to meet the unique constraints and opportunities of the site.
2. Communication process: The method should be outlined and collaborative and allow the viewpoints and perspectives of all members to be considered in the decision-making process. The outline should include the principles and goals of the project and associated timelines with specific measurable goals. The program plan needs to list the unique characteristics of the site and the general parameters of the project. It also needs to describe how sustainability goals will be met.
3. Project stakeholders and potential users for the site need to be identified and listed. Primary and secondary users should be described if this is relevant.

Edible landscapes are required to use an Integrated Site Development Process in order to qualify for SITES accreditation. Because edible landscapes require a specialized type of maintenance, this process is a valuable tool to outline specific maintenance criteria and assure that maintenance personnel are familiar with specific requirements for edible plants.

Construction methods as they apply to bed preparation, soil cultivation methods and planting times and methods should all be discussed during this Integrated Site Development Process.

Credit 2.3 - Engage Users and Other Stakeholders in Site Design

> Intent - Engage with site users and other stakeholders in meaningful participation during the site design process to identify needs and to supplement professional expertise with local knowledge (*SITES Guidelines and Benchmarks*, 2009, p.46).

This Prerequisite requires the following 5 components:

Positively engage a diverse group of potential site users/stakeholders in the following phases:

1. Identify site users/stakeholders (see *Prerequisite 2.2: Use an integrated site development process.*)

2. Engage with site users and other stakeholder in the site assessment process and the program plan:

1. Provide a minimum of two opportunities for participation that are accessible for site users/stakeholders.
2. Share with the participants a plan, model, and/or aerial photographs of the site with known site features including written descriptions.
3. Incorporate the knowledge gained about the site and local area as identified by the participants during the site assessment (see *Prerequisite 2.1 Conduct a pre-design site assessment and explore opportunities for site sustainability*). This may include but is not limited to the following: current and historic land use and management,

locations of interesting or unique features, known or perceived cultural and historical significance, and environmental issues, etc.

4. Identify the programmatic and functional needs of the various groups (e.g., recreational opportunities, walking/biking trails, playground, community garden, community gathering places).

3. Engage with site users and other stakeholder in schematic design review:

1. Provide a minimum of two opportunities for participation that are accessible for site users/stakeholders.
2. Provide a minimum of two schematic design alternatives and their associated outcomes using visual representations (e.g., sketches, models, photo simulations).

4. Engage with site users and other stakeholders in the design development presentation and review:

1. Provide a minimum of two opportunities for participation that are accessible for site users/stakeholders.

5. Present the final design to the public:

1. Present the final design to site users/stakeholders in at least two forms (e.g., website, community meeting, newspaper, civic display). The final design must be made available to the public for a minimum of one month. (*SITES Guidelines and Benchmarks*, 2009, pp.46-48).

This credit is designed to increase diversity of the design team by including additional stakeholders. Stakeholders "may include, but are not limited to, the following: neighbors (e.g., residential, commercial, industrial, institutional-education, religious, government, non-profit), interest groups (e.g., growth management, environmental, transportation), public officials from local jurisdictions, regulators, community leaders, business organizations, etc." (*SITES Guidelines and Benchmarks*, 2009, p.48).

Stakeholders for edible landscapes would be the end-users of the site. In community gardens, this would involve potential community gardeners. Community garden participants should be solicited to participate from the beginning. The American Community Gardening Association stresses the importance of this issue. “For (community) gardens to be effective tools for connecting people with local networks and services, they must be community-driven at every phase” (*ACGA Community Greening Review,* 2000, p.23).

Schively discusses the importance of including local participants in the design process. “In large measure, what made these (transportation enhancement) projects and their public involvement successful was that those facilitating the processes were cognizant of local conditions. They understood local politics, engaged key stakeholders, brought in design experts to supplement local knowledge, and were creative in tailoring the design solutions to the site and neighborhood context. Without the public’s input, including participants who both challenged and supported the projects, the outcomes identified above would not have been the same” (Schively, 2007, p.17).

The website for the Allen Street Community Garden in Somerville, Massachusetts outlines the process they used to solicit community involvement “Throughout the process, the City of Somerville conducted special outreach efforts to encourage multi-cultural participation. With the help of local organizations, the city translated public notices into Spanish, visited the homes of Spanish-speaking residents, and in place of a traditional community meeting, held a gathering where the city solicited residents’ comments on the plan for the garden” (U.S. Environmental Protection Agency, 2009, p.2).

Community gardens are an amenity that has wide-ranging community interest. In their policy review, the American Community Gardening Association addresses the importance of community involvement in this process. “While a vacant lot can be cleaned up and turned into a beautiful green space in a day, the potential for community development in its deepest sense lies in the processes leading up to and following the physical improvements. Gardens will not

succeed if individuals and families do not embrace the project as their own" (*Community Greening Review*, 2000, p.23).

2.5.1 Summary of Edible Landscape Compatibility for the 'Pre-Design Assessment and Planning' Section of SITES

Because of potential benefits and conflicts with edible landscapes in the local community, it will be very important to include community input in the site design process. Real or perceived benefits or threats can be better addressed during design; furthermore, local residents who have been included in the process will be more likely to embrace the built project.

Credit 2.3 which encourages the engagement of site users and other stakeholders is particularly well-suited for community gardens. Community involvement is very important for the stakeholders, both the possible participants and the local neighbors. Concerns about cost, construction and perceived neighborhood nuisances should all be taken into account. Pre-design meetings can also help to weld community effort toward the overall success of the project.

2.6 Site Design - Water

Water conservation is a primary concern for sustainable design. For this section of the SITES Guidelines there are one prerequisite and three credits which pertain to water use and conservation on the site. Edible landscapes are excluded from water use restrictions prescribed by this section; however rain harvesting and low-flow irrigation systems can greatly reduce water usage from baseline quantity. Water harvesting can also help in meeting the requirements for Credit 3.5 and Credit 3.6, which address the prevention of run-off water and accompanying pollutants from the site. Edible landscapes are compatible with reduced run-off water due to standard bed preparation practices.

Prerequisite 3.1 and Credit 3.2 – Reduce use of Potable Water

Intent – These two SITES criteria deal with reduced water usage, and will be discussed at the same time to avoid repetition. Prerequisite 3.1 mandates a reduction in potable water use for landscape irrigation by 50 percent from an established baseline (*SITES Guidelines and Benchmarks*, 2009, p.49), and Credit 3.2 mandates a reduction in irrigation use by potable water by 75 percent from a baseline (*SITES Guidelines and Benchmarks*, 2009, p.54). Prerequisite 3.1 and Credit 3.2 are based on LEED 2009 for New Construction and Major Renovations WE Credit 1: Water Efficient Landscaping.

Baseline water requirements for SITES Prerequisite 3.1 and Credit 3.2 are based on the average monthly evapotranspiration for the peak use month multiplied by the land area and by the conversion factor of 0.6233 to produce the amount of rainfall in gallons per month (*SITES Guidelines and Benchmarks*, 2009, p.50). SITES Guidelines use the EPA Water Budget Data Finder to find evapotranspiration rates and average rainfall amounts for specific local data. This tool can be found at http://www.epa.gov/WaterSense/nhspecs/wb_data_finder.html. For example, the data for July in Austin, Texas, is reported as 8.34" per month in evapotranspiration loss, and an average of 1.22" of rainfall. Using the information from the SITES baseline irrigation calculator, we have the following formula:

Irrigation Calculator:

Baseline Landscape Water Requirement (BLWR) = ET0 x A x Cu

Where:

ET0 = average reference evapotranpiration (ET0) for the site's peak watering month, provided locally (inches/month).
A = Area of irrigated landscape in square feet (area designed with permanent irrigation systems)
Cu = Conversion factor (0.6233 for results in gallons/month)

Therefore the BLWR for a 120 square foot area in Austin, Texas is as follows:

BLWR = 8.34 x 120 sq.ft. x 0.6233 = 623.8 gallons per month

Designed Landscape Water Requirements:

With the above information, specific baseline information for the plant types on the site can be found with the following formula:

Designed Landscape Water Requirements per Hydrozone -

(DLWRH) = RTM x [(ET0 x KL) - Ra] x A x Cu

Where:

RTM = Run time multiplier, equal to 1/low quarter distribution uniformity (dimensionless)
ET0 = average reference evapotranpiration (ET0) for the site's peak watering month, provided locally (inches/month)
KL = Landscape coefficient for type of plant in that hydrozone
Ra = Allowable rainfall (25% of average monthly rainfall for the site's peak watering month, provided locally (inches/month))
A = Area of hydrozone (square feet)
Cu = Conversion factor (0.6233 for results in gallons/month)

Therefore, using the equivalency charts on page 51 of the SITES Guidelines, and specifying a standard drip system on shrub plants with medium water requirements in Austin, Texas in July:

DLWRH = 1/70 x [(8.34 x 0.5) - .305] x 120 x 0.6233 = 0.41

The reduction from the baseline water usage is found with the following formula:

(BLWR – (DLWR – NPS))/BLWR

Where NPS = Non-potable water source.

Using the above data in this formula, with no non-potable water source:

(623.8 gpm – (.41 – 0))/623.8 = 93% reduction in non-potable water usage

There are some exemptions to the Sustainable Sites Initiative prerequisite and credit, including water used to establish plantings, water used for fire suppression and water used for edible landscapes. The SITES guidelines state as one of the exemptions "Water used to irrigate non-commercial food production gardens" (*SITES Guidelines and Benchmarks*, 2009, p.23), which means edible landscapes are exempted from Prerequisite 3.1. Credit 3.2 requires a 75%

reduction in potable water usage from the baseline. Additional points offered under Credit 3.2 of the SITES require no potable water use after plants are established. This would not be a viable option for edible plants which would require consistent watering, unless rain harvesting was employed. Even though edible landscapes are not in conflict with these criteria, it is important to consider non-potable irrigation sources for edible plantings.

Non-potable water sources include harvested rain water, storm water and graywater. Rain water is collected in rain barrels or cisterns to be used as needed. Rain water is safe to use on edible plants without treatment if it is not otherwise contaminated. In their online publication *Best Management Practice: Alternate Water Sources,* the U.S. Department of Energy (DOE) claims, “Rain water can be collected in cisterns and used with little or no treatment for a variety of non-potable purposes” (U.S. Department of Energy, 2009). This DOE publication also states that both storm water (run-off from hard surfaces during rain events) and graywater (defined as “water from bathroom sinks, showers and clothes washing machines” by the DOE), are commonly treated for the removal of pollutants and suspended solids before being released to the public for non-potable uses. This water is called “reclaimed water” and is available for use on edible landscapes within state, county and local guidelines. For example, the State of Texas, working through the Texas Commission on Environmental Quality (TCEQ), adopted general requirements that set limits on fecal coliform levels in reclaimed water that is used for the irrigation of edible crops (TCEQ, 2005). Likewise, the State of Oregon allows the reuse of “Class B” reclaimed water for the irrigation of processed food crops if the irrigation is halted three days before harvest, and the use of “Class A” reclaimed water for use on any agricultural use (Oregon Administrative Rules #340-055-0012, 2010).

County and municipal regulations vary in their regulations on reclaimed water use for edible plants. For example, the City of Fort Worth, Texas’ regulations allow the use of reclaimed water if “there is no direct contact with edible crops, unless the crop is pasteurized before consumption” (City of Fort Worth Ordinance #1844-01-2009, 2009). The City of Tampa, Florida

allows reclaimed water to be used for “irrigating fruit trees and gardens containing edible foods that will be peeled or cooked before serving” (City of Tampa, Florida, 2010). Hillsborough County, Florida allows the use of reclaimed water on edible crops that will be “peeled, skinned, cooked or thermally processed,” and allows the use of this water source on all crops that are irrigated with “ridge and furrow irrigation, drip irrigation, or a subsurface distribution system that will preclude direct contact of the crops” (County of Hillsboro, Florida, DEP Rule 62-610.650 Florida Administrative Code, 1996).

As potable water supplies become scarcer, non-potable sources will become more important. In the arid areas of the Western United States, it is estimated that half of the water used for irrigation is supplied by non-renewable water stored in aquifers and reservoirs. In drought years it is an even greater percentage (Gollehon, 2006, p.1). “In the United States, more than 4 million hectares – roughly a fifth of the nation’s irrigated area – are watered by pumping in excess of recharge. By the early eighties, the depletion was already particularly severe in Texas, California, Kansas, and Nebraska, four important food-producing states” (Postel, 1989, p.18).

Reduction in water usage can be achieved by any of the following methods:

2. Plant species factor – Areas are calculated for plant types, such as turf grass, trees, shrubs and ground cover. These areas are given coefficients by plant type. Coefficients are given for low, medium and high water usage. Water requirements will vary for edible plants. According to Mississippi State University’s online publication *Vegetable Gardening in Mississippi* “Vegetable gardens usually need about one inch of water (630 gallons per 1,000 square feet) per week in the form of rain or irrigation during the growing season” (Mississippi State University, 2010). Water needs will vary by type of edible plants, soil type, time of year and location.
3. Irrigation efficiency – Different types of irrigation (drip emitter, micro-spray, overhead spray and rotor) are given different efficiency coefficients on page 51 of the SITES Guidelines, to

determine baseline and design calculations. Low-flow irrigation systems are used for about half of the land devoted to fruit and vegetable production and are by far the most efficient means of irrigation. Drip systems are 95% efficient as opposed to overhead spray, which are 75 to 85% efficient and gravity-fed systems, which are only 40 to 65% efficient (Schaible, 2006). Most of this inefficiency is due to evapotranspiration (Gollehon, 2006). Evapotranspiration is partially due water loss through leaves during the plant's respiration. The second contributor to this type of water loss is due to evaporation directly to the air. This can be especially troublesome with the fine misting caused by high-pressure, overhead irrigation. According to Texas A & M's website on water conservation, "Drip irrigation offers increased watering efficiency and plant performance when compared to sprinkler irrigation. In areas of the state with poor water quality (i.e., high salt content), drip irrigation also allows safer use of "salty water" in the landscape and garden. Drip irrigation slowly applies water to soil. The water flows under low pressure through emitters, bubblers or spray heads placed at each plant. Water applied by drip irrigation has little chance of waste through evaporation or runoff" (Texas A&M University, *Efficient Use of Water in the Garden and Landscape*).

4. Use of captured rainwater – Rainwater collection in cisterns and rain barrels are good water sources for edible plantings. According to a University of Minnesota series on sustainable urban landscapes (SULIS), "Rainwater that is unpolluted is one of the best choices for irrigation because it contains few contaminants" (SULIS, University of Minnesota, 2006). However, a 1997 study of water quality from roof run-off in Switzerland, published in the *Journal of Contamination Hydrology*, found that "Roof runoff samples, from tile, polyester, and flat gravel roofs, were analyzed and metal concentrations were found to vary tremendously with roof type. First flush analyses showed polyester roofs contributing highest concentrations of copper (6,817mg/L), zinc (2,076 mg/L), cadmium (3.1 mg/L) and lead (510 mg/L). Concentrations in runoff from tile roofs were copper (1,905 mg/L), zinc

(360 mg/L), cadmium (2.1 mg/L) and lead (172 mg/L). Runoff from flat gravel roofs also contributed copper (140 mg/L), zinc (36 mg/L), cadmium (0.2 mg/L) and lead (22 mg/L). Runoff from roofs was found to contain not only heavy metals, but polycyclic aromatic hydrocarbons (PAHs) and organic halogens as well" (Gobel et.al., 2007, p.26). It is important to have water collected from roof run-off tested before using it on edible plants for these contaminants.

If rain barrels and cisterns are used to source irrigation systems, pressure may be low, depending on how full they are and the elevation above the emitters or drip tubing. This problem can be alleviated by raising the height of the collection tank or a small pump may be needed (Stryker, 2009).

5. Use of recycled graywater – The Department of Health in Western Australia (DHWA) defines graywater as "all the non-toilet wastewater produced by the average household, including water from bathtubs, showers, sinks, washing machines and dishwashers, and constitutes about 60% of domestic wastewater" (DHWA, 2002). This definition is used in a study of graywater quality, which found high levels of surfactants and higher than usual levels of boron, salt, and fecal coliforms in graywater than in treated water sources (Wiel-Shafran, et.al., 2006, pp. 350-351). Graywater should be tested for these contaminants, especially fecal coliforms, as this could cause serious health problems on edible plants.

These SITES credits do not specify a type of irrigation; they only provide suggestions of possible non-potable water sources. Despite the fact that edible plantings are excluded from meeting this credit, specifying drip systems for irrigation on edible landscapes in urban areas would be in keeping with the sustainability goals.

Credit 3.5 and Credit 3.6 – Manage Stormwater on Site and Protect Receiving Water Quality

Intent of Credit 3.5 – Replicate the hydraulic conditions (infiltration, runoff, and evapotranspiration) of the site based on historic, natural, and undeveloped ecosystems in the region (*SITES Guidelines,* 2009, p.63*).*

The intention of this credit is to maintain or replicate the natural water movement systems of the site. The Stormwater Management Model (SWMM) is used to model hydrology. Five sites from different regions across the United States are used as models for determining baselines. Sites are chosen from Raleigh, NC, Chicago, IL, Portland, OR, Denver, CO, and Los Angeles, CA., representing humid, semiarid, and arid conditions. The site hydrology is restored through increased water storage capacity. Water storage capacity is defined as "the capacity of a landscape or site to temporarily store and release water through infiltration, evapotranspiration, and water harvesting/storage (e.g., cisterns)" (*SITES Guidelines*, 2009, p.64). Three different site types are included in order to determine target hydrology goals:

1. Greenfield Sites - Development must be designed to achieve the same water storage capacity present on the site before development occurs.
2. Greyfield and Brownfield Sites - the target water storage capacity has been established as the typical background condition for selected locations across the U.S. and is representative of local conditions. To achieve this credit, these sites must be designed to increase the amount of water storage capacity on the site using the target condition as an ideal to strive for (*SITES Guidelines*, 2009, p.64).

Increased water storage and soil permeability strategies in the *SITES Guidelines* include:

1. Minimize impervious cover, such as solid concrete walkways and driveways. The following permeable paving options might be used for paths in edible gardens:
    - Permeable Concrete Pavers
    - Crushed Stone
    - Pea Gravel
    - Lawn Paths

An example of permeable paving layout is shown in the Olive Tree Learning Center Case Study Section of this report.

1. Use soil- and vegetation-based methods, such as compost-amended soil, multilayered plantings, green roofs, or bioretention facilities to capture, slow, and treat runoff.
2. Where infiltration is not desirable because of pollutant loadings, use other techniques (e.g., rainwater harvesting, green roofs, or bioretention) to reduce runoff from the site.
3. Compost-based erosion and sediment control BMPs (compost blankets, berms, and socks) also contribute to long-term vegetation establishment and infiltrative capacity (*SITES Guidelines*, 2009, p.66).

Intent of Credit 3.6 – Prevent or minimize generation, mobilization, and transport of common stormwater pollutants and watershed-specific pollutants of concern to receiving waters, including surface water and groundwater, and combined sewers or stormwater systems (*SITES Guidelines, 2009,* p.78*).*

Requirements for this credit include:

1. Document that all exterior materials were selected to minimize contribution of common stormwater pollutants and specific pollutants of concern to stormwater runoff.

AND

2. Incorporate into the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*) appropriate maintenance activities designed to reduce the exposure of pollutants to stormwater (see examples in the Potential technologies and strategies section below) and appropriate maintenance procedures and schedules for all Best Management Practices (BMPs) to ensure ongoing pollutant removal.

AND

3. Provide stormwater treatment for common stormwater pollutants and specific pollutants of concern by achieving, at a minimum, an average discharge concentration of less than or equal to 25 milligrams/liter total suspended solids

(TSS)—as a surrogate for most urban pollutants—for the volume treated (*SITES Guidelines*, 2009, p.78).

This credit requires that run-off pollution must be monitored from a minimum of 12 storm events or for 2 years. Point accumulation is as follows:

1. 3 points: A total of 80 percent of average annual volume of runoff discharged from the developed portion of the site receives stormwater treatment for pollutants of concern.

2. 5 points: A total of 90 percent of average annual volume of runoff discharged from the developed portion of the site receives stormwater treatment for pollutants of concern.

3. 8 points: A total of 95 percent of average annual volume of runoff discharged from the developed portion of the site receives stormwater treatment for pollutants of concern.

4. Additional point: Site uses soil- and vegetation-based systems to treat 100 percent of the treated water volume.

Potential technologies and strategies recommended by the SITES Guidelines are as follows:

1. Strategies to reduce the volume of stormwater runoff in edible landscapes include:

    1. Reduce impervious cover – Using pervious paving types listed under Credit 3.5 above.
    2. Disconnect impervious cover – Remove existing solid concrete and asphalt paving.
    3. Convey stormwater in swales to promote infiltration
    4. Use biofiltration to provide vegetated and soil filtering
    5. Evapotranspire (e.g., use engineered soils and vegetation on green roofs or in biofiltration areas/landscaping to maximize evapotranspiration potential)
    6. Infiltrate stormwater (infiltration basins and trenches, permeable pavement, etc.)

    These strategies are discussed in greater detail below.

2. Materials used in building, hardscape, and landscape materials that can be a source of pollutants in stormwater include:

    1. Copper and zinc roofs, roof gutters and downspouts, and siding
    2. Galvanized materials (fences, guardrails, signposts)
    3. Treated lumber
    4. Parking lot coal tar sealants
    5. Fertilizers
    6. Pesticides.

Of the above listed pollutants, fertilizers and pesticide are a primary concern for edible landscapes. This is discussed in greater detail below.

3. Plan for and implement maintenance activities designed to reduce the exposure of pollutants to stormwater, such as:

    1. Minimizing exposure to rainfall of stored materials that could contribute pollutants
    2. Developing and implementing a spill response plan
    3. Avoiding non-stormwater discharges (e.g., wash water)
    4. Minimizing the use of salt for deicing
    5. Avoiding routine maintenance of construction equipment on site to reduce pollutant loadings of oils, grease, hydraulic fluids, etc.
    6. Avoiding fueling of vehicles on site to the maximum extent practicable (*SITES Guidelines*, 2009, pp. 79-80).

SITES Guidelines suggest that a "variety of treatment practices be used together as a "treatment train" to provide multiple pollutant removal processes to reduce the concentrations of pollutants in stormwater and to provide redundancy in the system. Soil and vegetation-based controls are preferred due to their ability to reduce runoff through evapotranspiration, maintain infiltration rates, and regenerate adsorption capacity" (*SITES Guidelines*, 2009, p.80).

Run-off prevention for credits 3.5 and 3.6 are combined because they both address the reduction of soil runoff and accompanying pollutants during a rain event. This soil might otherwise be washed into water courses which increases the particulate and pollutants in the water and reduces the oxygen level, causing fish dye-off and decreasing wildlife habitat, as well as increased pollutants in potential sources of potable water (Postel, 2005, p.18).

Run-off of soils and resultant pesticide pollutants has been an ongoing problem in the United States. "The US EPA has declared that sediment contamination of our surface waterways is the biggest threat to our nation's water. When eroded sediment is transported from its site of origin to nearby water bodies it also carries fertilizers, pesticides and other contaminants attached to the soil particles" (Risse, 2009. p.2). "The U.S. Environmental Protection Agency has estimated that nonpoint source pollution contributes 45 percent, 76

percent, and 65 percent of the pollutants to impaired estuaries, lakes, and rivers, respectively" (Gregory et al., 1991).

Depending on how the soil is built and maintained, edible landscapes can prevent topsoil and pollutants from entering waterways. If edible plantings are planted in a raised bed, which is the preferred practice, and the soil is amended with organic matter, the percolation and water retention of the soil will be increased. This will allow rain water to filter slowly into the ground rather than sheet draining over the land and into rivers and streams. "the ability to compost to reduce pollutant carrying runoff and leachate (primarily due to its organic matter content) can provide surface and ground water quality benefits" (Gregory et al., 1991).

Additional strategies for reducing stormwater run-off include depressed storage, such as detention ponds, and stormwater swales which would slow and absorb run-off water. These methods are not in conflict with edible landscapes; however, they are not commonly associated.

Layers of organic matter used as mulch have also been shown to prevent soil run-off. In 2002 Iowa State University released a study which had studied 4" rainfall events of at least 30 minute duration on 3:1 slopes which had been covered by 2-4" layers of compost. Run-off on these compost covered sites was only one-fifth of similar unprotected sites (Maurer, 2006).

Compost should be incorporated into the soil as well to loosen the soil and increase permeability. A Florida study reported on by the *Journal of Environmental Hydrology* measured soil water-holding capacity and leachate from fields which had been amended with various types of compost and some that did not have any organic matter added. They found that the amended fields had greater water holding capacity in the root zone, as well as 15% less leaching into deeper soils (Savabi et al., 2005).

Care must be taken when incorporating organic matter into topsoil. When non-decomposed compost or uncomposted animal manures are placed on top of the beds, without working them into the topsoil, or when too much of these additives are used, nitrogen can leach

into waterways. Nitrogen rich compost and animal manures should not be placed too close to drainage ways (Bellows, 2002).

