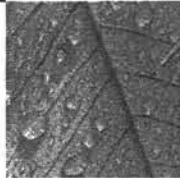


SECTION 4

WATER EFFICIENCY



	PTS	HOW TO VERIFY
4.1 INDOOR/OUTDOOR WATER USE		
4.1.1 Hot water delivery to remote locations aided by installation of: A. On-demand water heater at point of use served by cold water only. (Points per unit installed) B. Control-activated recirculation system.	6	Installer certified
4.1.2 Water heater located within 30 feet of pipe run of all bathrooms and kitchen.	9	Installer certified
4.1.3 ENERGY STAR® water-conserving appliances installed, e.g., dishwasher, washing machine	7 per appl.	Installer certified
4.1.4 Water-efficient showerhead using conventional aerator or venturi technology for flow rate < 2.5 gpm	2 per fixture	Installer certified
4.1.5 Water-efficient sink faucets/aerators < 2.2 gallons/minute	2 per fixture	Installer certified
4.1.6 Ultra low flow (< 1.6 gpm/flush) toilets installed: A. Power-assist B. Dual-flush.	4 6	Installer certified
4.1.7 Low-volume, non-spray irrigation system installed, e.g., drip irrigation, bubblers, drip emitters, soaker hose, stream-rotator spray heads	7	Installer certified
4.1.8 Irrigation system zoned separately for turf and bedding areas	6	Installer certified
4.1.9 Weather-based irrigation controllers, e.g., computer-based weather record	7	Installer certified
4.1.10 Collect and use rainwater as permitted by local code. (Additional credit for distribution system that uses a renewable energy source or gravity)	9	Builder certified
4.1.11 Innovative wastewater technology as permitted by local code, e.g., constructed wetland, sand filter, and aerobic system	7	Submit plan approved by local code or health department official
4.2 INNOVATIVE OPTIONS		
4.2.1 Shut-off valve, motion sensor, or pedal-activated faucet to enable intermittent on/off operation	6	Installer certified
4.2.2 Separate and re-use greywater as permitted by local code	6	Installer certified
4.2.3 Composting or waterless toilet as permitted by local code	6	Installer certified



	PTS	HOW TO VERIFY
5.1 MINIMIZE POTENTIAL SOURCES OF POLLUTANTS		
5.1.1 For vented space heating and water heating equipment: A. Install direct vent equipment or B. Install induced/mechanical draft combustion equipment.	8	Builder spec sheet
5.1.2 Install space heating and water heating equipment in isolated mechanical room or closet with an outdoor source of combustion and ventilation air.	6	Builder spec sheet
5.1.3 Install direct-vent, sealed-combustion gas fireplace, sealed wood fireplace, or sealed woodstove. or Do not install fireplace or woodstove.	6	Builder spec sheet
5.1.4 Ensure a tightly-sealed door between the garage and living area, and provide continuous air barrier between garage and living areas including air sealing penetrations, walls, ceilings, and floors.	9	Builder spec sheet
5.1.5 Ensure particleboard, medium-density fiberboard (MDF) and hardwood plywood substrates are certified to low formaldehyde emission standards ANSI A208.1, ANSI A208.2, and ANSI/HPVA HP1, respectively. Composite wood/agrifiber panel products must either contain no added urea-formaldehyde resins or must be third-party certified for low formaldehyde emissions.	6	Manufacturer's spec sheet Third-party listing
5.1.6 Install carpet, carpet pad, and floor covering adhesives that hold "Green Label" from Carpet and Rug Institute's indoor air quality testing program or meet equivalent thresholds verified by a third party.	6	Manufacturer's spec sheet Third-party listing
5.1.7 Mask HVAC outlets during construction and vacuum ducts, boots, and grilles before turning on central heating/cooling system.	5	
5.1.8 Use low-VOC-emitting wallpaper.	3	Builder's spec sheet
5.2 MANAGE POTENTIAL POLLUTANTS GENERATED IN THE HOME		
5.2.1 Vent kitchen range exhaust to the outside.	7	Builder spec sheet Use guidance in homeowner's manual