2.6.1 Summary of Edible Landscape Compatibility for the 'Site Design - Water' Section of SITES

Even though edible landscapes are excluded from Prerequisite 3.1 (reduction of potable water usage by 50% from baseline), conservation of potable water sources are an important consideration when designing a sustainable site. Graywater and stormwater reuse are possible sources for non-potable water that can be used on edible landscapes if the risk of contamination is alleviated; however, it is apparent from the literature review on this topic that harvested rainwater is the preferable non-potable water source. With any of these options, it is especially crucial that water sources be tested for contaminates before they are considered for use on edible landscapes.

Credits 3.5 and 3.6 which deal with stormwater runoff and the consequential protection of receiving waters can be easily attained with edible landscapes, especially if rain catchment systems and permeable paving are incorporated into the site. Mulch or gravel paths can be specified within edible landscapes, as well as raised beds for planting areas. Both of these design specifications will allow better water percolation and prevent sheet run-off in storm events.

2.7 Site Design – Soil and Vegetation

For this section of the SITES Guidelines there are two prerequisites and six credits which pertain to edible urban landscapes. The two prerequisites are 'Control Invasive Species' and 'Create a Soil Management Plan.' The applicable credits are 'Minimize Soil Disturbance', 'Preserve or Restore Plant Biomass', 'Use Native Plants', 'Use Vegetation to Minimize Building Cooling Requirements', 'Reduce Urban Heat Island Effects', and 'Reduce the Risk of Catastrophic Wildfire.' Edible landscapes are not in conflict with either of the prerequisites and

will benefit from plans to control invasive species and to reserve soil on site. The credits are mixed in their compatibility for edible landscapes. It would not be best practice to plant edible plants in undisturbed soil and existing vegetation must be removed for edible plantings, so the credits that deal with leaving soils and existing vegetation intact are incompatible. Likewise, the credit which specifies using native plants is not compatible. There are some edible plants that are native; however, their hybridized relatives have been cultivated to be more productive and flavorful, and are selected by edible gardeners for this reason.

Prerequisite 4.1 - Control and Manage Known Invasive Plants Found on Site

> Intent - Develop and implement an active management plan for the control and subsequent management of known invasive plants found on site to limit damage to local ecosystem services (*SITES Guidelines*, 2009, p.88).

This prerequisite requires that, as part of the Maintenance Plan (Prerequisite 8.1), a plan for the control of the invasive species located on the site to be implemented. The outline of the plan is meant to span a number of years, and to be implemented before, during and after development. Regional lists and State and Federal Noxious laws relating to invasive plant species are used to select invasive plants to include on the Maintenance Plan (*SITES Guidelines*, 2009, p. 88). Lists of invasive species for individual states can be found at *Invasive Noxious Weeds by State.* http://plants.usda.gov/java/noxiousDriver.

The following components must be included in the invasive species management plan:

1. Integrated pest management (IPM) strategies
2. A procedure for identifying and monitoring for additional invasive species that may colonize the site and new species as they are recognized by local authorities.
3. Initial treatment, follow-up treatments, long-term control including monitoring, and methods to dispose of invasive plant materials to prevent spread.

This credit does not specify that chemical herbicides may not be used to control invasive weeds, however, it does require that IPM stratagies should be implemented first. IPM weed control involves the series of actions;

1. Monitor and Identify Weeds,
2. Employ Prevention Measures, and, if pests occur, then use
3. Control Methods

Edible landscapes will be required to abide by these weed control measures in order to qualify for Sustainable Sites Initiative accreditation.

Prerequisite 4.2 – Use Appropriate Non-Invasive Species

> Intent – Use only plants that are non-invasive and appropriate for site conditions, climate, and design intent to improve landscape performance and reduce resource use (*SITES Guidelines*, 2009, p.90).

Edible plants are not generally considered as “invasive”, however, there are a number of edible plant species which are forbidden from interstate commerce, including the import of citrus species and rootstock into California. (Title 3, California Code of Regulations, Section 3435) This practice is meant to prevent the spread of certain diseases and disease carrying insects from state to state. A complete list of prohibited plants can be found at the USDA’s Animal and Plant Health Inspection Service website.

Certain edible plants may be of concern in specific states. The following are a few edible plants found on the *States’ Invasive Noxious Plant Species* website. Oregon prohibits the planting of Rubus discolor (Himalayan Blackberry). Ohio prohibits the planting of grapevines, and Connecticut prohibits Rosa rugosa, which is sometimes grown for rose hip tea. It is important to verify local, state and federal noxious plant species lists for the site location to make sure no invasive species are being planted. According to the *States’ Invasive Noxious Plant Species* lists, there are relatively few edible plants which are considered to be invasive,

and compliance with this prerequisite should not be a problem when landscaping with edible plants.

Prerequisite 4.3 – Create a Soil Management Plan

Intent - Develop and communicate to construction contractors a soil management plan (SMP) prior to construction to limit disturbance, assist soil restoration efforts, and define the location and boundaries of all vegetation and soil protection zones (*SITES Guidelines*, 2009, p.92).

For Credit 4.3 it is necessary to refer to the mapped locations of healthy soils and soils disturbed by previous development as identified in the site assessment (*Prerequisite 2.1)* and calculate the total surface area of each.

The SMP should include the following information:

1. Indicate designated soil management areas for all site soils, including, but not limited to:
    1. Soils that will be retained in place and/or designated as *vegetation and soil protection zones*.
    2. Soils that will be disturbed during construction, restored, and re-vegetated.
    3. Soils disturbed by previous development that will be restored in place and re-vegetated.
2. Indicate locations for all laydown and storage areas, haul roads and construction vehicle access, temporary utilities and construction trailers, and parking (all of which must be located outside of the vegetation and soil protection zones).
3. Describe how areas of restored soils will be protected from compaction (e.g., vehicle traffic or storage), erosion, and contamination until project completion.
4. Describe treatment details for each zone of soil that will be restored, including the type, source, and expected volume of materials (e.g., compost amendments, mulch, topsoil, etc.). See *Prerequisite 7.2: Restore soils disturbed during construction* and *Credit 7.3: Restore soils disturbed by previous development* for guidance.
5. Outline the footprint of buildings and hardscape (e.g, trails, roads, etc.) and any areas of vegetation that will be preserved in place.
6. Communicate the SMP to site contractors in site drawings and written specifications (*SITES Guidelines* 2009, p.92).

Prerequisite 4.3 requires applicants to abide by this Soil Management Plan in order to qualify for Sustainable Sites Initiative accreditation. Existing topsoil can be stockpiled on site and reused to create bed areas. Reuse of existing topsoil is fine for edible plantings; however, topsoil should be amended with organic matter to increase fertility and porosity (Savabi et al., 2005).

Credit 4.4 – Minimize Soil Disturbance in Design and Construction

Intent – "Limit disturbance of healthy soil to protect soil horizons and maintain soil structure, existing hydrology, organic matter, and nutrients stored in soils" (*SITES Guidelines*, 2009, p.95).

In order to achieve this credit, healthy soils must be located in "vegetative and soil protection zones." (VSPZ) These zones must meet the following criteria:

1. Construction from overall site development shall not decrease the capacity of the VSPZ to support the desired vegetation.
2. VSPZ shall be protected with a fence or other physical barrier that cannot be easily moved.
3. All construction and maintenance personnel shall be educated about the locations and protective measures of the VSPZ.
4. VSPZ can encompass one plant or can include several plants in a group.
5. No more than 10 percent of the total area of the VSPZ can contain development. Only minimal impact site development is allowed within the VSPZ (*SITES Guidelines,* 2009, p.16).

Minimal impact site development is defined as "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" (*SITES Guidelines*, 2009, p.17).

Credit 4.4 is based on the LEED SS Credit 5.1: Site Development—Protect or Restore Habitat, which reads as follows:

Intent - To conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.

Requirements:

CASE 1. Greenfield Sites1 - Limit all site disturbance to the following parameters:

1. 40 feet beyond the building perimeter;
2. 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter;
3. 15 feet beyond primary roadway curbs and main utility branch trenches;
4. 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and

CASE 2. Previously Developed Areas or Graded Sites
Restore or protect a minimum of 50% of the site (excluding the building footprint) or 20% of the total site area (including building footprint), whichever is greater, with native or adapted vegetation (LEED 2009, p.12).

An example of a 'Vegetative and Soil Protection Zone' prescribed by this credit, is shown on The Olive Tree Learning Center Case Study in Chapter 4. Credit 4.4 requires that healthy soil that exists on the site should not be disturbed. This could be a problem for edible landscapes. There are several methods for developing planting beds for edible landscapes. Generally, soils will be built and amended with organic matter raising the existing soil level. In their *Community Garden Guide Vegetable Garden Planning and Development,* The USDA Natural Resources Conservation Service recommends the following three soil preparation techniques for vegetable gardens:

1. Double Digging – A system of digging an 8" to 10" trench and amending the soil with organic matter and/or compost before refilling.
2. Direct Tillage – This soil preparation method involves disturbing the soil with the use of a mechanical or manual garden tiller to a depth of 6 to 8".
3. Till-less (No-Till) Garden – This bed preparation method may be the most suitable technique for the intent of Credit 4.4. It involves layering newspapers and compost on top of the soil to smoother vegetation. Soil horizons are only disturbed during planting with this method (USDA, pp. 2-4). Because this bed preparation method does not disturb the soil, there is less of a problem with soil erosion and the existing air pockets in the soil are not compacted. Rich discusses the importance of no-till bed preparation. "Unless organic agriculture adopts a practice of non-tillage, full soil restoration can never occur as it does not address the root cause of soil decline which is over-aerification via tilling" (USDA, p.1).

Credit 4.6 - Preserve or Restore Appropriate Plant Biomass on Site

Intent - Maintain or establish regionally appropriate vegetative biomass to support the ecosystem service benefits provided by vegetation on site (*SITES Guidelines*, 2009, p.101).

Credit 4.6 requires that the site should be maintained in natural biomass or restored to a natural state. The amount of biomass area is factored by type and coverage after 10 years of growth. The biomass types are rated with the following biomass density values:

1. Trees with understory - 6
2. Trees without understory (less than 10 percent herbaceous/shrub cover) - 4
3. Shrubs - 3
4. Desert plants - 1.5
5. Annual plantings - 1.5
6. Grasslands and turfgrass - 2
7. Wetlands – 6

(SITES Guidelines 2009, p.101)

These biomass density values are multiplied by the area of vegetation type to determine the overall biomass increase from baseline.

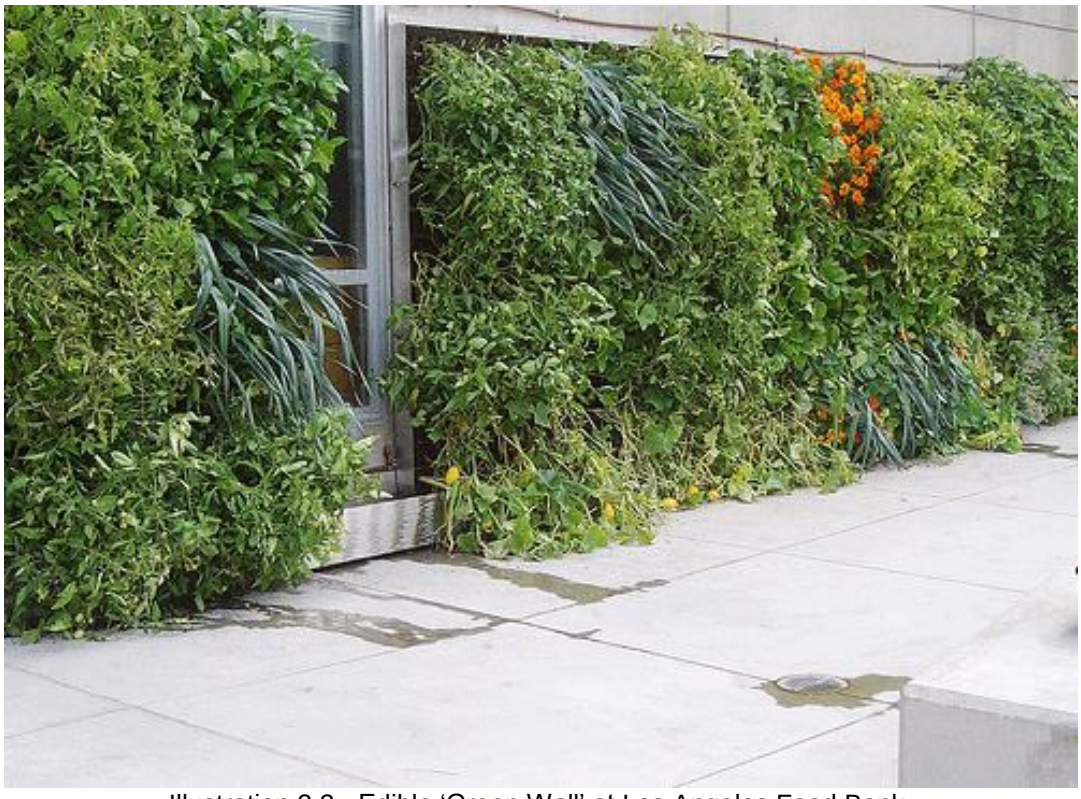

Illustration 2.2 - Edible ‘Green Wall’ at Los Angeles Food Bank.

Credit points are based on beginning and ending biomass levels. Possible strategies for attaining this credit include the use of “trees, green roofs, or vegetated structures (e.g., trellises) to cover non-vegetated surfaces such as walkways, roofs, or parking lots” (*SITES Guidelines*, 2009, p.101). Trellises or ‘Green Walls’ with edible plants could increase biomass vertically. Edible landscapes would need to be separated into plant types to determine if the biomass is sufficient to earn this credit. If biomass is planned to be removed on a site to make way for edible plantings, there could be a conflict of ecological benefit. An example of a plant biomass analysis is found in the Case Study of The Olive Tree Learning Center in Chapter 4.

Credit 4.7 – Use Native Plants

Intent – Plant appropriate vegetation that is native to the ecoregion of the state (*SITES Guidelines, 2009,* p.109).

This credit assigns point values based on the percentage of the site that is planted in native plants. Incremental values are 50, 75 and 100 percent of the site’s vegetated area and must be at least 2,000 square feet (*SITES Guidelines, 2009,* p.109). Listings of native plants can be found at:

1. The North American Native Plant Society, *http://www.nanps.org.*
2. The Lady Bird Johnson Wildflower Center’s Native Plant Information Network’s Native Plant Database *http://www.wildflower.org/plants/*.

There are some edible species that are native to the United States which might be planted as part of a native landscape. For example, there are many species of Vitis (grapevines) which are indigenous to North America. Likewise, there are a number of species of Rubus (blackberries, dewberries and raspberries) which are native. The USDA Natural Resources Conservation Service has maps of individual species which shows whether or not they are native to particular states on their website at http://plants.usda.gov/.

Edible plants have been cultivated and hybridized over many centuries to produce desired traits, such as sweetness or size, which has made them very different from related species in the wild. Suitable species of edible plants should be selected according to the environment of the site. County Extension Agents are good sources for edible plant choices. Recommended species and varieties are selected to prevent the need for additional water or pest control.

Mention should be given to the concept of 'Permaculture' planting, which was made popular by Bill Mollison and the Permaculture Institute. This type of planting "mimics the architecture and beneficial relationships of a natural forest" (Mollison, 1999, p.1). Permaculture uses edible trees, shrubs and perennials instead of replanting annuals each season. These planting might be used in conjunction with indigenous edible plants to create a low maintenance edible landscape which works with the existing ecosystem. Bill Mollison writes in his book *Permaculture: A Designers' Manual,* "The characteristics that typifies all permanent agricultures is that the needs of the system for energy are provided by that system… selected forests not only yield more than annual crops, but provide a diverse nutrient and fuel resource for such crops" (Mollison, 1999, p.6). Holmgren defines Permaculture as "Consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre, and energy for provision of local needs" (Holmgren, 2006, p.3).

Permaculture plantings are designed to be as natural and self-sustaining as possible, while providing useful produce. This type of edible landscape most closely resembles the intent of Credit 4.7. Edible plant species which can survive without specialized cultivation practices are limited. The best approach for Permaculture plantings is to plant species which are native or extremely adapted to the site's ecoregion.

Listing and mapping of native plants can be found at:

1. The USDA Natural Resources Conservation Service website http://plants.usda.gov/.
2. The North American Native Plant Society, *http://www.nanps.org.*

3. The Lady Bird Johnson Wildflower Center's Native Plant Information Network's Native Plant Database *http://www.wildflower.org/plants/*.

Credit 4.11 - Use Vegetation to Minimize Building Cooling Requirements

Intent - Place vegetation and/or vegetated structures in strategic locations around buildings to reduce energy consumption and costs associated with indoor climate control *(SITES Guidelines*, 2009, p.118).

Credit 4.11 deals with the cooling of buildings with shading trees. The requirements apply only to buildings using air-conditioning systems, and include two different options:

Option 1

1. 2 points: Use vegetation or vegetated structures to reduce annual building electricity use for cooling by 5 percent.

2. 3 points: Use vegetation or vegetated structures to reduce annual building electricity use for cooling by 7 percent.

3. 5 points: Use vegetation or vegetated structures to reduce annual building electricity use for cooling by 10 percent.

(See Calculation guidelines for Option 1 section below.)

Option 2: Use vegetation or vegetated structures to shade 100 percent of the surface area (excluding groundfacing surface) of all HVAC units within 10 years of installation AND achieve one of the following options to shade building walls and roof area:

1. 2 points: Use vegetation or vegetated structures to shade 30 percent of the surface area of west, southwest, southeast, and east walls and 30 percent of total roof area within 10 years of installation.

2. 3 points: Use vegetation or vegetated structures to shade 60 percent of the surface area of west, southwest, southeast, and east walls and 60 percent of total roof area within 10 years of installation.

3. 5 points: Use vegetation or vegetated structures to shade 90 percent of the surface area of west, southwest, southeast, and east walls and 90 percent of total roof area (*SITES Guidelines, 2009,* p.118).

Shade calculations are based on "the arithmetic mean of the percent wall and roof coverage at 10 a.m., noon, and 3 p.m. on the summer solstice. Wall and roof surfaces taller than 20-year old trees of average growth size for the region may be excluded from total wall

surface area calculations. Roof surfaces shaded by solar photovoltaic panels may be excluded from total roof area calculations" (*SITES Guidelines, 2009,* p.119).

Potential cooling for vegetation is based on the area of the country of the site location. The following are the area coefficients, based on data from the U.S. Department of Energy Commercial Buildings Energy Consumption Survey:

1. Northeast: 0.8 kWh/square foot
2. Midwest: 0.9 kWh/square foot
3. South: 3.1 kWh/square foot
4. West: 1.8 kWh/square foot

The cooling potential of vegetation is also based on The Tree Benefits Estimator (developed by the American Public Power Association), (*SITES Guidelines, 2009,* p.119). The Tree Benefits Calculator estimates the value of a tree measured by the species, size and location. For example, an 18" diameter pecan tree located in Austin, Texas is valued at $187. There are a number of shade trees that provide nuts in the United States, primarily in the Carya family. Standard size fruit trees will produce substantial shade as well.

Credit 4.12 - Reduce urban heat island effects

Intent - Use vegetation and reflective materials to reduce heat islands and minimize effects on microclimate and on human and wildlife habitat (*SITES Guidelines, 2009,* p.120).

Credit 4.11 is designed to reduce urban heat islands by shading hardscape and structures on a site. 3 points are available for this credit if 30% of hardscapes and structures are shaded and 5 points are available if 60% are shaded. Hardscapes include roads, sidewalks, courtyards, shelters and parking lots (*SITES Guidelines*, 2009, p. 120). Shade coverage is measured at 10 years of plant maturity.

Additional strategies for reducing urban heat islands include covering structures with solar photovoltaic panels, vegetated roofs, and/or surfaces with a solar reflectance index (SRI)

of at least 29. Credit 4.11 is based on the USGBC LEED 2009 SS Credit 7.1: Heat Island Effect—Nonroof and SS Credit 7.2: Heat Island Effect—Roof (USGBC, 2009, pp.16-17).

There are examples of edible landscape on vegetative roofs. Perhaps the most well known example is the new 'urban farmscape' designed as a rooftop garden in the heart of New York City. ‘‘There's an elevated walkway that's made for 10′x10′ planting plots, and vertical plant walls that weave throughout a commercial office space site" (Boyle, 2010). The elevated walkway and southern-facing building surfaces are designed to be planted in edible plantings. The produce from the 'urban farmscape' is estimated to feed about 200 people a year.

Illustration 2.3 - Urban 'Farmscape' in New York City.

Another of the many examples of edible rooftop gardens is above the Bastille Restaurant in Seattle. The 2,500 square foot roof garden provides herbs and greens for the restaurant, and tomatoes, garlic and peppers are planned additions. The herbs and vegetables are planted in wood frame boxes and plastic wading pools filled with a local brand of potting

soil. Although structural information was not available, the owners of the restaurant found it necessary to increase the load-bearing capacity of the roof in order to put in the garden (Easton, 2009).

Credit 4.13 - Reduce the Risk of Catastrophic Wildfire

Intent - Design, build, and maintain sites to manage fuels to reduce the risk of catastrophic wildfire both on site and in adjacent landscapes (*SITES Guidelines, 2009,* p.122). Requirements for Credit 4.13 are as follows:

1. All structures on the site must be designed using guidelines from the Firewise Construction Checklist.

AND

2. Design, build and maintain the landscape within 30 feet of all sides of structures to:

    1. Include low stature plantings limited to carefully spaced, low-flammability species,
    2. Avoid “ladder fuels” that transmit fire from ground level to tree canopy
    3. Incorporate into the site maintenance plan considerations for maintaining plants to reduce accumulation of dead plant material.
    4. Incorporate into the site maintenance plan a strategy to manage vegetative biomass and fuels at responsible levels throughout the vegetated portions of the site. Use prescribed fires or other fuel management techniques in frequencies and intensities similar to the natural fire regime for the ecosystem (*SITES Guidelines, 2009,* p.122).

Credit 4.12 requires that sites be designed according to the Firewise Construction Checklist, which can be found at http://www.firewise.org/usa/files/fwlistsz.pdf. This checklist recommends the following zones be created around the structure:

Zone 1 - This well-irrigated area encircles the structure for at least 30' on all sides, providing space for fire suppression equipment in the event of an emergency. Plantings should be limited to carefully spaced low flammability species.

Zone 2 - Low flammability plant materials should be used here. Plants should be low-growing, and the irrigation system should extend into this section.

Zone 3 - Place low-growing plants and well-spaced trees in this area, remembering to keep the volume of vegetation (fuel) low.

Zone 4 - This furthest zone from the structure is a natural area. Selectively prune and thin all plants and remove highly flammable vegetation. (*Firewise Communities Website*)

Although, Credit 4.13 is not in direct conflict with edible landscapes, there might be some problems coordinating the requirements with edible plantings. Planting areas would need to be 30 feet from structures, and this may be too limiting for edible planting area, depending on the area of the site. Edible plants are not considered to be highly flammable because of their usually high moisture content, although there will be exceptions. According to a report by the Pacific Northwest Extension publication, the types of plants which are listed as being highly flammable are generally fine-textured and have a low moisture content in the leaves. Although it is not specifically listed, asparagus is an example of an edible plant that would fall in to this category. Rosemary is another example of a flammable plant because of its high resin content. Dry mulches are also a potential fire hazard. Inorganic mulches such as crushed stone and gravel are fire-resistant alternatives (Starbuck, 2008). There may be a conflict with the location of fruit trees and Credit 4.12, because the lowest limbs allowed under this credit are 6 to 10 feet above the ground. Fruit tree branches are generally pruned lower to the ground (Ingles, 2002, p.2). More research is required on flammability of individual edible species.

2.7.1 Summary of Edible Landscape Compatibility for the 'Site Design – Soil and Vegetation' Section of SITES

The credits in this section are primarily concerned with maintaining native vegetation and existing soil structures. These credits are not necessarily in conflict with edible landscapes, especially on sites that have been previously disturbed. In the case of sites that are in a natural state, edible landscapes would require the disturbance of native soils and vegetation. Native vegetation would have to be removed to plant edible plants and existing soils need to be amended for most types of edible landscapes. There is also a conflict with Credit 4.7, which requires planting native species, as most edible plants are cultivars or hybrids.

Credit 4.11 (use vegetation to minimize building cooling requirements) and Credit 4.12 (reduce urban heat island effects) can be achieved with edible plantings. Trellised edible plants, large edible shrubs and fruit trees can all be used to shade buildings and paved areas;

however, it is unlikely that these plants would grow tall enough to cast enough shadow on buildings to significantly shade roof areas. Credit 4.13 (reduce the risk of wildfire) can be achieved if highly-flammable plants, such as rosemary, are not located in close proximity to buildings.

2.8 Site Design – Materials Selection

The materials section of the Sustainable Sites Initiative offers a number of credit points relating to the materials used on the project. Non-toxic and recycled materials are encouraged. The following chart shows an outline of the credits and possible strategies to attain them.