	PTS	HOW TO VERIFY
5.2.2 Provide mechanical ventilation at a rate of 7.5 cfm per bedroom + 7.5 cfm and controlled automatically or continuous with manual override. The ventilation equipment may be: A. Exhaust or supply fan(s), or B. Balanced exhaust and supply fans, or C. Heat-recovery ventilator, or D. Energy-recovery ventilator.	7 9 10 10	Builder spec sheet Use guidance in homeowner's manual
5.2.3 Install MERV 9 filters on central air or ventilation systems.	3	Use guidance in homeowner's manual
5.2.4 Install humidistat to control whole-house humidification system.	4	Use guidance in homeowner's manual
5.2.5 Install sub-slab de-pressurization system or infrastructure to facilitate future installation of radon mitigation system. *The more stringent requirement between a local building code and this provision shall apply.	6	Builder spec sheet
5.2.6 Verify all exhaust flows meet design specifications.	9	
5.3 MOISTURE MANAGEMENT (VAPOR, RAINWATER, PLUMBING, HVAC)		
5.3.1 Control bathroom exhaust fan with a timer or humidistat.	6	Builder spec sheet
5.3.2 Install moisture-resistant backerboard—not paper-faced sheathing—under tiled surfaces in wet areas.	6	Builder spec sheet
5.3.3 Install vapor retarder directly under slab (6-mil) or on crawl space floor (8-mil). In crawl spaces, extend poly up wall and affix with glue and furring strips, or damp-proof wall below grade. Joints lapped 12 inches.	9	Builder spec sheet
5.3.4 Protect unused moisture-sensitive materials from water damage through just-in-time delivery, storing unused materials in a dry area, or tenting materials and storing on a raised platform.	6	Builder's moisture management practice or plan
5.3.5 Keep plumbing supply lines out of exterior walls.	5	
5.3.6 Insulate cold water pipes in unconditioned spaces with one-half-inch insulation or other coating that comparably prevents condensation.	4	Builder spec sheet
5.3.7 Insulate HVAC ducts, plenums, and trunks in unconditioned basements and crawl spaces to avoid condensation.	4	Builder spec sheet
5.3.8 Check moisture content of wood before it is enclosed on both sides. Ensure moisture content of subfloor/substrate meets the appropriate industry standard for the finish flooring material to be installed.	4	Builder's moisture management practice or plan

5.4 INNOVATIVE OPTIONS



**6.1 PROVIDE MANUAL TO OWNERS/OCCUPANTS
ON THE USE AND CARE OF THE HOME. MANUAL
MUST INCLUDE ALL ITEMS BELOW:**

- A. Narrative detailing the importance of maintenance and operation to keep a green-built home green
- B. Local green building program certificate
- C. Warranty, operation, and maintenance instructions for equipment and appliances
- D. Household recycling opportunities
- E. Information on how to enroll in a program so that the home receives energy from a renewable energy provider
- F. Explanation of the benefits of using compact fluorescent light bulbs in high-usage areas
- G. A list of habits or actions to optimize water and energy use
- H. Local public transportation options (if applicable)
- I. Clearly labeled diagram showing safety valves and controls for major house systems.

PTS

HOW TO VERIFY

9

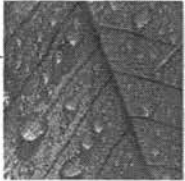
Copy of the home manual

**6.2 OPTIONAL INFORMATION TO INCLUDE IN THE
HOME MANUAL**

(Choose at least five.)

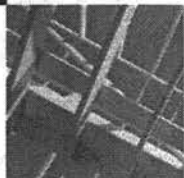
- A. A list of local service providers that focus on regularly scheduled maintenance and proper operation of equipment and the structure (sealants, caulks, gutter and downspout system; shower/tub surrounds, irrigation systems, etc.)
- B. A photo record of framing with utilities installed. Photos should be taken prior to installing insulation, clearly marked, and provided in homeowner's manual.
- C. List of Green Home Building Guidelines items included in the home
- D. User-friendly maintenance checklist
- E. Instructions for proper handling and disposal of hazardous materials
- F. Information on organic pest control, fertilizers, de-icers, and cleaning products
- G. Information about native or low-water landscape