Table 2.3 Materials Selection Credits (*SITES Guidelines*, 2009, p.124-141)

Materials Credits for Sustainable Sites Initiative			
Credit	**Purpose**	**Points**	**Possible Strategies**
Prerequisite 5.1	Only use tree products from non-threatened species		Identify suppliers who provide wood products from sustainably managed forests. Consider using recycled plastic or composite lumber instead of wood.
Credit 5.2	Maintain On-site structures, hardscapes, and Landscape Amenities	1-4 Pnts.	Identify opportunities to incorporate existing site materials into site design.
Credit 5.3	Design for Deconstruction and Disassembly	1-3 Pnts.	Establish a project goal for reusable products and identify material suppliers who can help achieve this goal. Design construction details to facilitate deconstruction without damage to the material.
Credit 5.4	Reuse Salvaged Materials and Plants	2-4 Pnts	Establish a project goal for salvaged materials and identify material suppliers or local projects who can help achieve this goal. Look for materials and salvageable plants existing on your site.
Credit 5.5	Use Recycled Content Material	2-4 Pnts.	Establish a project goal for recycled content and identify material suppliers or local projects that can help achieve this goal.
Credit 5.6	Use Certified Wood	1-4 Pnts.	Establish a project goal for recycled content and identify material suppliers or local projects that can help achieve this goal.
Credit 5.7	Use Regional Materials	2-6 Pnts.	Identify regional sources for plants, soils, and other landscape materials, including those that are reused, salvaged, or contain recycled content.
Credit 5.8	Use Adhesives, Sealants, Paints and Coatings with Reduced VOC Emissions	2 Pnts.	Specify low-VOC materials in construction documents.
Credit 5.9	Support Sustainable Practice in Plant Production	3 Pnts.	Identify—and select plants from—nurseries that actively implement better business practices to reduce damage to the environment and conserve resources.
Credit 5.10	Support Sustainable Practice in Materials Manufacturing	3-6 Pnts.	Identify and select materials from manufacturers that actively implement better business practices to reduce negative impacts to human health and the environment.

2.8.1 Summary of Edible Landscape Compatibility for the 'Materials Selection' Section of SITES

While there is no particular relationship between this section of *SITES, 2009* and edible landscapes, there is no direct conflict with the prerequisites and credits in this section. There is one prerequisite in this section, Prerequisite 5.1, which prohibits construction from the use of tree products which are endangered. Plastic and composite materials are suggested instead. The nine credits are concerned with the reuse of onsite or recycled materials, and the use of local and sustainably produced materials. For construction materials, stone and deconstructed concrete from on site can be used for edging and pavers. When selecting edible plants, first choice should be given to local nurseries that provide organically raised plant material. Surface finishes should be selected that have low VOC ratings. It is possible to earn 36 points toward SITES accreditation by selecting low impact materials for edible landscapes.

2.9 Site Design – Human Health and Well-Being

For this section of the SITES Guidelines there are seven credits which deal with human well-being and community building. The credits are 'Promote Equitable Site Development', 'Promote Equitable Site Use', 'Promote Sustainability Education and Awareness', 'Protect Cultural and Historical Sites', 'Provide Optimum Site Accessibility and Wayfinding', 'Provide Opportunity for Physical Activity', 'Provide Space for Mental Restoration', and 'Provide Outdoor Space for Social Interaction.' This section of the SITES is less concerned with ecology than with social and physical human health. Edible landscapes, community gardens in particular, are very well-suited for these credits, and could provide a means for earning points in this section.

Credit 6.1 - Promote Equitable Site Development

> Intent - During construction of the site, ensure that the project provides economic or social benefits to the local community (*SITES Guidelines*, 2009, p.142).

Credit 6.1 deals with benefits to the local community where the site is located. There are a three point options:

1. 1 point: Provide opportunities for job employment during construction (25 percent or higher of the labor component of the construction budget) to local, low-income individuals, locally owned and operated businesses and/or individuals from programs that support on-the-job training, green collar jobs, and youth development (e.g., AmeriCorps, Job Corps). Note that the 25 percent of the labor component of the construction budget must be comprised of positions within the lower 50 percent of the full job payroll scale. Ensure through multiple advertising and outreach strategies that job opportunities reach targeted individuals.

2. 2 points: Commit to a living wage requirement for 75 percent of workers employed during construction of the site.

3. 3 points: Develop a Community Benefits Agreement or other similar agreement that outlines how the project will be shaped to provide a range of community benefits during the construction of the site (*SITES Guidelines*, 2009, p.142).

Potential strategies to achieve this credit include a Community Development Agreement, which is defined as "an agreement made between the developer and coalition(s) of community organizations, addressing a broad range of community needs to ensure that affected residents share in the benefits of major developments. The agreement allows community groups to have a voice in shaping a project, to press for community benefits that are tailored to their particular needs, and to enforce developer's promises" (*SITES Guidelines*, 2009, p.143).

Community garden initiatives usually have very active community input. Seattle's P-Patch is a good example of a community gardening initiative with a strong community activity. As of April 1, 2010, there are 83 community gardens in the program and they all have waiting lists (City of Seattle Website). The American Community Gardening Association recommends on their website that the first step in creating a community garden should be to form a planning committee. The list of items for the planning committee contains the following consideration. "If the project is meant to benefit a particular group or neighborhood, it is essential that the group be involved in all phases" (ACGA, 2000). The ACGA also suggest in their publication *Starting a Community Garden* that all neighbors be invited to give input to prevent future problems. "Angry neighbors and bad gardeners pose problems for a community garden. Usually the two are

related. Neighbors complain to municipal governments about messy, unkempt gardens or rowdy behavior; most gardens can ill afford poor relations with neighbors, local politicians or potential sponsors."

For more information on developing a Community Benefits Agreement or examples of living wage, see *http://www.communitybenefits.org* and *http://www.goodjobsfirst.org/pdf/cba2005final.pdf*.
Specific information about living wage calculations can be found at: *http://www.livingwage.geog.psu.edu/*.

Credit 6.2 – Promote Equitable Site Use

Intent – During site use, ensure that the project provides economic or social benefits to the local community (*SITES Guidelines*, 2009, p.144).

This credit has 3 tiers of point accumulation:

1. 1 Point – Provide events identified as community need or desirable amenity during meetings with the local community. Examples of events may include, but are not limited to, the following: theater and music performances, art shows, guided nature hikes, etc. And provide and publicly announce free or discounted access to underserved community groups or populations that are economically and socially disadvantaged and who do not typically use the site.
2. 3 Points – Provide an on-site facility or desirable amenity that was identified as a community need during meetings with the local community. Examples of facilities may include, but are not limited to, the following: recreational facility, day care, health-care center, pavilion for farmers' market, community garden site and public restrooms.
3. 4 Points – Develop a Community Benefits Agreement or other similar agreement that outlines how the project will be shaped to provide a range of

community benefits in regard to site use (post-construction), (*SITES Guidelines,* 2009, p.144).

"Community Benefits Agreement" is defined as "an agreement made between the developer and coalition(s) of community organizations, addressing a broad range of community needs to ensure that affected residents share in the benefits of major developments. The agreement allows community groups to have a voice in shaping a project, to press for community benefits that are tailored to their particular needs, and to enforce developer's promises (*SITES Guidelines, 2009,* p.145).

Community gardens are specifically listed in the point criteria for this SITES credit, if identified as a community need. There is evidence that community gardens are very desirable as community amenities. According to the National Gardening Association "An estimated 5 million households are extremely or very interested in having a garden plot in a community garden located near their home" (Butterfield, 2009, p. 5). In the same report, it is shown that the desire for to garden has been increasing over the last year. "In total, 37 percent of all U.S. households, or an estimated 43 million households, plan to grow vegetables, fruit, berries, or herbs in 2009 compared with 31 percent, or an estimated 36 million households, in 2008. That's an increase of 7 million households or 19 percent from 2008 to 2009" (Butterfield, 2009, p.7). Most of this gardening activity is located in the home garden. In 2008, 91 percent of urban gardens were private gardens, and only 3 percent were community gardens (Butterfield, 2009, p. 11).

There are a number of government agencies that are encouraging the expansion of community gardens. "The USDA's has developed a "Community Food Projects Competitive Grants Program", which funds food projects that serve low income communities. Likewise, the demand for community gardens has not gone unnoticed by the US Congress. The Community Gardens Act of 2009 "Authorizes the Secretary of Agriculture to make grants to eligible entities to establish, build, or operate community gardens" (govtrac.us, 2009). The bill has been

referred to committee at the time of this writing. State and local communities are also promoting initiatives for community gardens. Across America, cities and townships are developing community garden plans as a part of their long-range Master Plans. Portland, Detroit, Cincinnati, New York City and Seattle are just a handful of the many municipalities who are including community gardens and urban farming in their city planning efforts.

Credit 6.2 specifically addresses "underserved community groups or populations that are economically and socially disadvantaged." Community gardens are especially needed in low-income and economically depressed urban areas. A paper written by the Resource Centres on Urban Agriculture and Food Security titled *Cities, Food and Agriculture: Challenges and the Way Forward,* discusses the importance of urban agriculture for these areas:

> Such policies will not only contribute to improving urban food security and nutrition, especially of the urban poor, but also build more resilient cities by providing vulnerable urban groups with new opportunities for income and job creation, reducing the urban food(t) print and food-related energy use, facilitating productive reuse of urban (organic) waste and improved urban water management and creating a better urban living climate (urban greening, heat reduction, CO2 capture, biodiversity). As such, urban and periurban agriculture not only constitute an important social safety net in periods of food and economic crises, but is also an essential component of strategies for building sustainable and healthy cities (Femke, 2009, p.6).

In 2007, The American Planning Association (APA) adopted a policy on urban food production. The Association found that "Inner cities have significant amounts of vacant land that, when used for vegetable gardening by low-income residents, produce multiple health, social, and economic benefits" (APA, 2007, p.5). Dale Allen Pfeiffer explains one approach to solving the problems of urban blight while providing economic and social stability with community gardens. "Limited leases to abandoned lots could allow gardeners to produce immediate benefits from land that ordinarily lies vacant for an average of 20 to 30 years. Instead of being magnets for litter, rats, and crime, such lots could become showplaces and centers for community socialization" (2006, p.71).

Urban farms might also be considered for this credit. Urban farm models vary in size and ownership. They may be owned by the city or they may be privately owned.

> An urban farm is considered to be one or more sites within the boundaries of a city, where the soil is cultivated for edible plants, and where the food produced is shared (whether for-profit or not, by sales or donation) with individuals other than the farmers themselves. The existing sites currently known as urban farms usually occupy a total of at least 1/4 acre (or 10,890 ft2) and have established a formal food distribution system, often selling through Community Supported Agriculture (CSA), at farmers markets, and to local restaurants (Myers, 2008. pp. 1-2).

Many cities have vacant land which they are willing to devote to community gardens on a temporary or, occasionally, permanent basis. “These lots may be owned by the municipality, an institution, a community group, a land trust, or some other entity. They may be leased private land, but the movement is towards public ownership to secure permanency as open space” (Lee, 2005).

Increased interest in community gardening makes this credit very compatible with Credit 6.2. Government initiatives can be a strong motivator to encourage community gardens, especially in underserved and economically depressed neighborhoods. These efforts can promote community cohesion, food security and public health.

Credit 6.3 - Promote Sustainability Awareness and Education

Intent - Interpret on-site features and processes to promote understanding of sustainability in ways that positively influence user behavior on site and beyond (*SITES Guidelines*, 2009, p.146).

Credit 6.3 is concerned with on-site education and interpretation through the following methods:

1. 2 points can be earned by providing a minimum of three educational or interpretive elements (e.g., maps, models, brochures, signage, and video) that draw attention to and explain sustainable features or processes of the site design, construction, operations, and/or maintenance. These educational and interpretive elements can

help users and visitors understand how sustainability can be applied to off-site situations as well. Credit 6.3 encourages visual illustrations which have an educational message. Only one of the three elements can be in the form of signage.

2. 4 points are available for interpretive or educational elements which are interactive and help users and visitors to integrate understanding of on-site examples of sustainability with experiences that extend beyond the site. Examples of these elements include websites, kiosks, demonstrations and tours. They may include, but are limited to the following: website, electronic kiosks, on-site demonstrations and tours. Where applicable, follow the guidelines stated in the low point value (*SITES Guidelines*, 2009, p.146).

This credit is designed as an educational tool with specific potential audiences in mind. Interpretive material would be beneficial for edible landscapes for educating people about various edible plant types' growth, cultivation and uses. In their online publication *Starting a Community Garden,* the American Community Garden Association (ACGA) recommends making a sign for the garden in order to "Let people know to whom the garden belongs and that it is a neighborhood project." They also recommend water-proof bulletin boards for posting community garden events such as work days.

Edible demonstration gardens would be very important in familiarizing site visitors with edible plants. Site maps or individual plant markers can help them to identify particular plant species. A comprehensive example of the goals in Credit 6.3 can be found at The Oregon Garden in Silverton, Oregon, which is the home of The Sustainable Plant Research and Outreach Center. The site has demonstrations gardens for green roofs, barley straw algae control, waste-water processing, soil improvement, composting and edible plants. Each of these demonstration events on the self-guided tour are marked with signage explaining the processes and plants (The Oregon Garden website).

Descanso Gardens in Flintridge, California demonstrates the stark contrast between edible landscapes and lawn plantings. The Garden has a kiosk in the center of the edible planting. On one side of the kiosk is a traditional lawn and, on the other side, is an edible planting of fruit trees, herbs and vegetables. The kiosk serves as both a viewing platform and an information center for the garden. (See illustration 2.3)

Illustration 2.4 - Descanso Demonstration Garden Kiosk.
Photo used by permission of Fritz Haeg.

Credit 6.4 - Protect and maintain unique cultural and historical places

Intent - Protect and maintain cultural and historical locations, attributes and artifacts to enhance a site's sense of place and meaning (*SITES Guidelines*, 2009, p.149).

The following points can be earned with Credit 6.4:

2 points can be earned with Credit 6.4 for protecting site features that are identified as significant to local culture and local histories. These sites do not have to be included in the National Register of Historic Places and/or National Historic Landmarks; however, they should be identified by a local government or historic preservation group as being an historic site or within an historic district. Preservation strategies need to be included in the Site Maintenance Plan, outlining yearly and long-term goals and specific maintenance activities. (see *Prerequisite 8.1: Plan for sustainable site maintenance*), outline the long-term strategies and identify short-term action plans to achieve preservation maintenance goals for the site's cultural/ historic feature(s). Two additional points can be earned if the site is preserved in conservation easements (*SITES Guidelines*, 2009, p.149). This Sustainable Sites Initiative credit is based on

the USGBC' LEED Neighborhood Pilot Development Credit 5: Reuse of Historic Buildings.

Edible landscapes are rich with historical context and could be used successfully as a part of an historical landscape. Travis Beck addresses edible landscapes in an historical perspective. "Edible landscaping is as old as gardening itself and has undergone a recent revival. Ancient Persian gardens combined both edible and ornamental plants. Medieval monastic gardens included fruits, vegetables, flowers, and medicinal herbs. Plans for 19th century English suburban yards, which modeled themselves after country estates, often included edible fruits and berries" (Beck, p. 1).

Illustration 2.5 - Parterre Garden. Austin, Texas.

Credit 6.5 - Provide for Optimum Site Accessibility, Safety, and Wayfinding

Intent - Promote site use by increasing user's ability to understand and safely access outdoor spaces (*SITES Guidelines*, 2009, p.152).

Credit 6.5 promotes site accessibility, safety and wayfinding without causing damage to the site ecology. To attain this credit, site accessibility needs to surpass the requirements of the American with Disabilities Act (ADA), through the use of lighting and clearly defined access and site lines. 'Wayfinding' enhancements include clearly defined entrances and gateways, landmarks and nodes, distinct areas, and orientation devices (*SITES Guidelines*, 2009, p.152).

Credit 6.5 seeks to promote enhanced site access and comfort, above what is required by federal, state and local regulation. This enhancement provides additional site amenities, such as additional seating, lighting, sight lines, enhances views, landmarks and the creation of distinct vegetation areas.

This credit could be used in addition to Credit 6.3 for increased access to community and demonstration gardens. The Allen Street Community Garden in Somerville, MA. is a community garden developed from a brownfield remediation site that provides ADA accessibility for raised bed gardening. Ramps and paving are provided for wheelchair accessibility. This model could be used to help earn Credit 6.5 (City of Somerville website). While this credit does not relate specifically to edible landscapes, there is nothing in the requirements that would prohibit edible landscapes from obtaining this credit.

Credit 6.6 – Provide Opportunity for Outdoor Physical Activity

Intent – Provide on-site opportunities that encourage outdoor physical activity (*SITES Guidelines*, 2009, p.156).

Credit 6.6 requires that the age of the potential user be identified, as well as an implementation plan that encourages physical activity of the potential user. All of the features of the plan must meet the Center for Disease Control (CDC) and Prevention Guidelines for physical activity. Guidelines for Credit 6.6 which apply to edible landscapes are as follows:

1. Provide at Least 2 of the following:
    1. Trail and/or bicycle networks of sufficient length and specifications for bike storage.

2. Playgrounds that are physically challenging and engaging for a variety of age groups.
3. On-site programs that support physical activity.
4. Site offers programming specifically for individual or team sports.
5. Site provides year-round exercise equipment that encourages muscle strengthening.

The only requirement satisfied by edible landscapes in the above list is to provide on-site programs which support physical activity, so this credit would require additional site amenities beyond edible gardening activities.

1. Support Services (Required): Provide services to support site users during physical activity (e.g., drinking fountains, bike repair services and emergency call boxes.)
2. Accessibility (Required): Design the physical activity features to meet standards set by the Americans with Disabilities Act (ADA).
3. Safety: Improve actual and perceived safety on the site. Must complete one of the three components below:
    1. Natural surveillance with lighting
    2. Visibility and sight lines
    3. Variety of options are provided for access.
4. Vegetation and Microclimate Considerations (Required): Address site microclimate and provide physical and or visual access to vegetation when locating and orienting physical activity features.

Additional point: Engage with potential site users and other stake holders to assess the greatest physical activity need(s) of the four largest user groups, OR all the user groups that represent at least 20 percent of the total. Provide at least two opportunities for participation that are accessible for site users/stakeholders (*SITES Guidelines*, pp. 2009, 156-157).

Even though it will not fulfill the entire credit, edible landscaping provides an abundance of opportunity for outdoor activity, and could be used as a component for Credit 6.6. "Recognized as an established recreational activity, community gardens have the potential to promote public health through increased physical activity, improved nutrition, increased social engagement, and improved mental health" (Teig, et al., 2009, p.2). According to the 2009 National Gardening Administration Study, gardeners spend an average of 5 hours per week in the garden. Also, 35 percent of gardeners surveyed in this study said one of the reasons they gardened was to spend more time outdoors (Butterfield, 2009, p. 5).

Demographics for each site will be unique, however, a quick look at the National Gardening Administration's study will reveal that 54 percent of food gardeners in the study were women, and 68 percent were 45 years of age and older. 29 garden sites participated in a Denver, Colorado study which had similar demographic findings: 64% were female, 36% were male and the average age was 46.8 (27–83 years). These examples of gardening demographics might help in planning for a physical activity model (Butterfield, 2009, p. 5).

This credit requires that the activity must be within the guidelines of the Americans with Disabilities Act. Edible landscapes can be ADA compliant with the use of raised beds and paved surfaces. For wheelchair access, pathways will need to be at least four feet wide to allow for forward reach into the beds. Six feet path widths would allow for two chairs to pass one another comfortably. A five foot wide turning radius will be required at the end of the path. Two to three feet would be a comfortable height to work in raised beds from a wheelchair, although ADA allows for compliance heights that are from nine inches to four and 1/2 feet. Specific requirements should be reviewed regarding paving surface and ramp angle requirements (*ADA Accessibility Guidelines for Buildings and Facilities,* 2002, Item 4.2*).*

Credit 6.7 - Provide Views of Vegetation and Quiet Outdoor Spaces for Mental Restoration

Intent - Provide visual and physical connections to the outdoors to optimize the mental health benefits Credit 6.7 seeks to "develop and implement a plan to provide views of vegetation and access to quiet outdoor space(s) on site to optimize mental health benefits of site users" (*SITES Guidelines*, 2009, p.161).

The following point accumulations are possible:

Option 1: For sites without regularly occupied building(s), provide quiet outdoor spaces that must be accessible to potential users and provide seating for 5 percent of total site users (Full-Time Equivalent (FTE) occupants and Temporary occupants).

1. Indicate the techniques employed to address the following:
    1. Provide a variety of seating within small defined spaces
    2. Minimize noise to an acceptable noise level
    3. Consider microclimate and other site-specific conditions (e.g., sun, shade, wind, etc.)
    4. Provide an aesthetic experience and access to vegetation.

OR

Option 2: For sites with regularly occupied building(s), provide quiet outdoor spaces that are accessible to potential users. These outdoor spaces must be within 200 feet of the building entrance(s) and provide seating for 5 percent of total site users (both FTE occupants and temporary occupants).

1. Indicate the techniques employed to address the following:
    - Provide a variety of seating within defined spaces
    - Minimize noise to an acceptable noise level
    - Consider microclimate and other site-specific conditions (e.g., sun, shade, wind, etc.).
    - Provide an aesthetic experience and access to vegetation.
2. Additional point (For sites with regularly occupied building(s) only):
3. Provide unobstructed views of appropriate plant species for 90 percent of the windows of rooms designated as common spaces (e.g., stairwells, office spaces, conference rooms, classrooms, lunch or break rooms, waiting rooms, or living/family/dining rooms)

OR

1. Provide views of appropriate plant species for 75 percent of all building windows. Appropriate plant species must meet or exceed the low point value of *Credit 4.6: Preserve or restore appropriate plant biomass on site* (*SITES Guidelines*, 2009, p.161).

Credit 6.7 can be satisfied with appropriate seating and views or views from buildings, with screening from harsh noise, wind and light. Edible plants can be used to frame landscape views in very dramatic ways as well. Allees of fruit trees, framing walkways and terminus views can be quite striking, especially when in bloom. Living walls, covered in fruit-producing vines can have ‘windows’ and ‘doors’ to frame views. Small, intimate seating areas or grand vistas of parterres can both be achieved with edible plantings.

Fritz Haeg, the author of *Edible Estates; Attack on the Front Lawn*, has created numerous edible gardens across the United States and in Great Britain. He has taken edible plants out of the confinement of the vegetable garden, and brought them in to more public spaces. He writes in his book “If we see that our neighbor’s typical lawn instead can be a beautiful food garden, perhaps we begin to look at the city around us with new eyes” (Haeg, 2010, p. ii). Haeg has shown the possibilities of using edible plants in traditionally ornamental plantings, and that these edible plantings can be used to create views and quiet places of contemplation.

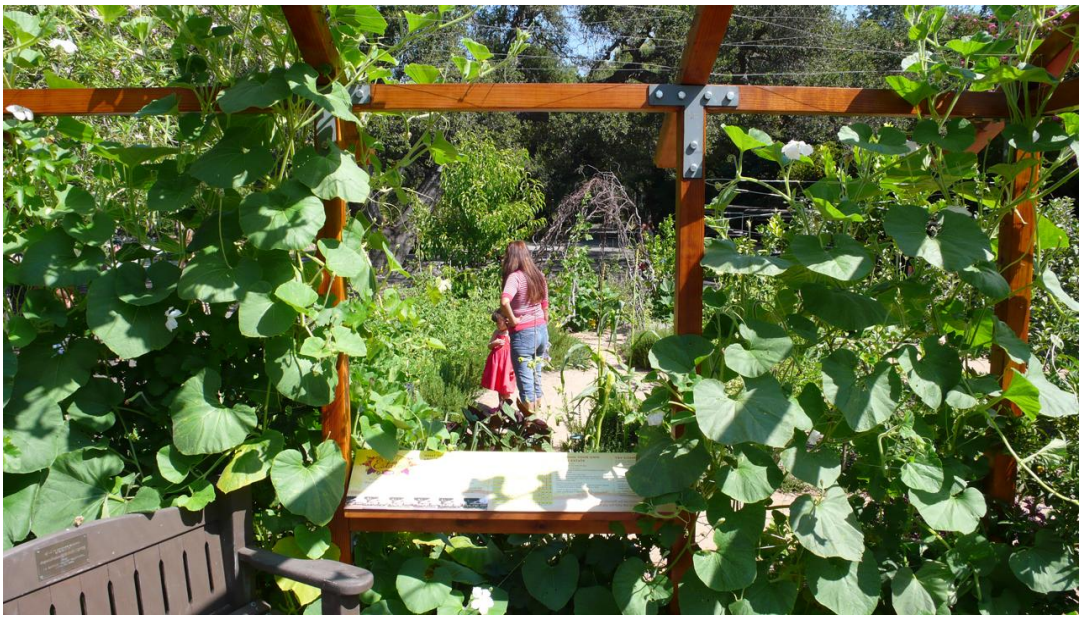

Illustration 2.6 - Framed View at 'La Canada' at Flintridge.
Photo used by permission of Fritz Haeg.