2

	PTS	HOW TO VERIFY
H. Information on how to keep a home's relative humidity in the range of 30%-60% I. Instructions for checking crawl space for termite tubes periodically J. Instructions for keeping gutters clean. Instructions should note that downspouts should divert water at least five feet away from foundation		
6.3 PROVIDE EDUCATION TO OWNERS/OCCUPANTS IN THE USE AND CARE OF THEIR DWELLINGS. A. Instruct homeowners/occupants about the building's goals and strategies and occupant's impacts on costs of operating the building. Provide training to owners/occupants for all control systems in the house.	7	
6.4 SOLID WASTE A. Encourage homeowners/occupants to recycle by providing built-in space in the home's design (e.g., kitchen, garage, covered outdoor space) for recycling containers.	1	
6.5 INNOVATIVE OPTIONS		

**7.1 PRODUCTS**

	PTS	HOW TO VERIFY
7.1.1 Product manufacturer's operations and business practices include environmental management system concepts (the product line, plant, or company must be ISO 14001 certified).	3	ISO 14001 certification
7.1.2 Choose low- or no-VOC indoor paints. VOC concentrations (grams/liter) of interior paints should be equal to or less than those specified by the EPA's Environmentally Preferable Purchasing Program: • Interior latex coatings: Flat: 100 grams/liter Non-flat: 150 grams/liter • Interior oil-based paints: 380 grams/liter	6	Builder spec sheet Manufacturer's spec or third-party listing
7.1.3 Use low-VOC sealants. VOC concentrations for construction adhesives and sealants should meet the limits specified in the California Air Resources Board Regulation for Reducing Volatile Organic Compound Emissions from Consumer Products: • Construction adhesives: the greater of 15% by weight or 200 grams/liter • Sealants and caulks: the greater of 4% by weight or 60 grams/liter • Contact adhesives: the greater of 80% by weight or 650 grams/liter	5	Manufacturer's spec or third-party listing
7.2 INNOVATIVE OPTIONS		
7.2.1 Builder's operations and business practices include environmental management system concepts (the builder must be ISO 14001 certified).	4	ISO 14001 certification



	PTS	HOW TO VERIFY
1.0 IDENTIFY GOALS WITH YOUR TEAM - Establish a knowledgeable team and communicate in writing. - Establish a “green development” mission statement. - Identify goals and objectives. - Identify team member roles and how they relate to various phases of development. - Provide training to onsite supervisors and team members on the green development practices that will be instituted onsite. - Create a checklist to be filled out onsite that contains only those targeted green development practices that will be implemented in this project (<i>see Guideline 4a for execution of this checklist</i>).		Written list of team members Written project mission statement Written project goals Written project team member roles Training materials information Checklist of green development practices that will be implemented
2.0 SELECT THE SITE Select the site to minimize environmental impact. - Avoid environmentally “sensitive areas” as identified through site footprinting process or third party. - Choose an EPA-recognized brownfield (<i>see User Guide for definition</i>). - Choose a greyfield site (<i>see User Guide for definition</i>). - Choose an infill site (<i>see User Guide for definition</i>).		Any one of the following: - Comprehensive plan - Wetland Institute - Local jurisdiction’s guidelines - Site footprinting process results - Set of site plans Confirmation from a federal, state, or local brownfield site inventory list or representative that the site is a brownfield

3.0 DESIGN THE SITE

Minimize environmental impact; protect, enhance, and restore the natural features and environmental quality of the site (points for each guideline are only rewarded upon execution of these plans).

- Conserve natural resources.
- Complete a natural resources inventory that is used to drive and create the site plan.
- Create a protection and maintenance plan for priority natural resources/areas during construction. *(See Section 4 for guidance in forming the plan.)*
- Locate roads, buildings, and other built features to conserve high-priority vegetation.
- Participate in a natural resource conservation program.
- Orient streets and configure lots to allow for the majority of homes to optimize solar potential *(see the Energy Efficiency module for guidance on solar resource optimization)*
- Minimize slope disturbance.
- Limit development footprint on steep slopes (slopes greater than or equal to 25%).
- Complete a hydrological/soil stability study for steep slopes, and use this study to guide the design of all structures onsite.
- Align roads with natural topography to minimize grade to reduce cut and fill.
- Reduce long-term erosion effects through the design and implementation of terracing, retaining walls, landscaping, and restabilization techniques.
- Minimize soil disturbance and erosion.
- Phase development to minimize exposed soils.
- Use alternative means to install utilities, such as tunneling instead of trenching, use of smaller equipment, shared trenches or easements, and placement of utilities under streets instead of yards.
 - Manage storm water properly.
 - Direct storm water to a locally approved regional storm water management and treatment facility that has been designed to address water quality.
 - Preserve and utilize natural water and drainage features.
 - Develop and implement storm water management plans that minimize concentrated flows and seek to mimic natural hydrology.