Credit 6.8 – Provide Outdoor Spaces for Social Interaction

Intent – Provide outdoor gathering spaces of various sizes and orientations to accommodate groups, for the purpose of building community and improving social ties (*SITES Guidelines*, 2009, p.165).

The following point accumulations are possible:

Option 1 – This option is for sites with regularly occupied buildings. The space must be accessible to all users. Outdoor spaces must provide seating for at least four people, or 5 percent of total site users (whichever is greater) and should be no further than 200 feet from a building entrance. In addition the site must:

1. Provide a variety of seating for moderate to large groups.
2. Consider microclimate and other site-specific conditions.
3. Provide visual and/or physical access to vegetation.
4. Provide other amenities, services, or activity spaces (e.g., games, wireless technology, food concessions, picnic/dining areas, outdoor auditorium, playground, etc.)

Option 2 – For sites without regularly occupied building(s), provide outdoor spaces that support and encourage social interaction. The space must be accessible to all users, and must accommodate 5 percent of total site users. In addition the site must:

1. Provide a variety of seating for moderate to large groups.
2. Consider microclimate and other site-specific conditions.

3. Provide visual and/or physical access to vegetation.
4. Provide other amenities, services, or activity spaces (e.g., games, wireless technology, food concessions, picnic/dining areas, outdoor auditorium, playground, etc.) (*SITES Guidelines*, 2009, p.165).

Edible gardens in urban areas, like many outdoor urban spaces, are good places for social interaction. Edible gardens are not necessarily better gathering places than other outdoor urban spaces; however, there is evidence that communal edible gardens produce a heightened sense of community among participants.

On the American Community Garden website, one of the benefits listed for community gardens is that they "Stimulate Social Interaction." A study of community gardeners in Denver, Colorado found that participants developed close social ties and reconnected with cultural and ethnic identities, as well as a place to keep updated on local community activities (Teig et al., 2009, p.9). According to a survey of community garden participants in Upstate New York, "Having a community garden in a neighborhood was reported by coordinators to improve the attitudes of residents toward their neighborhood for 51% of the gardens." The study also found an increased awareness of local civic issues, especially in low-income areas. "Community gardens that were located in low-income neighborhoods were four times as likely as gardens not in low-income areas, to lead to other issues in the neighborhood being addressed" (Armstrong, 2000, p.319). A study of 144 urban gardeners in Philadelphia and 67 non-gardening control participants found that "Gardeners were more likely than controls to regard their neighbors as friendly. They were also significantly more likely to participate in food distribution projects, neighborhood clean-ups and neighborhood social events. Gardeners gave significantly more positive responses to questions on psychosocial well-being and frequency of meaningful life events" (Blair et al., 1991, p.161). These studies demonstrate how community gardens might be a positive influence in the goal of building social interaction in an outdoor setting.

2.9.1 Summary of Edible Landscape Compatibility for the 'Site Design – Human Health and Well-Being' Section of SITES

This section of the SITES manual has many highly compatible points available for edible landscapes, especially in the case of public and community gardens, Credit 6.3 (encouraging sustainability awareness and education) can be achieved by teaching ways in which edible landscapes promote sustainable practices. Lessons in composting and reducing food miles are examples of how this credit might be implemented with edible landscapes. Credit 6.4 (emphasizing the protection of unique historical and cultural sites) can easily be achieved by the recreation of historical kitchen gardens and orchards as a part of historical accuracy. Credits 6.6 and 6.8, which are concerned with outdoor physical activity and social interaction are both very well-suited for community gardens, especially for middle-aged and older members of the community that may not be as willing to use the baseball and soccer fields. Credit 6.5 (provide optimum site accessibility, safety and way-finding) and Credit 6.7 (provide outdoor spaces for mental restoration) can be achieved with edible landscapes; however, they are more a design issue than in direct relationship with edible landscapes.

2.10 Construction

For this section of the SITES Guidelines there are two Prerequisites and four credits which pertain to edible landscape site construction. They are presented with potential strategies in chart form below. These prerequisites and credits are concerned with construction practices on the site. The primary goals are to minimize and repair soil disturbance, reuse natural plant and material resources from the site, and to select contractors who use lower-polluting equipment.

Reuse of existing site materials can be sustainable and economically sound in any site construction. In edible landscapes, pieces of concrete from deconstructed driveways and walks can be used as pavers, and stone found on site can be redirected as an attractive edging for raised beds. Cleared cedar limbs could be used as bed edging for a more rustic effect;

however, reuse of plant material is not a practical application for edible landscapes. Greenhouse gas emissions can be reduced during construction if beds are prepared with low-emission tillers, or by hand. Table 2.4, on the following page, outlines the possible credits and strategies to attain points in this section:

Table 2.4 Construction Credits for *SITES Guidelines* (*SITES Guidelines*, 2009, pp. 170-188)

Construction Credits for Sustainable Sites Initiative			
Credit	**Purpose**	**Points**	**Possible Strategies**
Prerequisite 7.1	Control and Retain Construction Pollutants	N/A	Temporary and permanent seeding, mulching, earth dikes, sediment traps, sediment basins, filter socks, compost berms and blankets, secondary containment, spill control equipment, hazardous waste manifests, and overfill alarms and construction sequencing
Prerequisite 7.2	Restore Soils Disturbed During Construction	N/A	Restore soils disturbed during construction in all areas that will be re-vegetated (all areas that will not be built upon) to rebuild soils' ability to support healthy plants, biological communities, water storage and infiltration.
Credit 7.3	Restore Soils Disturbed by Previous Development	2-8 Points	Limit disturbance during construction, Stockpiling and reusing existing site topsoils, Amending site soils in place with organic matter and mechanically correcting compaction, Importing a topsoil or soil blend designed to serve as topsoil.
Credit 7.4	Divert Construction and Demolition Materials from Disposal	3-5 Points	Reuse existing materials on site or recycle them for on-site use when possible. Non-composted and non-organic materials should not be added to soil.
Credit 7.5	Reuse or Recycle Vegetation, Rocks, and Soil Generated During Construction	3-5 Points	Use existing vegetation, soils, and mineral/rock materials as resources in site design.
Credit 7.6	Minimize Generation of Greenhouse Gas Emissions and Exposure to Localized Air Pollutants During Construction	1-3 Points	Select construction contractors who are committed to reducing diesel emissions from construction equipment and vehicles. Reduce construction emissions by reducing idling.

Topsoil is a precious natural resource. According to David Gutierrez, a staff writer for the *Naturalnews* online magazine, “Healthy topsoil is a home to billions of beneficial microorganisms per handful, in addition to nutrients, fungi and worms that are critical to healthy plant life. But it forms very slowly, at a rate of only an inch or two per several hundred years. And around the world, topsoil is vanishing much faster than it forms” (Gutierrez, 2008, p.1). Protected areas will need to be designated during on the landscape design to stockpile topsoil from disturbed areas. Topsoil can be amended with compost and soil amendments prior to returning to planting areas.

Soil building is generally an on-going process in gardening, and this is especially true for edible landscapes. Edible plants will produce a greater yield in fertile, humus-rich soil. “You could say building soil is the defining act of organic gardening. By regularly replenishing the nutrients your plants use, you keep the soil productive” (Organic Gardening ‘*Building Healthy Soil’*, 2009). An area will need to be reserved for soil and compost deliveries on the site. Compost heaps are ‘incubators’ for soil creation, and could be used for this purpose.

One of the requirements for this credit is to select construction contractors who use construction equipment that has low greenhouse gas emissions. Garden tillers are commonly used for bed preparation for edible landscapes, unless no-till methods are used. According to the California Air Resource Board (CARB), the average number of hours by respondents per year for tiller usage was 18 hours for residential and 72 hours for commercial sites (CARB, 2010). The Consumer Report found that 4-cycle engines actually produced fewer emissions than older 2-cycle engines. Low-emission electric tillers and attachments for electric string trimmers are available; however, the Consumer Report found these attachment type tillers to be cumbersome and not as powerful. These might be better for bed maintenance rather than initial soil cultivation (CARB, 2010).

2.10.1 Summary of Edible Landscape Compatibility for the 'Construction' Section of SITES

The available points in this section are concerned with re-using on-site materials and specifying construction methods that would apply to all types of landscapes, edible and otherwise. The point criteria are not in conflict with edible landscapes and can be easily achieved by design specifications. Repurposing of existing materials such as soils, stone and mulch from tree clearing should all be considered as favorable construction materials.

2.11 Operation and Maintenance

For this section of the SITES Guidelines there is one prerequisites and two credits pertaining to the operation and maintenance of edible landscapes. The two prerequisites are 'Plan for Sustainable Site Maintenance' and 'Recycle Organic Matter Generated On-Site.' The credit is for reduced greenhouse gas emissions during maintenance. There is no direct conflict with edible landscapes and these prerequisites and credits; however, there is a serious concern with the specific maintenance requirements for edible plants. Edible plants have unique cultivation requirements that will need to be addressed in the Site Maintenance Plan. This plan is designed with a checklist of maintenance practices, some of which are optional and some are not, which add up to an overall 'best practice' structure. For example, fertilizer and pesticide choices may be organic or chemical; however, Integrated Pest Management (a combination of the two) is recommended. Specific choices will determine how sustainable an edible landscape will be. Compost is listed as the preferred soil amendment for fertilizer application and Credit 8.3 offers points for on-site composting of healthy plant debris and other compostable materials. This credit is highly compatible with standard practice in edible landscape gardening.

Prerequisite 8.1 - Plan for Sustainable Site Maintenance

> Intent – Develop a Site Maintenance Plan that outlines the long-term strategies and identifies short-term actions to achieve sustainable maintenance goals (*SITES Guidelines*, 2009, p.190).

The areas that need to be addressed in the Sustainable Maintenance Plan which are specifically relative to the maintenance of edible plants are:

1. Plant Maintenance – Describe the process for maintaining vegetation according to long-term plans for the site and adhering to recognized standards for professional horticultural practice.

2. Plant Health – Describe the process for monitoring plant health to prevent problems. Identify the proper techniques for addressing dead, diseased, or pest-infested vegetation.

3. Pest Management – Control pests, diseases and any unwanted species of plants and animals using Integrated Pest Management (IPM) techniques.

4. Monitoring for and Control of Invasive Species - A procedure for identifying and monitoring for additional invasive species that may colonize the site and new species as they are recognized.

5. Composting or Recycling Methods of Healthy Plant Debris - Describe the process (e.g., composting or recycling) for managing excess organic plant material generated on site.

6. Composting or Recycling Methods of Diseased Plant Debris – Dispose of organic plant materials generated on site that are not suitable for composting or recycling (e.g. diseased vegetation) in a manner that does not increase the likelihood of spread.

7. Specifications for Soil Amendments - Describe the process for identifying soil deficiencies, including conducting soil test(s) prior to adding amendments and fertilizers. Specify use of the least harmful amendments (e.g,. compost) when necessary.

8. Specifications for Fertilizer Amendments - Describe the process for applying fertilizers (if needed) to ensure that application is effective and prevents harm to environmental and human health.

9. Methods for Control of Erosion and Compaction – Describe the process for alleviating soil erosion or compaction (due to site use or maintenance) that is detrimental to plant health.

10. Irrigation Water Allotment and Source - Describe the anticipated watering schedule (frequency and duration) and describe the process for maintaining non-potable water sources used for landscape irrigation.

11. Treatment for Irrigation Water – Describe the process for treating water features, if present (e.g. avoiding chlorine or bromine).

12. Water quality - Describe the appropriate maintenance activities designed to reduce the exposure to and the mobilization and transport of pollutants in runoff (*SITES Guidelines*, 2009, pp. 191-196).

There is a worksheet which must be filled out with the above list of criteria. These criteria in the Site Maintenance Plan involve the ongoing maintenance of the site, and the individual categories correspond with the prerequisites and credits which have been discussed in the preceding chapters. For example, the section on irrigation requires the person submitting the documentation to "Describe the anticipated watering schedule (frequency and duration) that allows the site to meet annual volume requirements and restrictions" (*SITES Guidelines*, 2009, p.193). While projected potable water amounts used for irrigation is submitted with Prerequisite 3.1 and Credit 3.2, the information required in Site Maintenance Plan deals with the ongoing irrigation practice. The Site Maintenance Plan helps to make sure that the site is cared for with the same sustainable intent of the construction. Prerequisite 8.1 is adapted from the U.S. Green Building Council's *LEED for New Construction and Major Renovations* v2.2 SS Prerequisite 1: Construction Activity Pollution Prevention.

Under the headings of 'Pest Management and Invasive Species Management' of the SITES Maintenance Plan Checklist, it is required that Integrated Pest Management Practice (IPM) be used for ongoing maintenance (*SITES Guidelines* 2009, pp. 191-192). Integrated Pest Management is defined as "an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means and with the least possible hazard to people, property, and the environment" (U.S. EPA. *Integrated Pest Management Principals)*. The following chart outlines the amount of pesticide usage in 2000-2001.

Table 2.5 U.S. Pesticide Usage 2000-2001

U.S. Pesticide Usage 2000-2001					
2000	Million Lbs. of Active Ingredient	% of Total US Usage	**2001**	Million Lbs. of Active Ingredient	% of Total US Usage
Herbicides	432	80	Herbicides	433	78
Insecticides/ Miticides	90	74	Insecticides/ Miticides	73	70
Fungicides	44	59	Fungicides	42	58
Nematicide/ Fumigant	131	84	Nematicide/ Fumigant	102	80
Other*	25	78	Other	25	83
Total	**722**	**78**	**Total**	**675**	**76**

*Other includes rodenticides, molluscicides, aquatic and fish/bird pesticides, other miscellaneous conventional pesticides, plus other chemicals used as pesticides (e.g., sulfur and petroleum oil).

(EPA Pesticide Industry Sales and Usage, 2000 and 2001 Market Estimates. 2004, p.4*)*

With IPM, a vigilant eye must be kept on the plants to deal with any problems before they get out of control and, if a problem is found, the least toxic solution is used first, working up to the more toxic methods as required. The Integrated Pest Management part of Prerequisite 8.1 seeks to reduce pesticide usage. The Table 2.5 shows pesticide usage in the United States for 2000-2001, organized into herbicide, insecticide and fungicide application. This table reveals that pesticide usage grew 7% between 2000 and 2001, and remained relatively steady by type. It is for all pesticide usage, not only fruit and vegetable production. While the information is not specific to edible landscapes, it does give an overall view of the amount of pesticide pollutants that might be partially reduced by IPM or completely organic methods.

Edible landscapes that implement organic maintenance practice are gaining in popularity. Despite these gains, there is still only a very small percentage of fruit and vegetable production dedicated to organic maintenance. “organic carrots (6 percent of U.S. carrot acreage), organic lettuce (4 percent), organic apples (3 percent) and other fruit and vegetable crops were…organically grown in 2005” (U.S.D.A. Economic Research Service. (*Organic Production,* 2010*).*

'Methods for Control of Erosion and Compaction' and 'Prevention of Pollution from Run-Off' are two of the categories in the Site Maintenance Plan which can be addressed by typical edible landscaping maintenance and bed preparation practices. Typically, edible landscapes in urban areas are planted in raised beds. This allows the plants' roots to have more depth of loose, friable soil in which to grow. According to an Environmental Protection Agency report on composting, the addition of organic matter in these raised beds will increase water infiltration and improve soil aeration, thereby reducing soil compaction and run-off. The EPA also recommends using mulch and vegetation to prevent soil erosion from wind, saying that mulch can reduce wind erosion by 80 % (US EPA, *Dust Control,* 2006, pp.1-2).

Credit 8.2 and Credit 8.3 – Provide for Collection Recycle Organic Matter Generated During Site Operation and Maintenance

Credit 8.2 - Intent - Provide space for collection of recyclable materials (including paper, glass, plastics, and metals), (*SITES Guidelines*, 2009, p.198).

The following two requirements are needed for this Prerequisite:

1. Conduct a waste audit to estimate the amount of recyclable materials generated in outdoor areas.

2. Co-locate collection containers for recyclables next to all trash receptacles and ensure that service is provided for collection and recycling of recyclable materials in outdoor areas to facilitate recycling and reduce waste generation and waste disposal in landfills. (*SITES Guidelines*, 2009, p. 198)

This prerequisite is adapted from the U.S. Green Building Council's *LEED for New Construction and Major Renovations* v2.2 MR Prerequisite 1: Storage and Collection of Recyclables (2009, p.47).

Credit 8.3 - Intent – Design for recycling of vegetation trimmings and, where applicable, food waste to generate compost and mulch to support nutrient cycling, improve soil health and reduce transportation cost and materials going to landfills (*SITES Guidelines*, 2009, p. 199).

Both Credit 8.2 and Credit 8.3 pertain to recycling waste rather than sending it to the landfill. Credit 8.2 is relevant to typically non-composted materials, such as plastics and glass. Credit 8.3 deals with compostable materials.

Credit 8.3 requires the applicant to conduct a waste audit to estimate the amount of vegetation trimmings (and food waste, if applicable) generated from the site and incorporate this information into the Site Maintenance Plan. The following points are available:

1. 2 points: Compost and/or recycle 100 percent of vegetation trimmings off site within 50 miles.

2. 3 points: Compost and/or recycle at least 50 percent of vegetation trimmings on site; compost and/or recycle the remaining organic matter off site within 50 miles.

3. 5 points: Compost and/or recycle 100 percent of vegetation trimmings on site.

4. Additional point value: For sites that generate food waste, provide space for on-site collection of compostable organics to prevent them from entering the municipal solid-waste stream.

The recycling of healthy plant debris and other compostable materials into compost is the intent of this credit. This practice reduces the amount of waste being put in landfills, as well as providing a healthy soil additive in the form of compost. The EPA found that "Yard trimmings and food residuals together constitute 23 percent of the U.S. waste stream" (U.S. EPA, *Municipal Solid Waste Generation,* 2010*).* Keeping this debris out of the landfills and putting it back into the soil increases organic matter and produces a healthier soil. According to a USDA report on soil agronomy "As soil organic matter increases, soil aggregation is improved because soil particles are glued together into larger, more stable aggregates. This increase in overall aggregation and in the stability of the aggregates has the following beneficial effects:

1. Resistance of soil dispersion
2. Less susceptibility to compaction
3. Improved soil aeration
4. Better soil drainage
5. Improved infiltration
6. Less susceptibility to soil erosion
7. Plant emergence (USDA. *Soil Quality – Agronomy.* 2010*,* p.2)

Compost is the recommended soil amendment and fertilizer in the Site Maintenance Plan (*SITES Guidelines*. 2009, p. 192). Composting is a much underutilized method of reducing waste and building soil on site. Rather than throwing vegetable waste and coffee grounds in the trash or hauling off shrub and tree trimmings, these things can be combined in a compost heap to produce a beneficial soil builder and fertilizer. A large portion of the waste created on site could be transformed into compost. The following is a list of possible materials which could be composted according to the U.S. EPA:

1. Animal manure
2. Cardboard rolls
3. Clean paper
4. Coffee grounds and filters
5. Cotton rags
6. Dryer and vacuum cleaner lint
7. Eggshells – no other dairy products
8. Fireplace ashes – not charcoal from grills
9. Fruits and vegetables
10. Grass clippings
11. Hair and fur – no animal flesh or fat
12. Hay and straw
13. Houseplants
14. Leaves
15. Nut shells
16. Sawdust
17. Shredded newspaper
18. Tea bags
19. Wood chips
20. Wool rags
21. Yard trimmings – from healthy plants, not treated with chemical insecticides, herbicides or fungicides (U.S. EPA, 2010*,* p.2*).*

Compost is a wonderful soil amendment for all plants, and edible plants are no exception. Not all of these compostable materials will be available for every site; however, the ones that are available should be added to the compost heap. Community gardens can compost healthy plant debris and collected compostable materials from gardeners' homes, lessening land-fill waste from both sources.

Credit 8.7 - Minimize Generation of Greenhouse Gases and Exposure to Localized Air Pollutants During Landscape Maintenance Activities

Intent - Reduce, avoid, or eliminate the use of landscape maintenance equipment that exposes site and adjacent building users to localized air pollutants and generates greenhouse gas emissions (*SITES Guidelines*, 2009, p. 206).

1. 1 point: Plan for the use of power maintenance equipment only during hours when the site is closed for use or during periods when the lowest percentage of site occupants are potentially exposed to landscape maintenance emissions. In the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*), designate times for emission-generating maintenance equipment use to occur only when the site is closed to users (i.e., not during hours of operation). For sites with constant site users (e.g., college and university settings), designate times for maintenance equipment use to occur when the number of site users is typically at its lowest.

2. 3 points: In the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*), specify that at least 50 percent of the power maintenance equipment used on site meets one of the following:
    1. Equipment is powered without the use of gasoline (e.g., electric, solar-powered, or fueled by compressed natural gas or propane).
    2. Equipment engine is certified to meet emission levels in the U.S. EPA Final Emission Standards for New Non-road Spark-Ignition engines, Equipment, and Vessels–Phase 3.151

3. 4 points:
    - Option 1: In the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*), specify that 100 percent of the power maintenance equipment used on site meets one of the following:
        1. Equipment is powered without the use of gasoline (e.g., electric, solar-powered, or fueled by compressed natural gas or propane).
        2. Equipment engine is certified to meet emission levels in the U.S. EPA Final Emission Standards for New Non-road Spark-Ignition engines, Equipment, and Vessels–Phase 3.

OR

1. Option 2: In the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*), specify that no power maintenance equipment is required for landscape maintenance (*SITES Guidelines*, 2009, p. 206).

An argument could be made that land devoted to edible plantings could be replacing lawns, thereby reducing emissions from lawn maintenance machinery. “Gallon for gallon — or, given the size of lawnmower tanks, quart for quart — the 2006 lawn mower engines contribute 93 times more smog-forming emissions than 2006 cars, according to the California Air Resources Board. In California, lawn mowers provided more than 2 percent of the smog-forming pollution from all engines” (Barringer, 2006).

The following information about various types of maintenance equipment and the estimated time generally assigned to their associated tasks will help to make this determination.

Table 2.6 Lawn Equipment Emissions

Lawn Equipment Emissions		
Equipment Type	**Annual Hours of Usage**	
	Residential	Commercial
Walk Behind Mower	20.5	603
Riding Mower	24	901
Garden Tractor	25	712
Tiller	18	72
Misc. Equipment	12	500
Chain Saw	26	349
General Utility	57	320
Percent of Lawn and Garden Equipment with 2-Stroke Engines	39.20%	33.70%

From the California Air Resource Board 'Survey of Utility Equipment Use', 2010.

Emissions will vary by equipment selection, site and task; however, it is worth noting that tiller usage will generally be seasonal bed preparation, while lawn mowing is much more frequent. There are electric-powered tillers available that meet the emissions criteria for Credit 8.7.

Like ornamental planting beds, edible landscapes can be hand-tooled. Once the beds have been prepared, weeds can be pulled by hand. Specifying that no power equipment would be used on the site could earn 4 points under this credit.

2.11.1 Summary of Edible Landscape Compatibility for the 'Operation and Maintenance' Section of SITES

Maintenance issues are of prime concern with edible landscapes. Beyond the criteria set forth in the Sustainable Sites Initiative, such as recycling of organic matter and the use of low-emission power equipment, which are well-suited to edible landscape maintenance practices, there are important concerns about the ability of maintenance personnel to care for edible landscapes. The maintenance issues that are particular to edible landscapes require

specialized knowledge that may be difficult to locate. This is a primary concern before considering edible landscapes as a part of sustainable projects.

2.12 Monitoring and Innovation

This section of the *SITES Guidelines and Benchmarks* has two sections which relate to edible urban landscaping. Credit 9.1 deals with the ongoing monitoring and documentation of a sustainable site. Credit 9.2 allows for further point accumulation in areas not covered specifically in the guidelines.

Credit 9.1 – Monitor Performance of Sustainable Design Practices

> Intent – Monitor and Document sustainable design practices to evaluate their performance over time and improve the body of knowledge on long-term site sustainability (*SITES Guidelines, 2009,* p.210).

This credit requires that at least three prerequisites and/or credits be monitored by a third party or qualified person on the design team and that they be presented to a peer review. The following list of prerequisites and credits which apply to edible landscapes are eligible for monitoring:

Prerequisite 3.1 – Reduce potable water use for landscape irrigation by 50 percent from established baseline.

Credit 3.5 Manage stormwater on site and/or

Credit 3.6 – Protect and enhance on-site water resources and receiving water quality.

Prerequisite 4.1 - Control and manage known invasive species.

Credit 4.9 – Restore plant communities native to the ecoregion.

Credit 7.3 – Restore soils disturbed by previous development.

Credit 6.3 – Promote sustainability awareness and education.

Credit 6.5 – Provide for optimum site accessibility, safety and wayfinding.

Credit 6.6 – Provide opportunities for outdoor physical activity.

Credit 6.7 – Provide views of vegetative and quiet outdoor spaces for mental restoration.

Credit 6.8 – Provide outdoor spaces for social interaction (*SITES Guidelines*, 2009, pp.211-212).

The monitoring of actual resource conservation as a result of SITES practices could be very valuable in promoting these principals. Monitoring water usage, run-off quantities, and water and soil quality on sustainable edible landscape sites as compared to non-Sustainable Sites Initiative sites would be very useful in making arguments for edible landscapes which employ SITES guidelines in their site development.

Because edible landscapes, especially community gardens, are well documented as having educational, social and health benefits, these sites could be very useful tools in monitoring social interaction and benefits. Both physical and mental effects of community gardens could be monitored at beginning and interval time periods to bolster previous studies.

Edible landscapes will require ongoing care and maintenance as well as seasonal planting of annual fruits and vegetables. Each site will be unique and the caretakers, whether they are homeowners or a commercial lawn service, will need to be well versed in edible plant maintenance. The amount of time required for maintenance will vary according to the size of the site and the variety of the plants.

Credit 9.2 – Innovation in Site Design

Intent – To encourage and reward innovative sustainable practices for exceptional performance above requirements and/or innovative performance in sustainable site categories not specifically addressed by the *Sustainable Sites Initiative Guidelines and Performance Benchmarks* (*SITES Guidelines, 2009,* p.214).

SITES Credit 9.2 is adapted from the U.S. Green Building Council's *LEED for New Construction and Major Renovations* v2.2 ID Credit 1: Innovation in Design (*SITES Guidelines, 2009,* p.83).

The intent of this credit is to reward sustainable innovation that is not specifically included in the *SITES Guidelines*. There are 4 points available for each innovation, for a possible accumulation of 8 points. Edible landscapes could be included under this credit since they are not included specifically in the document. An example of how these credits could be claimed is in the Olive Tree Learning Center Case Study in Chapter 4.

2.12.1 Summary of Edible Landscape Compatibility for the 'Monitoring and Innovation' Section of SITES

There is a very good opportunity to obtain credit points under this section of the Sustainable Sites Initiative. Credit 9.1 allows credit points for the monitoring of sustainable sites. Edible landscapes can be monitored in many areas, especially regarding the input and output of materials and yield, as well as social benefits such as physical activity and social interaction. Credit 9.2 allows points for innovation. Considering the fact that edible landscapes are not specifically included in the Sustainable Sites Initiative, they can be considered as an innovative design element.

2.13 Summary of Literature Review

Edible landscape sites must attain a certain number of points relating to ecological impacts in order to qualify as a Sustainable Sites Initiative site. There is no evidence uncovered in this literature review that indicates that edible landscapes would not be eligible for inclusion. As with any project being considered for SITES ranking, points can be achieved with a catered approach to the site development, matching the particulars of the site to as many applicable credits as possible. Some of these credits are more easily attained with common edible gardening practices, such as drip irrigation and increasing organic matter in the soil. Other credits will be more specific to the site, such as brownfield and greyfield site reclamation and inclusion of educational components. The majority of the attainable credits will be earned by deliberate decisions regarding the planning, construction and maintenance of the site.

CHAPTER 3

METHODOLOGY

3.1 Introduction – Research Design

The hypothesis of this research is that edible landscapes are compatible with the *SITES™ Guidelines and Performance Benchmarks, 2009*. The research used to study this hypothesis is primarily from an analysis of interviews with professionals associated with the design and structure of the *SITES™ Guidelines and Performance Benchmarks, 2009*. Methodology for this research is primarily qualitative. Qualitative research methods are best applied to interview studies because the information is textual rather than numeric in nature; furthermore, the data is subjective, based on the individual experiences of the respondents (Taylor and Bogdan, 1998.) These interviews were 'in-depth' in nature; a term defined by Taylor and Bogdan as "flexible and dynamic…nondirective, unstructured, non-standardized, and open-ended" (Taylor and Bogdan 1998, p. 88).

Each of the interview participants was asked a series of prepared questions. The questions were designed to be open-ended to encourage elaboration and a free exchange of ideas from the respondents. The interviews were transcribed and analyzed for common themes regarding compatibility of edible landscapes with the *Sustainable Sites Initiative, 2009*.

A "mixed model" (or 'triangulation') is employed in an effort to further clarify the interview analysis. According to Caracelli and Greene, the mixed model can be a side-by-side analysis, a sequential use of different methods, or an integrated process. (Caracelli and Greene, 1997, pp. 19-32) A sequential process was employed with this research. The interview portion of this research is corroborated by a thorough analysis of the individual SITES' prerequisites and credits and how they apply to a case study for an edible landscape at The

Olive Tree Learning Center. This case study provides an example of the compatibility of a particular edible landscape to the *Sustainable Sites Initiative, 2009*.

3.2 – Interview Participants

Interviewees were selected for this research based on their experience with the SITES development. Potential participants were selected from the Sustainable Sites Initiative Steering Committee and Technical Subcommittee who were seated on the Sustainable Sites Initiative Technical Subcommittee based on their field of expertise. The interview participants and their fields of specialty are as follows Respondents are identified by number rather than name to protect identity:

1. Hydrology
    1. Respondent #6 - Ph.D., P.E., D.WRE Research Associate Professor Center for Research in Water Resources University of Texas at Austin
    2. Respondent #8 - Environmental Protection Specialist Nonpoint-Source Control Branch Assessment and Watershed Protection Division Office of Wetlands, Oceans and Watersheds U.S. Environmental Protection Agency
2. Soil
    1. Respondent #9 - Ph.D. Research Assistant Professor of Urban Forestry Department of Forestry Department of Horticulture Virginia Tech
3. Vegetation
    1. Respondent #2 - Executive Director U.S. Botanic Garden
    2. Respondent #4 - Invasives Species Consultant
    3. Respondent #7 - Ph.D. Professor and Program Leader Urban Horticulture Institute Cornell University

4. Human Health and Well-Being
    1. Respondent #5 - Ph.D. Research Social Scientist College of Forest Resources University of Washington
5. More than one technical subcommittee
    1. Respondent #1 - ASLA, RLA, AICP, LEED AP Principal Landscape Architect/ Planner Conservation Design Forum
    2. Respondent #3 - Ph.D. Director, Landscape Restoration Program Lady Bird Johnson Wildflower Center

3.3 Data Collection Methods

Potential participants were contacted by e-mail regarding their availability and interest in participation in the project and interviews were scheduled with those who were interested. The interview respondents were widely dispersed in various areas of the United States, so all of the interviews were conducted by phone except one which was face to face. Although the interview questions are scripted, the interviews were conversational in nature and respondents were encouraged to elaborate when answering. Interviews were recorded using a Sony IC Recorder, and the recordings were then transcribed by GMR Transcripts in Tustin, California.

The first five interview questions are open-ended, leaving the respondents the freedom to elaborate on the topics and express their perceptions and attitudes. Question six, seven and eight are more specific, dealing with three explicit natural resources conservation areas; water, soil and ongoing maintenance. The final question asks the respondent to rate overall compatibility. Compatibility is measured by levels of perceived relative advantage and overall compatibility of edible landscapes with the *Sustainable Sites Initiative Guidelines and Benchmarks*. Complexity of incorporation of edible landscaping into sustainable site designs was also rated. It was discovered after asking about the complexity of incorporation a few times that it was a rewording of the overall compatibility question, so it was removed from the rest of

the interviews. Compatibility ratings are listed according to the degree of the respondents' level of satisfaction that edible landscapes are a good match for SITES criteria.

3.4 Research Questions for Sustainable Sites Initiative Professionals

Introductory questions – How long have you been associated with the SITES design team? Has your input been specific to the field of (hydrology…) or to a more wide range of sustainability issues?

1. Have edible landscapes been considered for SITES design criteria?
2. If so, what are the findings that have prevented edible landscapes from being included specifically as one of the design criteria?
3. Are you aware of any SITES pilot projects that have requested edible landscapes?
4. What are your thoughts on how edible landscapes might be beneficial to sustainable design?
5. What are your thoughts on criteria for continued maintenance on edible landscape projects?
6. Conservation of potable water is an important design consideration for SITES candidates. Under Prerequisite 3.1 and Credit 3.2 edible plantings are excluded from the irrigation area calculations in the SITES guidelines. If the entire landscape is planted with edible plants, can this credit still be claimed?
7. Soil conservation is also an important design consideration. Soil depletion in conventional agriculture from water and wind erosion and lack of soil-building practices is a big problem. What are your thoughts on how urban edible plantings can help to alleviate this problem?
8. IPM is the preferred maintenance practice for SITES certified projects and is also the preferred method for edible landscape maintenance to prevent soil and water pollution from pesticides, herbicides and fungicides. Are the maintenance practices on SITES certified projects monitored by a third party? If it is found that the project is not in compliance with their maintenance practice, can the Certification be revoked?

9. On a level of 1 through 5, 5 being the highest level, would you rate the following three attributes as they apply to the suitability of edible landscaping for SITES:

1. Relative Advantage
2. Overall Compatibility
3. Complexity of Incorporation

Thank you for your help with this project. Is there anyone associated with SITES development that you think I should contact to further my research?

3.5 - Analysis Methods

Interview responses to the research questions regarding the various SITES credits and prerequisites and how they are compatible with edible landscapes are covered in section 4.2. Interview responses were analyzed for common themes in order to discern consensus in various areas.

The interview findings are further corroborated by the analysis of the Olive Tree Learning Center Case Study. This analysis is done utilizing a direct comparison of possible point accumulation of this existing edible landscape with the SITES' prerequisites and credits. The Olive Tree Learning Center is not an actual pilot project in the Sustainable Sites Initiative Pilot Program, so the analysis is based on presumed credit attainability, based on the information in the *SITES Guidelines and Performance Benchmarks, 2009*.

The analysis of both the interviews and the point accumulation study are executed with analytical induction, as much as possible in an unbiased and objective manner. Inductive reasoning has been used for the analysis rather than mechanical or computer-generated methods. Taylor and Bogdan state that "researchers are constantly theorizing and trying to make sense of their data," (1998, p.141) and this has been the case throughout the research and analysis for this study.

3.6 – Limitations and Significance of Methodology

The different research models making up the “mixed model” are usually done separately of one another rather than in an integrated fashion, either to corroborate or append one another. “While the use of parallel methods may not, therefore, provide corroborative evidence, they may well add depth or breadth to a study and perhaps even hold the key to understanding the processes which are occurring.” (Jick, 1979, p.602)

In this type of research a greater knowledge of a topic is sought, seeking to expand on the conversation rather than ultimately defining an answer. “In-depth understanding, not validity, is sought in an interpretive study.” (Denzin, 1989, p.246) The purpose of this research is a greater understanding of the fit of edible landscapes into sustainable site design, using the interview analysis as the primary research instrument and the case study analysis as a tool for clarification.

CHAPTER 4

FINDINGS

4.1 Introduction

The 'mixed model' research methodology including the interviews, case study and analysis of the *SITES™ Guidelines and Benchmarks,2009* has revealed some common themes to the question of whether edible landscapes are compatible with the guidelines and benchmarks of the *Sustainable Sites Initiative*. These common themes are organized according to the following categories as they relate to edible landscapes:

1. Food Security
2. Potable Water Usage Considerations for Edible Landscapes
3. Soil Quality and Run-Off Relating to Edible Landscapes
4. Social Benefits and Community Perceptions
5. Operation and Maintenance Issues
6. Rating of Overall Advantage, Overall Compatibility and Overall Complexity

The expertise of the nine interviewees for this project has been very valuable in ascertaining the compatibility of edible plantings for the Sustainable Sites Initiative goals. The interviewees, who have all been involved with the Sustainable Sites Initiative design team since its inception, or shortly thereafter, contributed their knowledge in the areas of hydrology, soil, vegetation and health and human well-being; and related this expertise to the question of the compatibility of edible landscape to the *SITES™ Guidelines and Benchmarks*. Although the various respondents tended to focus on their specific field of expertise, there was an overall similarity in their approach to sustainable site development. Broader themes beyond the six categories listed above, the respondents viewed the effects of edible landscapes on the overall

project. Whether the focus was on hydrology, soils, vegetation or community development, all of the interviewees were concerned with how these elements fit in to the following:

1. Interdisciplinary Effects on Ecosystem Services – Measuring cumulative effects of these elements rather than individually.

2. Overall Sustainability – Based on baseline resource usage of comparable sites which do not employ sustainable criteria, and

3. Performance Levels – Measured in natural resource conservation and personal and community development.

These three concerns are addressed throughout the six more specific themes listed above.

4.2 Sustainable Site Development Criteria for Inclusion in the SITES Guidelines

The *SITES Guidelines and Benchmarks* targets the overall site ecology, or ecosystem services, through these different professional disciplines. In order to determine the compatibility of edible plants with *SITES*, it is important to look at the interviewees' responses regarding the overall criteria for inclusion. The interview respondents spoke a little about the formation and strategies for consensus and how they relate to edible landscapes. Respondent #3 discussed the overall goals of SITES and the criteria for determining content.

> We focused the entire Sustainable Sites Initiative on ecosystem services…We wanted to have a single unifying concept of what we were trying to achieve. At the end of the day, if 'Sustainable Sites' is successful, what does sustainability mean? And for us, that means that we're going to have as much or more ecosystem services produced by these landscapes than we had before we started.

This respondent explained that each site, and each credit as it applies to that site, had to be evaluated on an individual basis.

> There is no practice that by virtue of the practice is sustainable… So I'm very much against BMPs (best management practices) that [just state], 'Green roofs are good.' 'Edible gardens are good.' 'Community gardens are good.' I can give you as many examples of one that doesn't work as one that does, so it's all about performance. And the Sustainable Sites Initiative is set up with guidelines [and] performance benchmarks, because it's focused on achieving performance levels.

Ecological services are defined as “goods and services of direct or indirect benefit to humans that are produced by ecosystem processes involving the interaction of living elements, such as vegetation and soil organisms, and non-living elements, such as bedrock, water, and air.” In order to determine the compatibility of edible landscapes with ecological services, it is important to analyze the respondent’s answers to the individual questions regarding these elements.

4.3 Analysis of Interviewees’ Responses Regarding Edible Landscape Compatibility

While there is nothing preventing edible landscapes from being included as potential SITES candidates, most of the respondents stated that edible landscapes are unique situations that require criteria that are more specific than the focus of the *SITES Guidelines*. Respondents spoke about the conscious decision not to include agriculture in the Guidelines, because this was more regional in nature, and beyond the focus of the sustainability of individual sites.

A number of the respondents discussed the importance of remaining broad enough to cover all ecological issues pertaining to the site and still be specific enough on the requirements and how this had limited the inclusion of edible landscapes as a credit. Respondent #2 stated “The Sustainable Sites Initiative did not choose to focus specifically on edible landscapes, and what we hope to do is to get to that in a future version…” Respondent #9 explained that overall site ecology was the goal, rather than being too detail specific. “Rather than saying, ‘…we think this is good and you should do it this way, we think that is good and you should do it that way.’ We’ve really tried to [make the] outcome…the measurement.”

Respondent #4 commented on the committees’ conscious decision not to include edible landscapes as a specific credit. “We didn’t want to trample all over the community gardens, the community organic movement, the urban ornamental horticulture, and so we…exempted food produce gardens from these requirements for the time being…however, we did recognize that if you included…edibles within your landscape design, that was an approved thing to do.”

The decision to avoid urban agriculture as a part of the *SITES Guidelines and Benchmarks* was made early on. Respondent #3 spoke about this. "We actually had a very conscious effort that while we did want to promote community gardening, whether that's edible landscaping or anything else, we were not trying to provide standards for agricultural production. There are other efforts that are aimed at that, and so we stayed…away from really getting into recommendations associated with crop production, whether that be in an urban landscape or not." Respondent #7 addressed edible landscapes as a supplement to conventional agriculture. "Edible planting is great. It's not going to feed the world. It's going to feed the urban areas…at best it will be a supplement to the need for production agriculture."

Respondent #3 talked about current revisions to the Sustainable Sites Initiative which would allow for urban agriculture. "We're in the process of revising the first credit…Prerequisite, 1.1, which is about preserving prime farmland, and in urban environments, we are allowing…a mitigation alternative, instead of just no development on prime farmland. But in those cases, we want you to preserve at least some of it on that site and use it for community gardens." This provision would allow some development of prime farmland for edible landscapes in the form of community gardens.

None of the respondents are aware of anything in the current SITES document that prevented edible landscapes from being included. Overall, the consensus was that edible landscapes could be a good fit for sustainable sites and that it would probably be a part of a future Sustainable Sites Initiative, possibly in a separate document due to the unique nature. "It's a specialty and it requires…its own version of SITES, or its own chapter, its own section… it's definitely on our radar in terms of a future need, and there's definitely a need for it, but we'd have to have a specialty group of people to come work on it." (Respondent #2) One of the respondents was aware of a number of community gardens who have applied to be included in the pilot program, which is currently looking at sites to use for sustainability testing under the current *Sustainable Sites Initiative Guidelines and Benchmarks, 2009*.

The interview respondents spoke about the unique opportunities and problems associated with edible landscapes in a number of areas, including:

1. Food Security
2. Potable Water Usage
3. Soil Quality and Pollutant Run-Off
4. Social benefits and Community Perceptions, and
5. Maintenance Issues Specific to Edible Landscapes.

4.3.1 Food Security Considerations for Edible Landscapes

The importance of food production in an ecological system was addressed as it relates to food security. Respondent #4 explained the role of edible plants in the system. "If you are designing a sustainable landscape, it should be a landscape that not only deals with the regulating surfaces…it also needs to deal with food, fuel, fiber, flowers, forest, and fish and feed – the 'Seven F's' of agriculture are ecosystem services… encouraging people to use their landscape…if you can provide nourishment or any of the 'Seven F's', that's a bonus."

Respondent #1 stressed the importance of edible landscaping to food security as well as reconnecting with our food sources as a culture.

> I think there's another aspect…, which is just giving people the freedom to be able to grow their own or some portion of their own food...So really having edible landscape woven into the grain of the neighborhood and of the city is critical to be able to do that… I strongly want to get away from the focus on 'ornamental' (plants grown for beauty rather than edible fruit)…It's time to get into growing our food, growing our herbs, our medicines… every square foot of land should be restorative and be providing…

Respondent #5 elaborated on this issue as it relates to the problem of the inaccessibility of healthy fruits and vegetables to inner-city residents.

> And we're also hearing a lot about food security in our cities. So while sometimes community gardens and on-site gardens are fairly small, I think there is the possibility of providing food supplement. And that food supplement offers really valuable nutritional content which is an issue in some of our inner cities, some of our most built environments. So I see it as a valuable element in site design potential.

Permaculture plantings, which are discussed in the review of Credit 4.7, are mentioned by two interviewees as possible edible landscape options to address food security issues. “I think that there are technologies, Permaculture being one, or variations on Permaculture, that make food production in built environments or in the midst of built environments very possible.” (Respondent #5) When speaking about Permaculture, Respondent #9 gave an example of how this might work. “It depends on what kind of food you really insist on producing so, for example, let’s say you have a fig bush or something. You may not be getting the optimum production. You could be managing it just for its landscape value, but then people could go out there and eat the figs, you know, just in passing and so I think that…definitely accomplishes something, but it’s not as if you’re producing figs and selling them at the farmer’s market necessarily, but it’s still an edible landscape component.”

Respondent #9 talked about the importance of food security as it relates to fuel availability. “If you have actual significant food production very close to the consumers then you could reduce your impacts on the environment just simply because you’re not moving stuff around as much.”

Overall, the interviewees’ responses indicate that edible landscapes would be an important means to achieving more food security and fruit and vegetable availability to urban areas within a sustainable initiative.

4.3.2 Water Usage Considerations for Edible Landscapes

As noted in the literature review, Prerequisite 3.1 and Credit 3.2 of the Sustainable Sites Initiative deal directly with the reduction of potable water use. The intent of this credit is to encourage on-site water collection for plant watering with water collection systems such as rain barrels and cisterns. Interview respondents addressed the unique issues surrounding the use of non-potable water from rain collection systems on edible plants, and the reasons why edible landscapes are exempted from potable water use restrictions.

There is an exception to Prerequisite 3.1 which allows for potable water to be used for edible landscapes. Respondent #3 talked about the reason for this exception. "…we did want to incentivize community gardening, because of the philosophical and other implications... we would not hold community gardens to the same standard…the community garden serves so many other functions...so much of the rest of the landscape is primarily serving an ornamental purpose…that [could be provided]l without that extra water."

Even though there was no penalty associated with Prerequisite 3.1 regarding the use of potable water on edible landscapes, the common opinion is that the points for Credit 3.2 would probably not be granted if the entire landscape is planted in edibles. Respondent #3 said "Basically you couldn't say you've really reduced your potable water consumption by 75 percent if you're using potable water over 100 percent of your landscape. We wouldn't actually penalize you for it, but we aren't going to give you a credit for that either." Respondent #3 discussed the possibility of gaining Credit 3.2 if edible plantings requiring higher water usage were planted in a separate area from more drought tolerant plantings. "You might put all of your higher water use plants in one area, and put more intensive irrigation there. And maybe that's the part that gets excluded from your calculations, versus the rest of the landscape... My thought would be you'd isolate your high water use edibles, and take that out of your calculations."

There was also some discussion of water quality for edible plantings in the interviews. "we acknowledge that if you've got water that's come off of parking lots, or from toilets, or certain areas, and you're reusing it as irrigation, you can't use it on edible crops unless you've had it fully tested, and you're clear that it doesn't have any microorganisms that puts this food at risk. That we acknowledged, but we did not go into the specifics. "(Respondent #2)

Irrigation water for edible landscapes that was harvested from roofs did not carry the same concerns as contaminated run-off water. In fact, the respondents agree strongly that rain-collection in cisterns and rain barrels are a very good water source for edibles.

> Vegetables can do better on rainwater, if you're doing rainwater collection anyway… And this is the really good reason it's good to have these multidisciplinary teams. If I had been the king, there would be no exclusion. I do all my vegetable gardening from rainwater that's been collected off my roof… But the reason it was compromised is that we felt, a lot of folks felt that cisterns and that rainwater collection is still not practical everywhere around the country. It's also not always available in the quantities you want, when you need it. I think those are design issues that can be solved." (Respondent #3)

Possible health department and city code issues involving non-potable water usage on edible plants are discussed by Respondent #4. "We want people to grow tomatoes in Arizona, and tomatoes in Arizona are going to take a little more water. We want you to do it right. And we wanted to make sure you weren't using wastewater, at the same time holding this delicate balance that if you're doing a completely urban edible garden, we didn't want you to be hampered by health department requirements."

Potable water usage on edible plantings would be allowed; however, rain catchment would still be the preferred water source according to the interview respondents. Although, it is possible to attach low-flow drip irrigation systems to rain barrel and cistern spigots, these sources do not always have enough 'head pressure' to push the water through to the end of the hose unless there is a significant grade change, so a pump may be required. Solar pumps are available that would be in keeping with the sustainability of the system.

4.3.3 Soil Quality and Run-Off Relating to Edible Landscapes

Soil quality and soil loss from run-off are addressed in the 'Soils and Vegetation' and 'Construction' sections of the *Sustainable Sites Initiative Guidelines and Benchmarks*. The prerequisites and credits, which deal with soil building and retention, are discussed with the interviewees as they relate to edible landscapes. Both soil quality and soil retention are addressed as they related to edible landscapes.

Sustainability goals for soil quality are based on natural soil systems (target soils) for the site. These soils may be in a pre-development, undisturbed state, which would most

probably require some amendment for fruit and vegetable production on edible landscape plants.

Respondent #3 discussed the concept of target soils which are based on the reference soils of the desired ecological communities, matching soil pH, organic material in the soil and compaction levels.

> In the case for the Sustainable Sites…you have to have a reference soil, that gives you an idea of how much organic material should be in that soil, what its level of compaction should be, and those kind of things…then you have your physical nature of the soil (which) needs to be roughly similar to reference conditions, and that is in terms of soil particle sizes and everything else…So my physical particle size needs to be roughly equivalent to the target conditions. The chemical composition needs to be similar to the compositions…, in terms of pH, in terms of nutrient loading, everything else. Your organic matter needs to be appropriate to your target conditions. Your biological community should be appropriate to those conditions…and so if you can handle four out of the five of those, and show that you are within the range of your reference conditions, then you have healthy soils.(Respondent #3)

In the part of the interviews relating to soil for edible landscapes, it was commonly mentioned that target soils would differ from reference soils for edible landscapes. Respondent #3 elaborated on how soils might be amended for edible landscapes. "…that doesn't mean you can't modify your soil, but you need to pick a different reference type… And so you could actually tweak your reference soil conditions a bit, based on what you're trying to get to." Respondent #8 said "there's a lot to…be said for soil regeneration, whether using organic soil amendments, inoculations of mycorrhizae or compost teas. I think that's really where the future will be, in terms of production. It's creating a rich and varied soil base." Respondent #2 talked about the complexities of soil-building for edible landscapes. "

> There are times when no till… is good, but there are times with food crops when they've really got to build the soil, and we've got to make sure we have good drainage. I think we've got to get grading done well. We've got to get plenty of compost in the soil. We've got to make sure it drains. We've got to know whether or not it's appropriate to use a mulch, and that really depends on what the crop is. There are so many factors and variables.(Respondent #2)

According to the interviewees' responses to soil building for edible landscapes, and how this might fit with the goals of the Sustainable Sites Initiative, there is not a conflict with

additional organic matter that edible plants require if no-till methods are used and the additional organic matter is not structurally different than the target soil.