PTS

HOW TO VERIFY

Pre- and post-development natural resources inventory
Protection and maintenance plan
Certificate or letter indicating participation in a natural resources conservation program

House plans

Hydrological/soil stability study results
Topographical map with contour lines

Sediment and erosion control plans

Storm water management plan

- Minimize impervious surfaces, and utilize permeable materials for
 - Parking areas
 - Walkways
 - Streets—minimize street widths and rights-of-way as per recommendations in either local code or in *Residential Streets, 3rd Edition*:
 - a. No on-street parking: 18 feet
 - b. Parking on one side: 22–24 feet
 - c. Parking on both sides: 24–26 feet
- Use an advanced wastewater system as an alternative to the conventional septic system and drain field, where municipal sewage is not available. Examples include sand/media filters, aerobic treatment units, and community package plants.
- Devise landscape plans to limit water demand while preserving or enhancing the natural environment.
- Formulate a plan to restore or enhance natural vegetation that is cleared during construction or development. Within this plan, phase landscaping to ensure denuded areas are quickly vegetated.
- Select turf grass and other vegetation that are native or regionally appropriate species.
- Limit turf areas of landscaped area, selecting native and regionally appropriate trees and vegetation in a way that complements the natural setting.
- Group plants with similar watering needs (hydrozoning).
- Specify planting of trees to increase site shading and moderate temperatures (*see also Energy Efficiency Guideline 3.3.5.1 specifying siting of trees to reduce the energy consumption of the home*).
- Require onsite tree trimmings of regionally appropriate species to be used as protective mulch during construction or as a base for walking trails.
- Establish an integrated pest management plan to minimize chemical use in pesticides and fertilizers.
- Maintain wildlife habitat.
- Preserve open space as wildlife corridors where possible.
- Institute wildlife habitat measures
- Participate in a wildlife conservation program.
- Prepare operation and maintenance plan (manual) for transfer of common open spaces, utilities (storm water, wastewater), and environmental management.
- Disassemble existing buildings, and reuse or recycle the building materials (deconstruction) instead of demolishing.

PTS

HOW TO VERIFY

System specifications

Landscape plan



Certificate or letter indicating participation in a wildlife conservation plan

Copy of the manual

Catalogue reused or recycled building materials

4.0 DEVELOP THE SITE

Minimize environmental intrusion during onsite construction.

- Provide onsite supervision and coordination during clearing, grading, trenching, paving, and installation of utilities to ensure that targeted green development practices are implemented.
- Conserve existing onsite vegetation.
- Provide basic training in tree and other natural resource protection to onsite supervisor.
- Minimize disturbance of and damage to trees and other vegetation designated for protection through installation of fencing and avoidance of trenching, significant changes in grade, and compaction of soil and critical root zones.
- Prepare designated existing trees and vegetation for the impacts of construction through pruning, root pruning, fertilizing, and watering.
- Improve the soil with organic amendments and mulch.
- Minimize onsite soil disturbance and erosion.
- Demarcate limits of clearing and grading.
- Create construction “no disturbance” zones using fencing or flagging to protect vegetation and sensitive areas from construction vehicles, material storage, and washout.
- Install and maintain sediment and erosion controls.
- Stockpile and cover good soil for later use.
- Reduce soil compaction from construction equipment through laying mulch, chipped wood, or plywood sheets.
- Stabilize disturbed areas within the EPA-recommended 14-day period.

PTS**HOW TO VERIFY**

Protection and maintenance plan

Protection and maintenance plan and/or set of site plans

Sediment and erosion control plans

5.0 INNOVATIVE OPTIONS

Seek to obtain waivers or variances from local development regulations to enhance green building.

- Cluster development to preserve meaningful open space.
- Reduce street widths.
- Share driveways or parking.
- Other (specify).

Set of site plans

Set of site plans

Set of site plans



DISCLAIMER

This publication contains guidance for builders engaged in or interested in green building products and practices for residential design, development, and construction. This publication is not intended to be exhaustive and all-inclusive, and the enclosed guidelines are not to be considered the only method of green building. These guidelines for green building originate from the collective experience of leading personnel in the green building movement (marketplace) but must, due to the nature of the responsibilities involved, be presented only as a guide for the use of a qualified developer, builder, remodeler, or design professional.