Soil retention and the prevention of run-off is another soil-related issue that was addressed by the interviewees. Respondent #8 talked about the sustainability goal of reducing soil run-off. “We were most interested in creating credits to address hydrology… from a landscape perspective, but to reduce the impact of increased volumes and velocities on receiving waters.” Two of the interviewees spoke specifically about soil run-off and how this issue relates to edible landscapes. “Any situation where you are adding organic matter to the soil, in an urban setting, is probably going to improve soil quality… I think a lot of typical landscapes really don’t permit that and one of the things about sustainable sites is it recognizes that there is a demand that you keep vegetative matter on site, if possible. (Respondent #9) Respondent #6 spoke about the importance of raised beds to prevent erosion. “If you’re doing raised gardens and you’re doing mulching…I don’t think you’re going to have substantial sediment losses from garden type plots.”

4.3.4 Human Health and Well-Being and Edible Landscapes

Human health and well-being is a unique element in the Sustainable Sites Initiative when compared to the other sections, because it is more of a sociological issue than an ecological issue. Comments on this topic are favorable regarding the effects of edible landscapes on communities, especially as they related to community gardens. Interview respondents addressed the psychological as well as the physiological benefits of edible landscapes.

Respondent #3 talked about the significance of this section of the *SITES Guidelines*. “So the philosophical and sociological implications of community gardening are perhaps more significant than the direct ecological benefits.” Respondent #5 also talked about the social benefits.

> Well what we know from the research literature on community gardens, and I would say citizen engagement with nature…is that there is social cohesion that emerges as people work together for common… in doing so there's an excuse, if you will, or an opportunity to get to know other people who are in proximity to you; be they co-workers, be they fellow students, be they neighbors…and so often these organizations of people, formal or informal…start to tackle other issues or other concerns in their communities. So you see this ripple effect which is quite interesting…that's one dynamic where I think food growing contributes to sustainability. (Respondent #5)

The implication of people growing their own food was addressed as a psychological as well as a physical need. Respondent #3 said "I think it's actually much better to get people thinking about what it takes to grow food production. What it takes – the investment that it takes in time and effort and money to produce [food], so they're not taken for granted." Respondent #9 elaborated on the mental benefits that edible landscapes might offer through a reconnection with the natural world. "My other feeling is that the more…people interact with plants, the better it is for them and for society because plants are essentially the foundation of life on earth."

4.3.5 Operation and Maintenance for Edible Landscapes

Edible plants require specific maintenance beyond that needed for ornamental landscapes. For example, fruit trees and bramble fruits must be pruned annually, and plants must be checked regularly for insect and disease problems. This unique type of maintenance will require well-trained care takers. Respondents spoke on this issue at length.

Respondent #7 said, "I think that people have to go into it with a pretty good knowledge. They just can't plant a bunch of fruit trees and expect them to grow themselves," Respondent #2 elaborated

> They need care from someone who understands them, knows the plants, and loves them, because you can't have a landscape company take care of an edible landscape. It's not going to work. The life cycles of the plants are extremely different. They have different needs at all different times of year. You've got to be paying attention to that…it's just a daily thing that you need to be in touch with."

This respondent elaborated on the maintenance problem using the example of school gardens, which receive little to no care during the summer when school is not in session.

> That has been one of the problems with school gardening…You need to be there to know what's happening, and pay attention to the details. That's what it's all about. It's all about timing. You've got to harvest at the right time. You've got to sow your seed at the right time. You've got to understand the soil, and the water, and the climate. All these things…require a skill and a connection." (Respondent #2)

Respondent #9 suggested Permaculture plantings to address maintenance problems on low-maintenance sites.

> …there's also a lot of interest in things like Permaculture and edible landscaping and things of that nature… in a school, there's no one there in the summer and there's no maintenance provided by the county and so it becomes this sort of nightmare of maintenance…someone just needs to be out there every week doing something, you know, pulling a few weeds or checking this or checking that. And it doesn't happen and it just becomes impossible so the school is really like a study in what low maintenance really means.

Respondent #3 talked about the necessity for an end-user that has a vested interest in the produce.

> Unless it's a really well-integrated in the community, or …there's a use that the commercial effort's going to make, the food crop's never harvested. It's left to rot. It becomes a maintenance nightmare…it sounded good when it was in the design phase, but they really didn't have a plan for the maintenance and use... Now, if there's a restaurant that is committed to utilizing the produce as part of their fare, great. If there's a community that has said, 'We're going to adopt this landscape, and maintain it, and harvest...' But too often, I've seen this done in a commercial setting where it's done to get some style points, and it's never really thought through on how to utilize that space.

Respondent #3 said the most effective method of dealing with site maintenance would be to have the maintenance crew, or someone with similar experience, sit in on the planning session, and be involved in the design process.

> Those are the guidelines we want during the design process, not at the end. We don't want to turn over a design that's never really been ground truthed…it looks great on paper [but] It's not maintainable… I would say the same thing would apply to any type of edible landscape, in the sense that who's going to be maintaining that landscape, and how's it going to be maintained, and what has to happen, has to be thought through the design process.

According to Respondent #3, even though maintenance is included in Section 8 of the Sustainable Sites Initiative, it is also a part of Section 2, the 'Pre-Design and Assessment' portion for this very reason.

The problem of additional pollutants from pesticides on urban edible gardens was mentioned by Respondent #6. "The concern…from the hydraulic team…would be people being tempted to fertilize or use pesticides or that kind of thing."

Another unique maintenance situation for edible landscapes is the problem of neighborhood perceptions that edible landscapes are unkempt. Respondent #9 spoke about this problem as it relates to community gardens." I'm a community gardener and I pay to use a community garden myself. And oftentimes, in various other community garden settings that I've been involved in, plots are abandoned or not tended well. And so, that may be received as an eye sore or as a potential pest issue by surrounding residents." Edible landscapes are not the norm, and this 'difference' may not be accepted by the neighborhood.

The interviewees were asked about ongoing maintenance after the project has been certified. Landscapes, edible or otherwise, are living and evolving, as opposed to buildings, which are fairly static once they have been built; therefore, maintenance over the lifetime of the landscape is very relevant to sustainability. Respondent #1 talked about how the SITES manual address the issue of assuring that projects are being maintained sustainably after certification. "It's really not feasible or practical to have a monitoring through the Sustainable Site Initiative to ensure long-term compliance. But having a plan in place and then having the establishment (construction) completed according to the initial plan gets you a certification. Then I believe they're talking about having a way to re-up your certification after a period of time."

Respondent #3 talked about the importance of long-term maintenance planning and anticipating maintenance problems.

> There will be a pest outbreak. I don't know necessarily what it's going to hit, but there will be one, and how do I address that? There will be droughts. How do I address that? …one of the species I selected will just fail to thrive. Now what do I do? So that's a real management plan that is operational… a real management plan may even begin

> looking into 50, 60 years in the future. How do you handle tree replacement, as these trees mature and die? Is there a plan for that? A real, true management plan incorporates all of that.

This respondent also addressed the fact that many designers are not concerned with the landscape maintenance due to lack of personal experience.

> I'm not even sure the designer understands it, to tell you the truth. I mean so in fairness to them, they've never had to maintain a landscape like this. And it is a neat idea. And that's what they're selling. A maintenance plan requires both the client and the designer to confront the implications of that design while still in the design phase, and you can make cheap changes. (Respondent #3)

Maintenance issues surrounding sustainable edible landscapes are a major concern of the respondents. Other concerns expressed by the respondents include locating qualified maintenance personnel who are available year round and know how to cultivate edible plants, as well as concerns about neighborhood perceptions. The respondents emphasized that these concerns should be addressed during the planning stages rather than after installation.

4.3.6 Results of Question#9 – Rating of Relative Advantage, Overall Compatibility and Overall Complexity

Question # 9 in the interview asked respondents to rate the relative advantage, overall compatibility and the overall difficulty of incorporation of edible landscapes to the Sustainable Sites Initiative goals. The items are rated 1 to 5, with 5 being the highest value. In design, this question seemed to be a fairly straightforward. The respondents found this question to be confusing and difficult to answer. Some of them chose to rate only one or two of the items, and some not to rate any of them. The results of the rated items are found in the following chart:

Table 4.1 Results of Question #9

Rating Values of Compatibility of Edible Landscapes to SITES		
Respondent #	Relative Advantage	Overall Compatibility / Complexity
1	5	5
2	5	5
3	5	No Response
4	4	5
5	4	5
6	4	5
7	No Response	No Response
8	3	3
9	4	5
Average	4.25	4.71

Note: Overall Complexity (difficulty of incorporating edible plants into the SITES Goals) of Implementing Edible Landscapes in SITES Projects – After this third rating question had been asked a few times, it became apparent that it was just a rewording of the second item (Overall Compatibility.) Because of this, the results are not included.

The most common response to the compatibility and relative advantage of edible landscapes to SITES goals was that it was dependent on the particular site and its ultimate use. Respondent #5 discussed this issue. “I would say it’s compatible... I think it depends on the type of development. And it’s hard to see somebody planting tomatoes in front of an office building downtown.” The concept of ‘highest and best use’ of the land was also a part of this dialogue. “If you had matured deciduous forest on the site, and then, you wanted to try to come in and develop the site as an urban farm, you’d probably have a net negative… impact on hydrologic vegetation soils perspective…it would depend on where you were starting… and what your intent was.” (Respondent #8)

Two of the interviewees rated the relative advantage in the mid range. While edible landscapes could be beneficial, they did not consider them to be essential to achieve sustainability.

> The main intent is to promote a more sustainable landscape and accrue all the other potential benefits, and edible landscapes could be another potential benefit in terms of the overall sustainability goals… you're providing food. You're providing community involvement. You are generating the soils… And you're reducing energy, hopefully, because you're not trucking in as much food from afar. I would say a three again. Because I don't think use of edible plants would really necessarily really give us more momentum (in ecological goals). (Respondent #8)

A number of the answers regarding overall advantage are specific to the problem of maintaining edible sites. A problem with the complexity of long-range maintenance is addressed by respondent #3. "I would say it's more complex than a standard landscape, because, to be done well, you have to have a user group for the product. And that makes it more complex."

The general consensus of the respondents is that edible landscapes fit well with *SITES Guidelines and Benchmarks'* prerequisites and credits, and that adding an edible element into a site would be beneficial; however they also stressed that the SITES manual is not designed to address specific types of landscapes, and that edible landscapes may require their own manual. The overwhelming response was that the relative advantage and overall compatibility of edible landscapes to SITES depended on the 'highest and best use' for the site and the ultimate user.

4.4 General Responses to Research Questions

Responses to the original research questions are briefly summarized below:

1. Have edible landscapes been considered for SITES™ design criteria?

> The general consensus for this question is that the SITES™ design criteria was broader, that focusing on a particular design type was too limiting, and that edible landscapes could require a separate manual.

2. If so, what are the findings that have prevented edible landscapes from being included specifically as one of the design criteria?

> None of the respondents were aware of any issues preventing edible landscapes from being considered for inclusion as SITES™ projects.

3. Are you aware of any SITES™ pilot projects that have requested edible landscapes?

> At the time of the interviews, Respondent #3 said that there were 345 submittal applications for pilot projects. He said that some of the applicants were community garden projects; however they had not decided on which applicants would be accepted at that point.

4. What are your thoughts on how edible landscapes might be beneficial to sustainable design?

> There were numerous ideas presented about the benefit of edible landscapes to sustainable design, especially as they related to Permaculture, food security and productive use of the land.

5. What are your thoughts on criteria for continued maintenance on edible landscape projects?

> Many of the respondents were concerned about the special needs of edible landscapes and much emphasis was placed on the need to organize a competent maintenance team before even considering edible landscapes.

6. Conservation of potable water is an important design consideration for SITES™ candidates. Under Prerequisite 3.1 and Credit 3.2 edible plantings are excluded from the irrigation area calculations in the SITES™ guidelines. If the entire landscape is planted with edible plants, can this credit still be claimed?

> Respondent #3 said that the exemption for edible landscapes to Prerequisite 3.1, which requires that potable water use be reduced by 50% from baseline, would exclude edible landscapes from this requirement; however, if an entire site was planted in edibles that used potable water, than the points associated with this credit (Credit 3.2) would probably not be allowed.

7. Soil conservation is also an important design consideration. Soil depletion in conventional agriculture from water and wind erosion and lack of soil-building practices is a big problem. What are your thoughts on how urban edible plantings can help to alleviate this problem?

> None of the respondents stated that edible landscapes would reduce the burden of soil depletion associated with conventional agriculture practices, due to the small amount of land use by urban edible landscapes.

8. IPM is the preferred maintenance practice for SITES™ certified projects and is also the preferred method for edible landscape maintenance to prevent soil and water pollution from pesticides, herbicides and fungicides. Are the maintenance practices on SITES™ certified

projects monitored by a third party? If it is found that the project is not in compliance with their maintenance practice, can the Certification be revoked?

> At the time the interviews were conducted, there was no system for ongoing monitoring beyond Credit 9.1, which allows points for voluntary monitoring. Additionally, at the time of the interviews there was no system for revocation of SITES™ accreditation.

4.5 Case Study – Olive Tree Learning Center

4.5.1 Olive Tree Learning Center – Site Information

An analysis of a specific edible landscape site will clarify how edible landscapes can be developed within the guidelines of the *Sustainable Sites Initiative*. Although the Olive Tree Learning Center has not been proposed as a candidate for the SITES pilot program, it is an example of specific opportunities and liabilities of an edible landscape within these parameters. These opportunities and liabilities are demonstrative of how an edible landscape may fit into the SITES credit rating system; however, this is only one example and each site will be unique.

The Olive Tree Learning Center is an Early Childhood Learning Center in Austin, Texas. There are currently 30 students attending the school, between the ages of 18 months and 5 years of age. The School is on a one-third acre site, which is located near the center of the City, in close proximity to Zilker Park and the Long Center for the Performing Arts.

The School curriculum includes growing vegetable plants from seed and small containers in their garden, which the director of the School decided to expand in December of 2009. The decision was made to plant the entire site in edible plants, including fruit trees, herbs and vegetable plants as well as bramble fruit. The existing non-edible plants on the site remain, although some needed to be transplanted.

Illustration 4.1 – Olive Tree Learning Center Site Plan

4.5.2 Olive Tree Learning Center – Site Design Elements

During the site assessment phase an initial meeting was held with the director, the owners and the designer about the landscape needs and desires to have an edible landscape. Specific design considerations included a poorly drained concrete pad where the kids rode their tricycles when it was not covered in mud. It was determined in the meeting that soil infiltration should be increased with additional organic matter, and that rain barrel water collection should be used to catch roof runoff in order to reduce soil runoff during rain events.

Participants in the preliminary design meeting expressed an interest in planting the entire site in edibles. The site has existing vegetable bed plantings in raised beds that are enhanced with the addition of pathways and a fence which also serves as a vertical plant structure. The existing play equipment remains in the original locations, with additional fruit trees and perennial vegetable (such as asparagus and artichokes), as well as herbs planted on the periphery. Soil disturbance is limited by hand planting and manual soil building. Construction and maintenance are to be done by hand if at all possible. New concrete paths for tricycle riding are to be mixed by hand in wheelbarrows, and the entire site is bed planting and pathways, so there would be no need for lawn equipment such as mowers or blowers. On-site compost bins and cold frames as well as water stations for plant watering are a part of the design, to provide for plant debris disposal, and plant propagation and watering on site. An onsite recycling effort is in place and will be maintained. The above design considerations help the project to gain points in the SITES rating system.

4.5.3 SITES Compatibility of The Olive Tree Learning Center Edible Landscape

Specifics about the site development and compatibility with various prerequisites and credits from the SITES are as follows:

Site Selection:

Prerequisite 1.1 – Limit Development of Soils Designated as Prime Farmland, Unique Farmland, and Farmland of Statewide Importance

Prerequisite 1.2 – Protect Floodplain Functions

Prerequisite 1.3 – Preserve Wetlands

Prerequisite 1.4 – Preserve Threatened or Endangered Species and Their Habitats

None of these prerequisites are in conflict with the proposed site development. The site is not on farmland and uses no soils from farm sites. It also is not located within floodplain or wetland areas, and there are no threatened or endangered species effected by development.

Credit 1.5 – Select Brownfields or Greyfields for for Redevelopment – This site has been previously graded, so it is classified as a greyfield. – **5 points.**

Credit 1.6 – Select Sites Within Existing Community – Site is located within ½ mile of at least 5 Basic Services including a civic center, convenience store, hair care salon, outdoor recreation facility and a dry cleaners. – **6 points.**

Credit 1.7 – Select Sites that Encourage Non-Motorized Transportaton – Site is located on a sidewalk that spans 8 blocks, and a bicycle network of at least 5 continuous miles is located within ¼ mile. There is also bike storage capacity on the site. – **5 points.**

A total of 16 points are accumulated under the 'Site Selection' section of the Sustainable Sites Initiative.

Pre-Design Assessment and Planning

Prerequisite 2.1 – Conduct a Pre-Design Site Assessment and Explore Opportunities for Site Development

Prerequisite 2.2 – Use an Integrated Site Development Process

The pre-design phase of development for this site included professionals associated with all phases of sustainable design, installation and maintenance of the site. Opportunities were explored for sustainable water usage, soil and vegetation reuse and preservation, and

installation and maintenance practices. It was also decided that construction and plant materials would be as low impact as possible and from local sources when available. Propagation of many of the vegetable plants is on site, as the children start many of the plants from seed.

Credit 2.3 – Engage Users and Other Stakeholders in Site-Design – Owners, teachers, children and parents at the Olive Tree Learning Center were solicited for ideas on site development and plant selection. The children were asked about the types of vegetables they like to eat so they could be included in the planting design. The design was displayed at the School and made available for comment for over a month. – **4 points**

A total of 4 points are earned under the 'Pre-Design Assessment and Planning' section of SITES.

Site Design – Water

Prerequisite 3.1 – Reduce Potable Water Use for Landscape Irrigation by 50% From Established Baseline – Even though this Prerequisite has an exemption for edible plantings, it was decided in the planning session that non-potable water usage would be reduced by the use of rain harvesting for plant irrigation. Rain barrels are designed to collect roof run-off; however, this will not be sufficient to reduce potable water usage by 50%.

Credit 3.2 – Reduce Potable Water Use for Landscape Irrigation by 75% or More from Established Baseline – Using the formula found on pages 47-48 of this report, it is found that the site would not achieve a 75% reduction in water use over the baseline with the use of rain barrel water harvesting for the plant irrigation source.

Credit 3.5 – Manage Stormwater on Site – Water storage is increased on site through rain barrel water collection of roof runoff and pervious surfaces for driveways and pathways, except for concrete paving for tricycle pathways. Play areas are designed with pervious pea gravel surfaces and planting beds are to be mulched with fine-shredded hardwood bark mulch to allow water to percolate through these surfaces. – **5 points**

Credit 3.6 – Protect and Enhance On-Site Water Resources and Receiving Water Quality – All the construction materials specified for this site are non polluting, and plant maintenance is specified to be entirely organic with no chemical fertilizers or pesticides. Biofiltration is enhanced by adding organic matter to the soil. – 3 to 9 points available – Estimated – **3 points.**

A total of 15 points are earned under the 'Site Design - Water' section of SITES.

Site Design – Soil and Vegetation

Prerequisite 4.1 – Control and Manage Known Invasive Plants Found on Site

Prerequisite 4.2 – Use Appropriate, Non-Invasive Plants

Prerequisite 4.3 – Create a Soil Management Plan

Known invasive species for this site are listed in the Site Management Plan with methods for control should they occur. These methods are limited to hand pulling and digging to prevent herbicide use. None of the plants specified on the planting plan are known to be invasive in Austin, Texas. A Soil Management Plan is created for this site which specifies that soils are to remain undisturbed except to be amended with organic matter, and not to be removed from the beds.

Credit 4.4 – Minimize Soil Disturbance In Design and Construction – Existing soils are left in place and plants are 'pocket-planted', with the most minimal disturbance of soil possible. – **6 points**

Credit 4.6 – Preserve or Restore Appropriate Plant Biomass on Site - No points are earned for this credit, because there is not enough difference between the beginning and ending point of plant biomass. Existing trees on the site made up a large portion of the biomass density for both the existing and proposed plant biomass. Biomass density values are from the values ascribed to the "Temperate Grasslands, Savannas & Shrublands" biome from the SITES Guidelines, as Austin, Texas falls within this North American biome. Table 6.1 shows the values for this biome, comparing the required changes in the beginning and ending biomass density.

Table 4.2 Point Accumulations for Plant Biomass Density for Austin, Texas.

Values for Biomass Changes in the Temperate Grasslands, Savannahs and Shrublands Biome						
		Planned Site BDI				
		0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0 or Above
Existing Site BDI	0-0.5	No Credit	3 pnts.	5 pnts.	8 pnts.	8 pnts.
	0.5-1.0	No Credit	No Credit	3 pnts.	5 pnts.	8 pnts.
	1.0-1.5	No Credit	No Credit	No Credit	3 pnts.	8 pnts.
	1.5-2.0	No Credit	No Credit	No Credit	No Credit	8 pnts.
	2.0 or Above	No Credit	No Credit	No Credit	No Credit	8 pnts.

Table 4.2 shows the existing and proposed plant biomass, categorized by vegetation type.

Table 4.3 Plant Biomass Index for Olive Tree Learning Center– Existing and Proposed

Existing Vegetation Biomass Density			
Vegetation Type Zone	**Biomass Density Value for Zone**	**Percent of Total Site**	**Biomass Density for Zone**
Trees with Understory	6	0.17	1.02
Trees without Understory	4	0.17	0.68
Shrubs	3	0.004	0.012
Annual Planting	1.5	0.006	0.009
Total			**1.721**

Proposed Vegetation Biomass Density			
Vegetation Type Zone	**Biomass Density Value for Zone**	**Percent of Total Site**	**Biomass Density for Zone**
Trees with Understory	6	0.26	1.56
Trees without Understory	4	0.18	0.72
Shrubs	3	0.02	0.06
Annual Planting	1.5	0.02	0.03
Total			**2.37**

Because of the large amount of existing biomass on the site, the change in the biomass density at the Olive Tree Learning Center is only 0.649; therefore, it does not qualify for points under the requirements for Credit 4.6.

Credit 4.11 – Use Vegetation to Minimize Building Cooling Requirements – Option 2 – Air Conditioning Units on this site are shaded by a vine-covered lattice screen, and 30% of the roof will be shaded within 10 years by new and existing trees. Trees proposed for the site that will

shade the roof are standard size fruit trees, and their height will not be more than 25 feet at maturity. The School is a one-story building, between 12 and 15 feet in height. **– 2 points**

Credit 4.12 – Reduce Urban Heat Island – 30% of all site hardscapes are shaded by existing and proposed vegetation within 10 years. – **3 points**

A total of 10 points are earned under the 'Site Design – Soils and Vegetation' section of the Sustainable Sites Initiative.

Site Design Materials

Prerequisite 5.1 – Eliminate the Use of Wood From Threatened Species – The wood used for the fence, trellis, arbor and lattice construction is cedar, which is not a threatened species.

Credit 5.2 – Maintain On-Site Structures, Hardscape and Landscape Amenities – 95% of existing structures, hardscapes, and landscape amenities are retained on this site. – **4 points**

Credit 5.4 – Reuse Salvaged Materials and Plants – All on-site materials and existing, non-invasive plants are kept on-site. Existing plants total 10% of the plant material on the site. – **2 points**

Credit 5.5 – Use Recycled Content Materials – Concrete for tricycle paving on the site is from recycled concrete. – **2 points**

Credit 5.6 – Use Certified Wood – 100% of the wood used for fencing, arbors, lattice work and trellises are from certified sources. **4 points**

Credit 5.7 – Use Regional Materials – 90% of materials, plants and soil are within local distance requirements. – **6 points**

Credit 5.8 – Use Paints, Sealants, Adhesives and Coatings with Reduced VOC Emissions – Wood surfaces are specified to be sealed or painted with low VOC products. – **2 points**

Credit 5.9 – Support Sustainable Practice in Plant Production – Plants are purchased from local nurseries that use peat-free soil mixes, purchase 35% of their energy from renewable sources, use IPM plant maintenance, use non-potable water for 70% of irrigation, reduce waste through composting and recycling. **3 points**

A total of 23 points are earned under the ‘Materials’ section of the Sustainable Sites Initiative.

Site Design – Human Health and Well-Being

Credit 6.3 – Promote Sustainability Awareness and Education – Educational elements for this site include demonstrations for students in plant propagation, plant cultivation and composting. – **4 points**

Credit 6.6 – Provide Opportunity for Outdoor Physical Activity – Two physical activity features are required for this credit. Playground equipment and surfaces for tricycles are provided along with gardening activities. – **5 points**

Credit 6.7 – Provide Views of Vegetation and Quiet Outdoor Spaces for Mental Restoration – Aesthetic natural experiences are provided for children in the way branches are specified to be pruned, creating ‘hiding’ places under Mulberry trees and Fig shrubs. Bench seating is added in the front of the school for parents while waiting for students. – **3 points**

Credit 6.8 – Provide Outdoor Spaces for Social Interaction – Outdoor gardening activities and seating are provided within 200 feet of the building. Seating areas are shaded by deciduous trees in the summer. Picnic and playground areas are also provided. – **3 points**

A total of 15 points are earned under the ‘Site Design – Human Health and Well-Being’ section of the Sustainable Sites Initiative.

Construction

Prerequisite 7.1 – Control and Retain Construction Pollutants

Prerequisite 7.2 – Restore Soils Disturbed During Construction

No pollutants are expected to be generated during construction, because of low-impact site development practice and materials selections. Likewise, soil disturbance is expected to be minimal during construction.

Credit 7.3 – Restore Soils Disturbed by Previous Development – Soils on this site are not disturbed except for individual planting holes and the additions of compost, beneficial mycorrhizal fungi and worm castings in the planting holes. **2 points**

Credit 7.5 – Reuse or Recycle Vegetation, Rock and Soil Generated During Construction – 100% of land-clearing materials are retained on site. Soils that are removed from pathways are redirected to planting beds. Healthy plant debris is composted on site, except for large limbs, which will be ground for mulch unless they are diseased. – **3 points**

Credit 7.6 – Minimize Generation of Greenhouse Gas Emissions and Exposure to Localized Air Pollutants During Construction – All construction is to be done without machinery, except concrete mixing for pathways. **3 points**

A total of 8 points are earned under the 'Construction' section of the Sustainable Sites Initiative.

Operation and Maintenance

Prerequisite 8.1 – Plan for Sustainable Maintenance – The Site Maintenance Plan for this site has been developed with the Integrated Design Team as required by this Prerequisite. The Design Team set specifics for the ongoing maintenance of the edible trees, herbs and vegetables including seasonal pruning, planting schedule, soil amendments, organic fertilization schedules, organic pesticide treatments, composting requirements, disposal of diseased plant material, hand removal of weeds and that irrigation water come from harvested rain water.

Prerequisite 8.2 – Provide for Storage and Collection of Recyclables – On site collection for paper, glass, plastics and aluminum are provided.

Credit 8.3 – Recycle Organic Matter Generated During Site Operation and Maintenance – A waste audit conducted for the site found that healthy plant debris and compostable waste from student and teacher lunches will be composted on site. – **5 points**

Credit 8.7 – Minimize Generation of Greenhouse Gases and Exposure to Localized Air Pollutants During Landscape Maintenance Activities – No lawn equipment machinery will be used on the site. Beds will be hand cultivated and weeded. **4 points**

A total of 9 points are earned under the 'Operations and Maintenance' section of the Sustainable Sites Initiative.

Monitoring and Innovation

Credit 9.1 – Monitor Performance of Sustainable Design Practice – Ongoing records will be kept for produce yields for the site and how the produce is used. – **10 points**

A total of 10 points are earned under the 'Site Design – Human Health and Well-Being' section of the Sustainable Sites Initiative.

4.5.4 – Summary of Point Accumulation for the Olive Tree Learning Center

Through low-impact site development and materials selection the Olive Tree Learning Center is able to accumulate 103 points, which would earn this site a 'One Star' Rating under the following point rating system:

- One Star – 100 Points
- Two Stars – 125 Points
- Three Stars – 150 Points
- Four Stars – 200 Points

The points earned are only estimated within this study and have not been rated by anyone associated with the Sustainable Sites Initiative.

The SITES section with the highest number of points is by far the 'Materials' section with 23 of the total points. Simply by specifying non-polluting materials, almost a quarter of the points for this site are earned. Organic maintenance and low-impact construction specifications provided 17 of the points, and 15 points are earned by using non-potable water sources and controlling runoff on the site. Because the site is not associated with community development,

the points earned under the 'Human Health and Well-Being' section are relatively low at only 15 points. The 'Monitoring and Innovation' section points are contingent on record-keeping on the amount of produce that is grown on the site and how it is used. The location of the site within an urban area added to the 16 point total under the 'Site Selection' section, and an integrated planning process yielded 4 of the total points.

Looking at this one site, it is easy to see how variable the point accumulation can be, and how one edible landscape is rated under the *Sustainable Sites Initiative Guidelines and Benchmarks*.

4.5 Summary of Findings

Overall, it was found that edible landscapes can fit as a candidate site for the Sustainable Sites Initiative. Analysis of the SITES Guidelines and Performance Benchmarks and the interviews indicates very strongly that this compatibility is contingent on the specifics of the site. Interview respondents agreed that edible landscapes can have a high compatibility with the 'Human Health and Well-Being' section of the Sustainable Sites Initiative. Concerns centered around potable water usage, possible fertilizer and pesticide run-off and maintenance issues. They all stated that ecological and sustainability performance levels as they relate to edible landscapes would be made on a site specific basis. The findings point to the following site factors which would need to be considered:

1. The Original Condition of the Site – Base site information regarding soil contamination, site location and existing vegetation and hydrology on the site should all be taken into account.
2. The Intended Use of the Site – 'Highest and Best Use' of the site should be considered. Are edible plants the most sustainable choice?

3. The End User of the Site – How the property is going to be maintained and who is going to maintain it.

These considerations are not unique to edible landscapes; however, there are unique circumstances surrounding edible landscapes when contrasted with ornamental landscapes. The general consensus of the interview respondents was that edible landscapes are so unique that they may require a separate manual for sustainability criteria. Specific maintenance requirements and resource usage are of particular concern. According to information gathered from the interviews, edible landscapes require amended soil, consistent water and, most importantly, someone who is qualified to care for them. When weighing the potential societal, economic and psychological benefits of edible landscapes, the use of natural resources and the alteration of site ecology should be carefully considered.

CHAPTER 5

CONCLUSION

5.1 Introduction

This findings of this research shows that edible landscapes are compatible with the goals and benchmarks of the *SITES™ Guidelines.* It has become clear during this research that there are special considerations associated with edible landscapes which require study and planning beyond those of ornamental plantings. The existing site, the intended use and the end user are all influential in the decision to make edible plantings a part of a SITES project.

The interviews revealed that the 'highest and best use' of the site must be taken into consideration in order for the project to be sustainable. Increased need for resources should be balanced with potential benefits. For example, if a brownfield is reclaimed for use as a community garden, as is the case in the Allen Street Community Garden, it would be a net benefit. If the site is a natural stand of hardwood trees, it would probably be a net negative to clear the trees and plant a vegetable garden.

The goals and benchmarks in the *Sustainable Sites Initiative* are geared toward the overall reduction of negative impacts on the environment. The inclusion of edible landscapes as potential candidates is more dependent on the methods of site development and maintenance than with the type of plants being grown. Less sustainable edible landscape development and maintenance practices might include the overuse of chemical fertilizers, pesticides and fungicides, which depletes the fertility of the soil's microbial activity and causes polluted run-off into waterways. Poor organic content in soils that are used for food production is another unsustainable practice that would deter inclusion as a SITES project. A comprehensive approach to site development and maintenance is important for all sites seeking SITES ranking,

whether they are edible or not. Consideration must be given to the ecological impact of all the elements affecting the site.

From the information in the preceding chapters, it is clear that edible landscaping in urban environments must be approached holistically in order to meet the goals of the Sustainable Sites Initiative. The various ecological components do not stand alone. Edible landscapes, like all landscapes, are living and evolving. The difference between edible landscapes and the more naturalistic plantings promoted by SITES is that, ideally, the more natural landscapes result in less long-term involvement, allowing natural processes to predominate.

In contrast, the health of edible landscapes requires diligent and long-term care. The project cannot be solely concerned with the physical design and not the design of the maintenance. As pointed out in the analysis of the interviews, the construction and maintenance procedures need to be thoroughly reviewed during the planning process. Neighbor's perceptions and concerns with edible landscapes, such as compost heap location and potential problems with the unconventional look of edible landscapes are best addressed during the planning phase as well. In order for edible landscapes to meet the sustainable objectives, the overall design, implementation and maintenance of the project will need to be in harmony.

The Sustainable Sites Initiative takes a broad approach to site development which allows for a variety of landscape types. The designers realized that there is not a singular solution for every site. Each site, each landscape and each maintenance team involved with a SITES project will have their own unique characteristics. The encompassing scope of the *SITES Guidelines and Benchmarks* allows the designer wishing to design with edibles to fit this into the scheme.

The analysis of this research did reveal concerns with natural resource usage, especially the credits in the 'Vegetation and Soils' section concerning water and ecoregion conservation. For example, soil horizons will most likely be altered for edible plants, as the bed

grade will probably be raised with additional organic matter. This would alter the natural ecosystem, making this practice incompatible with credits that require protective zones where natural soil and plants are not disturbed, unless no-till bed preparation is used. Bed preparation practice will depend on reference soil quality, and the requirements of the edible plants being grown.

There are also major considerations with the expertise and commitment of the maintenance team for edible landscapes. These concerns will need to be carefully weighed by the design team before deciding to use edible plants.

A rating chart showing the compatibility of the applicable prerequisites and credits is included in this chapter. Although the ratings are based on the information in the *Sustainable Sites Initiative Guidelines and Performance Benchmarks* and the interview response, they are included in this chapter because they are subjective and open to interpretation. The compatibility charts below only illustrates the likelihood of point suitability. The weighing of points is dependent on site specifics.

5.2 Analysis of SITES Prerequisites and Credits for Compatibility with Edible Landscapes

The compatibility chart below demonstrates a strong compatibility in some of the desired sustainability sections and poor compatibility in others. Each of the Sustainable Sites Initiative's prerequisites and credits are charted according to their compatibility with edible landscapes. The five possible ratings are:

1. Highly Compatible
2. Compatible
3. Neutral
4. Poor Compatibility
5. Not Compatible

Because each site will be unique, potential point accumulation and eligibility are variable. Credits which are not specifically related to edible landscapes are given a 'Neutral' rating. Point calculations will vary for each site, and point tabulations are only meant to be

representational of overall compatibility. For this analysis, sites are assumed to be planted entirely in edible plants, which may or may not be the case for specific sites. Relative compatibility was based on common edible gardening practice as it pertains to the requirements of the particular credits. The following charts rank compatibility by SITES sections in a range from not compatible through highly compatible, the point values are listed under the appropriate heading:

Table 5.1 Compatibility Ratings for the 'Site Selection' Section of the Sustainable Sites Initiative

Prerequisite / Credit	Point Value	Description	Not Compatible	Poor Compatibility	Neutral	Compatible	Highly Comp -atible
Site Selection - 11 Highly Compatible Points							
Prerequisite 1.1		Limit Development of Farmland Soils			x		
Prerequisite 1.2		Protect Floodplain Functions			x		
Prerequisite 1.3		Preserve Wetlands			x		
Prerequisite 1.4		Preserve Endangered Species Habitat		x			
Credit 1.5	5 - 10	Select Brownfield or Greyfield Sites					5-10
Credit 1.6	6	Select Sites Within Existing Communities					6
Credit 1.7	5	Select Sites that Encourage Non-Motorized Transport				5	

Table 5.2 Compatibility Ratings for the 'Pre-Design Assessment and Planning' Section of the *Sustainable Sites Initiative*

Prerequisite / Credit	Point Values	Description	Not Compatible	Poor Compatibility	Neutral	Compatible	Highly Comp -atible
Pre-Design Assessment and Planning - 4 Highly Compatible Points							
Prerequisite 2.1		Pre-design Site Assessment			x		
Prerequisite 2.2		Integrated Site Development Process			x		
Credit 2.3	4	Engage Stakeholders in Design Process					4

Table 5.3 Compatibility Ratings for Edible Landscapes with the 'Site Design – Water' Section of the *Sustainable Sites Initiative*

Site Design - Water - No Highly Compatible Points							
Prerequisite / Credit	**Point Values**	**Description**	**Not Compatible**	**Poor Compatibility**	**Neutral**	**Compatible**	**Highly Comp -atible**
Prerequisite 3.1		Reduce Potable Water use by 50% from Base		x		x - If Harvested	
Credit 3.2	2-5	Reduce Potable Water use by 75% from Base				2-5 - If Harvested	
Credit 3.3	3-8	Protect and restore riparian, wetland, and shoreline buffers		3-8			
Credit 3.4	2-5	Rehabilitate Lost Streams, Wetlands and Shorelines		2-5			
Credit 3.5	5-10	Manage Stormwater on Site			5-10		
Credit 3.6	3-9	Protect and Enhance On-site Water Resources and Receiving Waters			3-9		
Credit 3.7	1-3	Rainwater/Storm-water Features for On-site Amenity			1-3		
Credit 3.8	1-4	Water Feature Maintenance to Conserve Resources			1-4		

Table 5.4 Compatibility Ratings for Edible Landscapes with 'Soil and Vegetation' Section of the *Sustainable Sites Initiative*

Prerequisite/ Credit	Point Values	Description	Not Compatible	Poor Compatibility	Neutral	Compatible	Highly Compa -tible
Site Design - Soil and Vegetation - No Highly Compatible Points							
Prerequisite 4.1		Control and Manage Invasive Plants Found on Site			x		
Prerequisite 4.2		Use Appropriate, Non-Invasive Plants			x		
Prerequisite 4.3		Create a Soil Management Plan				x	
Credit 4.4	6	Minimize Soil Disturbance in Design and Construction		6			
Credit 4.5	5	Preserve Special Status Vegetation		5			
Credit 4.6	3-8	Preserve or Restore Plant Biomass				3-8	
Credit 4.7	1-4	Use Native Plants	1-4				
Credit 4.8	2-6	Preserve Plant Communities Native to Ecoregion	2-6				
Credit 4.9	1-5	Restore Plant Communities Native to Ecoregion		1-5			
Credit 4.10	2-4	Use Vegetation to Minimize Building Heating Requirements		2-4			
Credit 4.11	2-5	Use Vegetation to Minimize Building Cooling Requirements			2-5		
Credit 4.12	3-5	Reduce Urban Heat Island Effects				3-5	
Credit 4.13	3	Reduce the Risk of Catastrophic Wildfire		3			

Table 5.5 Compatibility Ratings of Edible Landscapes for the 'Site Design – Materials Selection' of the *Sustainable Sites Initiative*

Site Design - Materials Selection - No Highly Compatible Points							
Prerequisite/ Credit	**Point Values**	**Description**	**Not Compatible**	**Poor Compatibility**	**Neutral**	**Compatible**	**Highly Compat-ible**
Prerequisite 5.1		Eliminate the Use of Wood from Threatened Tree Species			x		
Credit 5.2	1-4	Maintain On-site Structures, Hardscapes and Landscape Amenities			1-4		
Credit 5.3	1-3	Design for Deconstruction and Disassembly			1-3		
Credit 5.4	2-4	Reuse Salvaged Materials and Plants			2-4		
Credit 5.5	2-4	Use Recycled Content Material				2-4	
Credit 5.6	1-4	Use Certified Wood			1-4		
Credit 5.7	2-6	Use Regional Materials			2-6		
Credit 5.8	2	Use Products with Reduced VOC Emissions			2		
Credit 5.9	3	Support Sustainable Practice in Plant Production				3	
Credit 5.10	3-6	Support Sustainable Practice in Material Manufacturing			3-6		

Table 5.6 Compatibility Ratings of Edible Landscapes for the 'Site Design – Human Health and Well-Being' Sections of the *Sustainable Sites Initiative*

Site Design - Human Health and Well-Being 12 - 20 Highly Compatible Points							
Prerequisite/ Credit	**Point Value**	**Description**	**Not Compat-ible**	**Poor Compatibility**	**Neutral**	**Compatible**	**Highly Compatible**
Credit 6.1	1-3	Promote Equitable Site Development					1-3
Credit 6.2	1-4	Promote Equitable Site Use					1-4
Credit 6.3	2-4	Promote Sustainability Awareness and Education					2-4
Credit 6.4	2-4	Protect and Maintain Unique Cultural and Historical Places				2-4	
Credit 6.5	3	Provide Optimum Site Accessibility, Safety and Wayfinding			3		
Credit 6.6	4-5	Provide Opportunity for Outdoor Physical Activity					4-5
Credit 6.7	3-4	Provide Opportunity for Outdoor Views and Quiet Spaces			3-4		
Credit 6.8	3	Provide Outdoor Spaces for Social Interaction					3
Credit 6.9	2	Reduce Light Pollution			2		

Table 5.7 Compatibility Ratings for the 'Construction' Section of the *Sustainable Sites Initiative*

Construction - No Highly Compatible Points							
Prerequisite / Credit	**Point Values**	**Description**	**Not Compat-ible**	**Poor Compatibility**	**Neutral**	**Compatible**	**Highly Comp-atible**
Prerequisite 7.1		Control and Contain Construction Pollution			X		
Prerequisite 7.2		Restore Soils Disturbed During Construction			X		
Credit 7.3	2-8	Restore Previously Disturbed Soils			2-8		
Credit 7.4	3-5	Divert Construction and Demolition Materials from Disposal			3-5		
Credit 7.5	3-5	Reuse and Recycle On-Site Materials			3-5		
Credit 7.6	1-3	Minimize Greenhouse Gas Emissions			1-3		

Table 5.8 Compatibility Ratings for the 'Operations and Maintenance' Section of the *Sustainable Sites Initiative*

Prerequisite/ Credit	Point Values	Description	Not Compatible	Poor Compatibility	Neutral	Compatible	Highly Compatible
Operations and Maintenance 2 - 6 Highly Compatible Points							
Prerequisite 8.1		Plan for Sustainable Site Management				X	
Prerequisite 8.2		Provide for Storage and Collection of Recyclables					x
Credit 8.3	2-6	Recycle Organic Matter Generated On-Site					2-6
Credit 8.4	1-4	Reduce Outdoor Energy Consumption			1-4		
Credit 8.5	2-3	Use Renewable Outdoor Energy Sources			2-3		
Credit 8.6	1-2	Minimize Exposure to Tobacco Smoke			1-2		
Credit 8.7	1-4	Minimize Greenhouse Gas Emissions During Construction			1-4		
Credit 8.8	4	Reduce Emissions and Promote Fuel-Efficient Vehicles			4		

Table 5.9 Compatibility Ratings for the 'Monitoring and Innovation' Section of the *Sustainable Sites Initiative*

Monitoring and Innovation - No Highly Compatible Points							
Prerequisite/ Credit	**Point Values**	**Description**	**Not Compatible**	**Poor Compatibility**	**Neutral**	**Compatible**	**Highly Compa-tible**
Credit 9.1	10	Monitor Performance of Sustainability				X	
Credit 9.2	8	Innovation in Site Design				8	

An analysis of the above information reveals the particular strengths and weaknesses of edible landscape compatibility with SITES criteria. In particular, the prerequisites and credits in the 'Site – Human Health and Well-Being' scored high, and those in the 'Site – Soil and Vegetation' scored low, especially in regards to soil disturbance and native plant preservation and use.

The results in the section on 'Site Selection' are mixed. The prerequisites are all neutral; however Credit 1.5, which deals with brownfield and greyfield development, scores high on compatibility for an edible landscape site, if the site can be remediated. The suitability of these sites for edible plants will need to be carefully evaluated for existing pollutants, especially lead and pollutants from highway runoff. If soil needs to be removed, as was the case for the Allen Street Project where the top three feet of soil was removed, the cost of this removal and any available grant money must be carefully analyzed before the site is selected. Edible plantings on reclaimed brownfield sites have greater concern with site pollutants than ornamental plantings, because the plants will be eaten. Credits 1.6 and 1.7 of the 'Site Selection' section, dealing with infill development and the use of non-motorized transport, are found to be highly compatible with edible landscapes, especially as they relate to community gardens. These gardens can be located within walking distance of transit stops or on bike corridors and in inner city neighborhoods. Credits 1.6 and 1.7 would work well with Credit 6.2 'Promote Equitable Site Use.'

The 'Pre-Design and Assessment' section is an important consideration for edible landscapes. The planning phase is the time to discuss maintenance requirements for edible plants with maintenance personnel and end-users. It is also a good time to evaluate strategies for sustainability and point accumulation. Although this credit is highly site specific to community garden planning, Credit 2.3 in this section which deals with community involvement in the pre-design process was found to be highly compatible. Community needs and concerns regarding edible landscapes can be addressed at this time to diffuse potential conflicts before they occur.

Accumulation of points under the ‘Site Design – Water’ section will be dependent on the irrigation source for edible plants. Although edible landscapes are excluded from Prerequisite 3.1, which requires the reduction of potable water use by 50% from baseline, low flow emitters and drip systems combined with rain barrel, cistern, and other water collection systems can eliminate potable water usage for irrigation.

Points earned under Credit 3.2. Credits 3.5 and 3.6 are compatible with edible landscapes. These credits are concerned with the prevention of soil and pollution runoff. Edible landscape sites can deal with these issues with the use of raised beds and permeable paving in pathways. No-till planting and mulch can hold soil in place. These are all common practice in edible gardening. The Sustainable Sites Initiative does not dictate that plants be grown organically, even though use of chemical fertilizers and pesticides must be justified in the Site Maintenance Plan. Specifying organic gardening methods on the Site Maintenance Plan can help in gaining site accreditation and alleviate concerns about toxins on fruits and vegetables in edible gardens.

The ‘Site – Soils and Vegetation’ section of the Sustainable Sites Initiative has the highest instance of incompatible credits, and these are related to soil and vegetation disturbance and the use of native plants. Edible landscapes can be planted using no-till bed cultivation and using native plants in a Permaculture type planting; however, this type of planting would be contrary to typical edible gardening practice. To grow edible plants without soil or vegetation disturbance using native plants would earn credits in this section, however if a site is in its natural state, competition with native plants and shallow soils may reduce yield, making this a questionable practice for most edible gardeners.

Credits from the ’Materials’, ‘Construction’ and ‘Operation and Maintenance’ sections are neutral, except for Credit 8.3 and Credit 8.7, which deal with recycling organic matter generated on-site and minimizing green-house gases from maintenance activities, respectively. These credits are not overly specific to edible landscapes; however, they can be easily

incorporated into edible landscape plans. For example, the site construction plan can specify that beds shall be prepared with low-emission tillers and maintained by hand to help in earning Credits 7.6 and 8.7. Under the 'Materials' section, low VOC paint can be specified to paint trellises and arbors to earn points from Credit 5.8. Another possible strategy for earning points under these sections would be the reuse of concrete removed from impervious hardscapes as paving steps, or the use of stone from the site as edging or accent boulders. Point accumulation under these sections can be used to raise totals and achieve higher levels of certification.

Edible landscapes scored high points in the 'Site – Human Health and Well-Being' portion of the *SITES Guidelines and Benchmarks.* This type of landscape use can be a powerful tool for point accumulation if community gardens are included. Of course, not all edible sites will be community gardens. Edible plantings on commercial or residential sites are beneficial in 'food mile' savings, composting efforts, and economic and health benefits. The act of producing food for oneself, friends and family, or even to donate to food banks, is mentally rewarding. It can create bonds with like-minded gardeners working together in a community garden. These bonds spread into other community initiatives, creating a social cohesion. Benefits for human health and well-being relating to edible landscapes are as much societal as ecological, promoting community sustainability. Points are earned under this section for the promotion of economic and social benefits, outdoor physical activity, and social interaction through the use of awareness and education signage and programs. These credits are all attainable with community gardens, even when they are only a portion of the overall site. For example, Descanso Gardens, which was discussed in Chapter 2, is only a part of a larger system of gardens. The edible garden educates site users at a kiosk in the center of a divided space with lawn on one side contrasted with an edible garden on the other. This small demonstration garden, within the context of a larger system, can be eligible to earn points under Credit 6.2 'Promote Equitable Site Use', Credit 6.3 'Promote Sustainability Awareness and Education',

Credit 6.7 ‘Provide Outdoor Space for Mental Restoration’ and Credit 6.8 ‘Provide Outdoor Space for Social Interaction’, for a total of 9 to 15 points.

Site development using edibles can be compatible with the overall goals of the Sustainable Sites Initiative, as long as the use of natural resources and the abilities and needs of the site users are taken into consideration. Edible plantings have unique needs beyond ornamental landscapes that need to be addressed and weighed against potential benefits in order to make them successful in an ecologically sustainable context.

5.3 Importance of Findings

This research and analysis in this study involving sustainable site selection, water usage, soil hydrology, plant selection, and human health and well-being will be helpful to design professionals who are considering edible landscapes for Sustainable Sites Initiative Projects. In particular, the profession of Landscape Architecture is influenced by this study, especially regarding the profession’s dedication to health, safety and welfare. Landscape architects can find a reasonable argument in the findings of this study for the use of edible landscapes to encourage sustainable site design and the promotion of personal health and community well-being.