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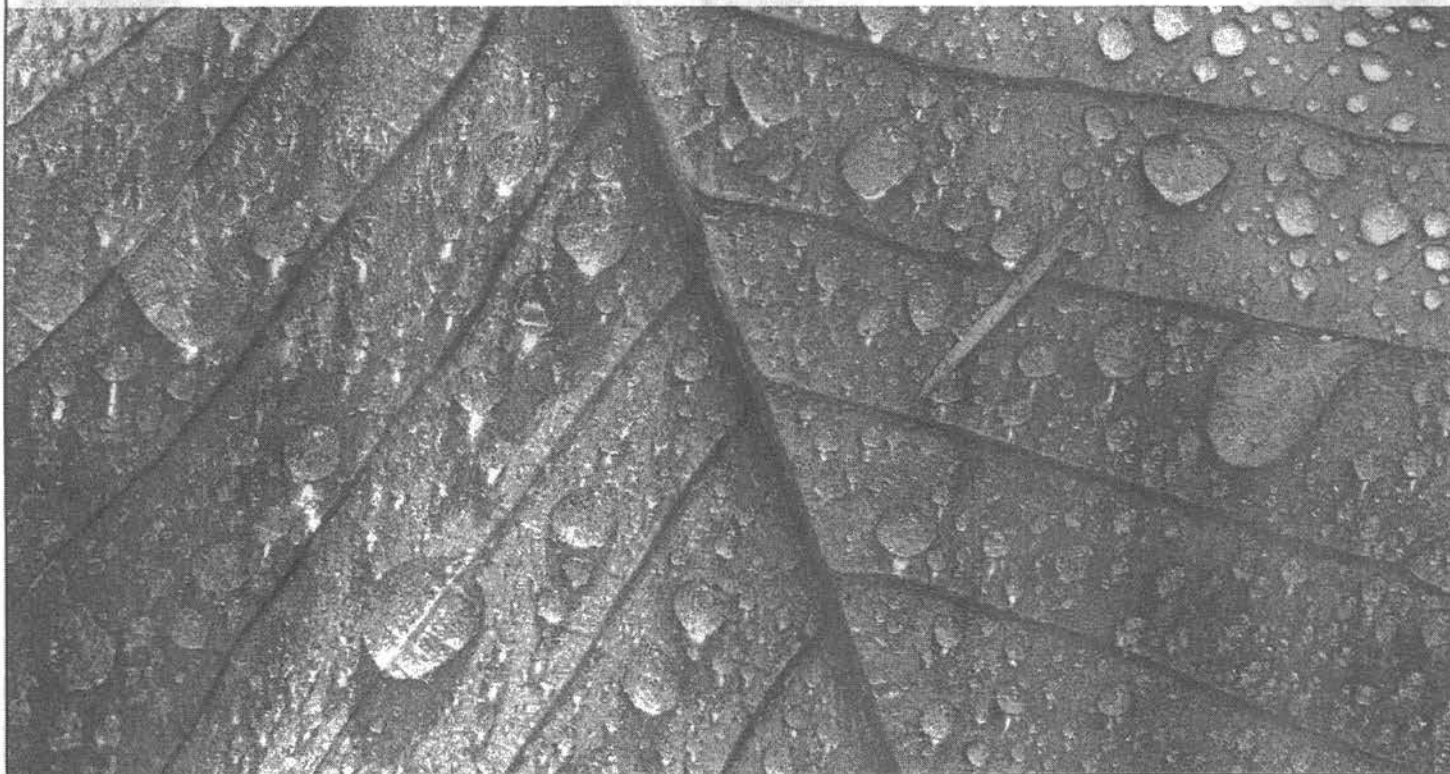
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1.1 SELECT THE SITE

1.1.1 Avoid environmentally “sensitive areas” as identified through site footprinting process or existing third-party data.

Intent:

Thoughtful site selection can be the first step in building a green home. By avoiding environmentally sensitive areas, a builder can help preserve land that might function as a corridor for wildlife, recreational open space, or habitat sanctuary. By selecting a site that has at any time been identified as an environmentally sensitive area, a builder will receive no credit for this line item, regardless of the site’s classification at the time of construction.