One of the tenets of the Sustainable Sites Initiative is to “Design with nature and culture.” Edible landscapes can work in natural systems for the benefit of the site users within site parameters. This study has laid out the possibilities of edible landscapes to combine nature and culture within the criteria of the *Sustainable Site Initiative, 2009*, a guide for landscape architects and other design professionals who are seeking a more sustainable built environment.

This work sheds some light on how edible landscapes may fit into sustainable designs, however, further research needs to be done to determine the full sustainable impact.

5.4 Suggestions for Further Research

Based on the findings of this study, it is suggested that further research be done in the following areas:

1. Comparisons need to be done with conventional agricultural practices to determine actual resource savings or loss in the areas of:
    1. water usage
    2. soil depletion
    3. economies of scale for individual crops in relation to food miles and ecological input, and
    4. pesticide and fertilizer pollution from runoff
2. Edible landscape sites should be studied over a period of time to determine ultimate sustainability as compared to Sustainable Sites Initiative projects which plant non-edible landscapes.
3. Research needs to be done on the environmental footprint of community gardens in the following areas:
    1. water usage
    2. soil hydrology, and
    3. on-site compost generation
4. Yields of edible landscapes using the following comparisons:
    1. No-till and tilled bed preparation
    2. Permaculture and traditional plantings, and
    3. Edible native species and hybrid edible plants
5. Measureable studies should be done on the physical and psychological effects of community gardens in the following areas:
    1. Physical health and weight loss
    2. Social Interaction Matrices
    3. In-depth mental health studies on site and in general
6. Flammability of individual edible plant species to determine fire retardant properties.
7. Initial and long-term cost comparisons should be done for edible landscapes planted under SITES Guidelines as compared to those which are not.

8. Comparison of fundamental ecological services between small-scale urban edible gardens and larger scale farms per unit of production.

APPENDIX A

PREREQUISITES AND CREDITS NOT DIRECTLY RELATED TO EDIBLE LANDSCAPES

Prerequisite 1.1 – Limit Development of Soils Designated as Prime Farmland, Unique Farmland and Farmland of Statewide Importance

Intent – "Protect soils designated by the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) as prime farmland, unique farmland, or farmland of statewide importance to conserve for future generations the most productive farmland in the United States." (*SITES Guidelines and Benchmarks*, p.15)

These three areas, prime farmland, unique farmland and farmland of statewide importance are defined in Section 657.5 of the National Environmental Policy Act (NEPA) as follows:

Prime Farmland – 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, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods. In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding."

Unique Farmland - land other than prime farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods, Examples of such crops are citrus, tree nuts, olives, cranberries, fruit, and vegetables.

Farmland of Statewide Importance - Generally, additional farmlands of statewide importance include those that are nearly prime farmland and that economically produce

high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable. In some States, additional farmlands of statewide importance may include tracts of land that have been designated for agriculture by State law.

Because this is a prerequisite, these designated farmlands are not allowed to be developed in order to receive SITES accreditation. Also, no soils are allowed to be removed from designated farmland sites. At least 95% of land designated as prime, unique or of statewide importance must be protected from development in Vegetation and Soil Protection Zones (VSPZ). (*SITES Guidelines and Benchmarks*, p.15)

Edible landscapes could be in conflict for this prerequisite, depending on whether or not the site falls within designated farmland boundaries. There is some question as to whether the site would be exempted because the site would actually be producing "food, feed, forage, fiber, and oilseed crops." Protected farmland must be located within Vegetation and Soil Protection Zones (VSPZ). See definition and protection methods on p.21 of this document.

Prerequisite 1.2 – Protect Floodplain Functions

> Intent - Protect floodplain functions by limiting new development within the 100-year Floodplain for waterways of all sizes. (*SITES Guidelines and Benchmarks*, p.19)

This prerequisite prohibits the development of sites which would change the grade of soil on both Greenfields (previously undeveloped and ungraded sites) and Greyfields or Brownfields (previously developed or graded sites or sites that have been contaminated.) Edible landscapes would not be eligible for Sustainable Sites Initiative accreditation if they are located within 100-year Floodplain boundaries. FEMA flood maps or Flood Insurance Rate Maps (FIRM) are available to locate these boundaries.

Prerequisite 1.3 – Preserve Wetlands

Intent - Avoid development of areas that contain wetlands, including isolated wetlands. (*SITES Guidelines and Benchmarks*, p.22)

This prerequisite prohibits site development in wetlands. Designated wetlands are to be protected in Vegetation and Soil Protection Zones. Edible landscapes would not be allowed in wetland areas in order to qualify for SITES accreditation.

Prerequisite 1.4 – Preserve Threatened or Endangered Species and Their Habitats

> Intent - Avoid development of areas that contain habitat for plant and animal species identified on federal or state threatened or endangered lists or on the International Union for Conservation of Nature Red List of Threatened Species as critically endangered or endangered. (*SITES Guidelines and Benchmarks*, p.24)

This site selection criterion requires that potential wildlife habitats for threatened species be protected in Vegetation and Soil Protection Zones. Specific information about threatened species' habitats can be found at the following three sources:

1. U.S. Fish and Wildlife Service Species Report. http://ecos.fws.gov/tess_public/StateListing.do?state=all.
2. USDA Natural Resources Conservation Service – Threatened and Endangered Species. http://plants.usda.gov/threat.html. March 30, 2010.
3. The IUCN Red List of Threatened Species. http://www.iucnredlist.org/.

In order to qualify for SITES accreditation, edible landscapes would not be allowed in habitat areas of endangered species.

Credit 3.3 - Protect and Restore Riparian, Wetland, and Shoreline Buffers

> Intent - Preserve and enhance riparian, wetland, and shoreline buffers to improve flood control and water quality, stabilize soils, control erosion, and provide wildlife corridors and habitat. (*SITES Guidelines,* p.57)

This credit seeks to preserve and/or restore "sites with shorelines, wetlands, and streams with

an identifiable channel." These areas are to be protected in a Vegetation and Soil Protection Zone, and restoration must include:

1. Stabilization of stream channel or shoreline, without the use of bulkheads.
2. Re-vegetation with native plant communities.

Point accumulation is based on increased riparian buffer widths. The following chart shows the possible buffer width changes and how they affect point numbers.

Point Value Table for Riparian Buffer Widths							
	Ending Width						
	0-10'	>10 - 25'	>25 - 50'	>50 - 100'	>100 - 200'	>200 - 300'	>300'
Initial Width							
0 - 10'	No Credit	3 Points	5 Points	8 Points	8 Points	8 Points	8 Points
>10 - 25'	No Credit	No Credit	3 Points	5 Points	8 Points	8 Points	8 Points
>25 - 50'	No Credit	No Credit	No Credit	3 Points	5 Points	8 Points	8 Points
>50 - 100'	No Credit	No Credit	No Credit	No Credit	3 Points	5 Points	8 Points
>100 - 200'	No Credit	No Credit	No Credit	No Credit	3 Points	5 Points	8 Points
>200 - 300'	No Credit	No Credit	No Credit	No Credit	No Credit	5 Points	8 Points
>300'	No Credit	No Credit	No Credit	No Credit	No Credit	No Credit	8 Points

(*SITES Guidelines,* p.57)

This credit should not be influenced by edible landscapes, as edible plants should not be planted in riparian buffers.

Credit 3.4 – Rehabilitate Lost Streams, Wetlands, and Shorelines

Intent - Rehabilitate ecosystem functions and values of any streams, wetlands, or shorelines that have been artificially modified, using stable geomorphological and vegetative methods. (*SITES Guidelines,* p.60*)*

This credit pertains to the restoration of streams, wetlands and shorelines that have been artificially modified. It is not relevant to edible landscapes.

Credit 3.7 - Design Rainwater/Stormwater Features to Provide a Landscape Amenity

Intent - Integrate visually and physically accessible rainwater/stormwater features into the site in an aesthetically pleasing way.

Credit 3.7 has the following requirements:

1. Incorporate into the site maintenance plan (see *Prerequisite 8.1: Plan for sustainable site maintenance*) appropriate maintenance activities for the feature(s) without the use of chemicals likely to harm aquatic life, such as chlorine and bromine. Include maintenance activities to ensure that the water feature(s) will not create habitat for mosquitoes.

AND

2. Document that the rainwater falling on the site is treated as an amenity through the way it is received, conveyed and managed on the site, and made accessible to site users.

This credit is primarily concerned with the appearance of rain and stormwater catchment. It is not directly involved or impacted by edible landscape plantings.

Credit 3.8 - Maintain water features to conserve water and other resources

Intent - 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. (*SITES Guidelines*, p.85)

Requirements for this credit include the determination that receiving waters will not suffer from lack of water that has been diverted to water features, and that systems are maintained without the use of chemicals likely to harm aquatic life, such as chlorine and bromine. The credit also requires that the water source for the water feature should have limited potable water source. Points are awarded based on percentage of potable water usage.

This credit is primarily concerned with the design of water features. It is not directly involved or impacted by edible landscape plantings.

Credit 4.5 - Preserve all Vegetation Designated as Special Status

Intent - Identify and preserve all vegetation designated as special status by local, state, or federal entities. (*SITES Guidelines*, p.99)

The *SITES Guidelines and Benchmarks* defines special status as "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." (p. 100) A comprehensive list of special status plants can be found by listing plant name and county of the site on the US Corps of Engineers' *Natural Resources Management Gateway* at: http://corpslakes.usace.army.mil/employees/species/species.cfm.

Special status vegetation is to be protected in Vegetation and Soil Protection Zones (VSPZ). Edible plants should not be planted in these zones in order to apply for this credit.

Credit 4.8 - Preserve Plant Communities Native to the Ecoregion

Credit 4.8 - Intent - Preserve plant communities native to the ecoregion of the site to contribute to regional diversity of flora and provide habitat for native wildlife. (*SITES Guidelines,* p.111)

Sites which qualify for this credit are those on which human disturbance is minimal and exotic and invasive plants make up less than 25 percent of the total area. Credit points are based on the percent of the site which is preserved: Preserved area must be contiguous and a minimum of 2,000 square feet.

1. 2 points: Preserve at least 25 percent of the total area of existing native plant communities on site, and designate the native plant communities as a *vegetation and soil protection zone.*

2. 3 points: Preserve at least 50 percent of the total area of existing native plant communities on site, and designate the native plant communities as a vegetation and soil protection zone.

3. 5 points: Preserve at least 75 percent of the total area of existing native plant communities on site, and designate the native plant communities as a vegetation and soil protection zone.

4. Additional point: Preserve native plant communities to provide habitat corridors connecting to off-site natural areas or buffers adjacent to off-site natural areas for migrating wildlife. This option applies to habitat for species of concern within your region. (*SITES Guidelines,* p.111)

Protected plant communities are required to be located in Vegetation and Soil Protection Zones (VSPZ). Edible plants could be planted on the same site; however, not within these zones, unless they are native and non-invasive. Listing and mapping of native plants can be found at:

1. The USDA Natural Resources Conservation Service website http://plants.usda.gov/.
2. The North American Native Plant Society, *http://www.nanps.org.*
3. The Lady Bird Johnson Wildflower Center's Native Plant Information Network's Native Plant Database *http://www.wildflower.org/plants*/.

Credit 4.9 - Restore Plant Communities Native to the Ecoregion

Credit 4.9 – Intent - Restore appropriate plants and plant communities native to the ecoregion of the site to contribute to regional diversity of flora and provide habitat for native wildlife. (*SITES Guidelines,* p.114)

This Credit deals with disturbed sites which have been stripped of native ecology. The requirements apply to "sites that have been previously developed, graded, or otherwise disturbed by humans such that no native plant communities exist or exotic and invasive plants make up more than 25 percent of the total area of the native plant communities as identified in the site assessment." (*SITES Guidelines,* p.114) Point accumulation is based on the percentage of the site which is restored to native plant communities, based on 10 year plant maturity:

1. 1 point: Restore native plant communities to comprise at least 25 percent of the site vegetated area.
2. 3 points: Restore native plant communities to comprise at least 50 percent of the site vegetated area.
3. 4 points: Restore native plant communities to comprise at least 75 percent of the site vegetated area.
4. Additional point: Restore native plant communities to provide habitat corridors connecting to off-site natural areas or buffers adjacent to off-site natural areas for migrating wildlife. (*SITES Guidelines,* p.114)

Edible plants could be planted on the same site; however, not within restored areas, unless they were native and non-invasive. Listing and mapping of native plants can be found at:

1. The USDA Natural Resources Conservation Service website http://plants.usda.gov/.
2. The North American Native Plant Society, *http://www.nanps.org.*
3. The Lady Bird Johnson Wildflower Center's Native Plant Information Network's Native Plant Database *http://www.wildflower.org/plants*/.

Credit 4.10 - Use Vegetation to Minimize Building Heating Requirements

Intent - Place vegetation in strategic locations around buildings to reduce energy consumption and costs associated with indoor climate control for heating. (*SITES Guidelines,* p.116)

Credit 4.10 deals with the placement of trees and large shrubs to provide windbreaks from prevailing winter winds. The requirements apply only to buildings using mechanical heating systems.

The windbreak shall meet the following requirements:

• Locate the windbreak at least 60 feet and no more than 200 feet from the building wall(s) facing the prevailing winter wind (the windbreak provides ideal wind protection at distances two to five times the mature height of the trees).

• Locate the windbreak such that it does not cast shadows on the building.

• Use spacing guidelines below for trees and shrubs in the windbreak to provide vegetation density that is adequate to protect the building.

Plant Spacing for Credit 4.10

1. Shrubs and Narrow-Crowned Deciduous Trees - 3–6 feet
2. Small Evergreen Trees - 6–12 feet
3. Medium Evergreen Trees - 10–20 feet
4. Large Evergreen Trees - Up to 20 feet
5. Small Deciduous Trees - 8–12 feet
6. Medium Deciduous Trees - 12–20 feet
7. Large Deciduous Trees - Up to 24 feet

(*SITES Guidelines,* p.116)

There are 2 available points for this Credit if one row of vegetation is planted along the full length of the building. There are 4 points for two rows of vegetation, spaced 12-20 feet across, extending at least 50 feet longer than the building face.

According to a Department of Energy publication entitled *Landscaping for Energy Efficiency,* "The density of a tree's leaves or needles is important to consider. Dense evergreens, like spruces, make great windbreaks for winter winds." (p.7)

It is questionable whether or not many edible trees and shrubs would be good plant selections for Credit 4.10. Rather than being dense, most nut and fruit trees are pruned to have open canopies to allow sunlight and air circulation. (University of California, 2000)

Credit 6.9 - Reduce light pollution

> Intent - Reduce light pollution by minimizing light trespass on site for the purpose of reducing sky-glow, increasing nighttime visibility and minimizing negative effects on nocturnal environments and human health and functioning. (*SITES Guidelines*, p.156)

Credit 6.9 seeks to reduce light pollution for different lighting zones (LZ). The zones are:

LZ1 - Dark (park and rural settings)

LZ2—Low (residential areas)

LZ3—Medium (commercial/industrial, high-density residential), and

LZ4—High (major city centers, entertainment districts)

Site lighting is not directly related to edible landscapes, however, edible plantings would not prevent an applicant from earning this credit.

Credit 8.4 – Reduce Outdoor Energy Consumption for All Landscape and Exterior Operations

> Intent – Select energy-efficient outdoor fixtures and equipment to reduce energy consumption and costs associated with site use and operations. (*SITES Guidelines*, p. 201)

The following point accumulations are possible:

1. 1 point: Select outdoor fixtures and equipment (lighting, water feature pumps, etc.) to achieve a 30 percent average annual energy reduction from the estimated baseline energy use for those products. The baseline energy use is that of the lowest-cost comparable item.

2. 3 points: Select outdoor fixtures and equipment (lighting, water feature pumps, etc.) to achieve a 60 percent average annual energy reduction below the estimated baseline energy use for those products. The baseline energy use is that of the lowest-cost comparable item.

3. 4 points: Select outdoor fixtures and equipment (lighting, water feature pumps, etc.) to achieve a 90 percent average annual energy reduction from the estimated. (*SITES Guidelines*. p. 201)

There is no conflict with this prerequisite and edible landscapes.

Credit 8.5 - Use Renewable Sources for Landscape Electricity Needs

Intent - Use electricity from renewable sources to reduce the greenhouse gas emissions associated with site operations and minimize air pollution, habitat destruction, and pollution from fossil fuel-based energy production. (*SITES Guidelines*, p. 203)

Renewable Sources must meet the Center for Resource Solutions (CRS) Green-e products certification requirements. The following point accumulations are possible:

1. 2 points: Use on-site *renewable energy sources* to generate 50 percent of site outdoor electricity OR engage in at least a two-year contract for the purchase of 100 percent of site electricity from renewable sources.
2. 3 points: Use on-site renewable energy sources to generate 100 percent of site outdoor electricity OR engage in at least a four-year contract for the purchase of 100 percent of site electricity from renewable sources. (*SITES Guidelines*, p. 203)

Credit 8.5 is adapted from one credit from the U.S. Green Building Council's *LEED 2009 for Neighborhood Development,* GIB Credit 15: Infrastructure Energy Efficiency which reads:

Intent - Reduce air, water, and land pollution from energy consumption.
Requirements:
Design or purchase any traffic lights, street lights, water and wastewater pumps and treatment systems that are included as part of the **project** to achieve a 15% annual energy reduction beyond an estimated baseline energy use for this infrastructure. If any traffic lights are installed as part of the project, use light emitting diode (LED) technology. (p.131)

AND, the following two credits from the 2009 LEED Manual:

EA Credit 2: On-site Renewable Energy which reads:

Intent - To encourage and recognize increasing levels of on-site renewable energy self-supply to reduce environmental and economic impacts associated with fossil fuel energy use.

Requirements:
Use on-site renewable energy systems to offset building energy costs. Calculate project performance by expressing the energy produced by the renewable systems as a percentage of the building's annual energy cost and use the table below to determine the number of points achieved.

Use the building annual energy cost calculated in EA Credit 1: Optimize Energy Performance or the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database to determine the estimated electricity use. (p.126)

And, EA Credit 6: Green Power, which reads:

Intent - To encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Requirements:
Engage in at least a 2-year renewable energy contract to provide at least 35% of the building's electricity from renewable sources, as defined by the Center for Resource Solutions' Green-e Energy product certification requirements.

All purchases of green power shall be based on the quantity of energy consumed, not the cost.

OPTION 1. Determine Baseline Electricity Use
Use the annual electricity consumption from the results of EA Credit 1: Optimize Energy Performance.
OR
OPTION 2. Estimate Baseline Electricity Use
Use the U.S. Department of Energy's Commercial Buildings Energy Consumption Survey database to determine the estimated electricity use. (p.45)

Credit 8.6 - Minimize Exposure to Environmental Tobacco Smoke

Intent - Minimize exposure of site users to environmental tobacco smoke (i.e. secondhand smoke) to improve human health. (*SITES Guidelines*, p. 204)

The following point accumulations are possible:

- 1 point: Develop and implement a policy to prohibit smoking outdoors at least 25 feet away from building entries, operable windows, air intakes, bus stops, parking for persons with disabilities, patios, overlooks, playgrounds, recreational fields, and other outdoor gathering areas where people could inadvertently come in contact with tobacco smoke when occupying, entering, or leaving the site. A site is not required to extend no-smoking zones beyond the boundaries of the site. Clearly designate outdoor smoking areas that meet the above requirements and provide adequate waste disposal.

- 2 points: Develop and implement a policy to prohibit smoking within the entire site. To implement a tobacco-free policy, post appropriate signs in the specified tobacco-free area. (*SITES Guidelines*, p. 204)

Credit 8.6 is adapted from the U.S. Green Building Council's *LEED for New Construction and Major Renovations* v2.2 IE Q Prerequisite 2: Environmental Tobacco Smoke (ET S) Control.

There is no conflict with this prerequisite and edible landscapes, however, vegetable plants in the Solanaceae family may benefit from the use of this credit, as Tobacco Mosaic Virus is spread by gardeners with tobacco residue on their fingers. (Cerkauskas, p.2)

Credit 8.8 - Reduce Emissions and Promote the Use of Fuel-Efficient Vehicles

Intent - Promote the use of vehicles that have reduced emissions and/or high fuel efficiency to reduce pollution and land development impacts from automobile use. (*SITES Guidelines*, p. 208)

The following points are available for Credit 8.8:

Option 1: Provide on-road vehicles that have reduced emissions and/or high fuel-efficiency for 3 percent of Full-Time Equivalent (FTE) occupants and provide preferred parking for these vehicles.

OR

Option 2: Provide preferred parking for carpools or vanpools for 3 percent of the total vehicle parking capacity OR provide infrastructure and support programs to facilitate shared vehicle usage such as carpool drop-off areas, designated parking for vanpools, or car-share services, ride boards, and shuttle services to mass transit.

AND

Provide preferred parking for vehicles that have reduced emissions and/or high fuel-efficiency for 3 percent of the total vehicle parking capacity of the site. Providing a discounted parking rate is an acceptable substitute for preferred parking for low-emitting/fuel-efficient vehicles. In order to establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20 percent. This approach is acceptable as long as the discounted rate is available to all customers (not limited to the number of customers equal to 3 percent of the vehicle parking capacity), publicly posted at the entrance to the parking area and available for a minimum of two years.

OR

Option 3: Install alternative-fuel refueling stations for 3 percent of the total vehicle parking capacity of the site (liquid or gaseous fueling facilities must be separately ventilated or located outdoors). (*SITES Guidelines*, p. 208)

Credit 8.8 is adapted from the U.S. Green Building Council's *LEED for New*

Construction and Major Renovations v2.2 SS Credit 4.3: Alternative Transportation: Low

Emission & Fuel Efficient Vehicles, which reads as follows:

Intent - To reduce pollution and land development impacts from automobile use.

Requirements:
OPTION 1
Provide preferred parking1 for low-emitting and fuel-efficient vehicles2 for 5% of the total vehicle parking capacity of the site. Providing a discounted parking rate is an acceptable substitute for preferred parking for low-emitting/ fuel-efficient vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e., not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area and available for a minimum of 2 years.
OPTION 2
Install alternative-fuel fueling stations for 3% of the total vehicle parking capacity of the site. Liquid or gaseous fueling facilities must be separately ventilated or located outdoors.
OPTION 3
Provide low-emitting and fuel-efficient vehicles1 for 3% of full-time equivalent (FTE) occupants.
Provide preferred parking2 for these vehicles.
OPTION 4
Provide building occupants access to a low-emitting or fuel-efficient vehicle-sharing program. The following requirements must be met:

1. One low-emitting or fuel-efficient vehicle must be provided per 3% of FTE occupants, assuming that 1 shared vehicle can carry 8 persons (i.e., 1 vehicle per 267 FTE occupants). For buildings with fewer than 267 FTE occupants, at least 1 low emitting or fuel-efficient vehicle must be provided.
2. A vehicle-sharing contract must be provided that has an agreement of at least 2 years. (p.8)
   Credit 8.8 is also adapted from the U.S. Green Building Council's *LEED for New*

Construction and Major Renovations v2.2 SS Credit 4.4: Alternative Transportation: Parking

Capacity, which reads as follows:

Intent - To reduce pollution and land development impacts from automobile use.

Requirements:
CASE 1. Non-Residential Projects:

OPTION 1
Size parking capacity must meet but not exceed minimum local zoning requirements. Provide preferred parking for carpools or vanpools for 5% of the total parking spaces.
OPTION 2
For projects that provide parking for less than 5% of full-time equivalent (FTE) building occupants:

1. Provide preferred parking1 for carpools or vanpools, marked as such, for 5% of total parking spaces.

2. Providing a discounted parking rate is an acceptable substitute for preferred parking for carpool or vanpool vehicles. To establish a meaningful incentive in all potential markets, the parking rate must be discounted at least 20%. The discounted rate must be available to all customers (i.e., not limited to the number of customers equal to 5% of the vehicle parking capacity), publicly posted at the entrance of the parking area, and available for a minimum of 2 years.

OPTION 3

Provide no new parking.

CASE 2. Residential Projects:

OPTION 1

Size parking capacity to meet but not exceed minimum local zoning requirements
Provide infrastructure and support programs to facilitate shared vehicle use such as carpool drop-off areas, designated parking for vanpools, car-share services, ride boards and shuttle services to mass transit.

OPTION 2

Provide no new parking.

CASE 3. Mixed Use (Residential with Commercial/Retail) Projects:

OPTION 1

Mixed-use buildings with less than 10% commercial area must be considered residential and adhere to the residential requirements in Case 2. For mixed-use buildings with more than 10% commercial area, the commercial space must adhere to non-residential requirements in Case 1 and the residential component must adhere to residential requirements in Case 2.

OPTION 2

Provide no new parking. (pp. 10-11)

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Cheryl has an associate's degree in horticulture from Tarrant County College and an undergraduate degree in Interdisciplinary Studies from the University of Texas at Arlington, with concentrations in Studies of the Southwest and Landscape Architecture. This thesis will complete the degree requirements for a masters' degree in Landscape Architecture from the University of Texas at Arlington.