Information / How to Implement:

“Sensitive areas” may be identified within a comprehensive plan, by a wetland institute, or by the local jurisdiction. Other excellent sources of detailed environmental information about a site are professionals such as arborists, landscape architects, ecologists, and wildlife biologists. These experts can provide assistance in identifying a potential site’s natural resources and environmentally sensitive areas.

Resources:

- American Society of Consulting Arborists, www.asca-consultants.org/why.html
- American Society of Landscape Architects, www.asla.org/members/pigroups.cfm
- International Society of Arboriculture, www.isa-arbor.com/home.asp
- Society of American Foresters, www.safnet.org/certifiedforester/
- The Ecological Society of America, www.esa.org/

1.1.2 Choose an infill site.

Intent:

Building on an infill site can effectively conserve resources (e.g., infrastructure) and preserve open space that could be lost from “green field” development.

Information / How to Implement:

Infill areas are vacant or underutilized lots of land served by existing physical installations such as roads, power lines, sewer and water, and other infrastructure.

Resources:

- Policy Link, Equitable Development Toolkit, Infill Incentives, www.policylink.org/EDTK/Infill/.
- Northeast-Midwest Institute and Congress for the New Urbanism, *Strategies for Successful Infill Development* (2001), www.nemw.org/infillbook.htm.

1.1.3 Choose a greyfield site.

Intent:

Redevelopment of a greyfield site can provide an efficient use of land and infrastructure. Greyfield redevelopment allows for the preservation of open space and wildlife habitat in the midst of growth.

Information / How to Implement:

Within these guidelines, a greyfield is defined as “any site previously developed with at least 50% of the surface area covered with impervious material.” The development of a greyfield site can be daunting, but local or national incentives may exist to reward those builders who go through the process. Incentives may include the elimination of development-related fees, contribution from the local government in the development of offsite improvements, and tax breaks. For more information, contact the Congress for the New Urbanism, Urban Land Institute, American Planning Association, or the International Council of Shopping Centers.

Resources:

- Congress for the New Urbanism, www.cnu.org
- Urban Land Institute, www.uli.org
- American Planning Association, www.planning.org
- International Council of Shopping Centers, www.icsc.org
- Congress for the New Urbanism and PricewaterhouseCoopers, *Greyfields into Goldfields: From Falling Shopping Centers to Great Neighborhoods* (February 2001), www.cnu.org/cnu_reports/Executive_summary.pdf
- Congress for the New Urbanism and PricewaterhouseCoopers, *Greyfield Regional Mall Study* (January 2001), www.cnu.org/cnu_reports/Greyfield_Feb_01.pdf

1.1.4 Choose an EPA-recognized brownfield.**Intent:**

Remediation of a brownfield results in the environmental restoration of a polluted site, a transformation that makes an abandoned site habitable. Like greyfield and infill development, brownfield development provides an efficient use of land and infrastructure while allowing for the preservation of open space and wildlife habitat in the midst of growth.

Information / How to Implement:

The U.S. Environmental Protection Agency (EPA) characterizes brownfields as “real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.” The EPA estimates that there are 450,000 such sites around the country. Grants, loans, and training are available through the EPA’s Brownfield Initiative to assist builders and developers in the remediation and development of brownfield sites.

Resources:

- U.S. Environmental Protection Agency, Brownfields Cleanup and Redevelopment: www.epa.gov/Brownfields/index.html
- The EPA has introduced two Web-based tools to give the public additional access to information about brownfield properties and cleanup efforts. The tools allow residents to locate brownfields in their area and provide access to information about cleanup grants. Go to www.epa.gov/Brownfields/bfwhere.htm

1.2 IDENTIFY GOALS WITH YOUR TEAM**1.2.1 Establish a knowledgeable team.**

- A. Identify team member roles and how they relate to various phases of green lot design, prep, and development.
- B. Create a mission statement that includes the project’s goals and objectives.

Intent:

One of the earliest challenges for a builder in developing a green lot is assembling an effective team to help the builder implement best green practices throughout the process. Those involved in the development phase must understand what the mission of the site is, what it means to be a green lot, and why green practices should be followed. Once this baseline is established, coordination and communication with and among the various team members is essential to successful development.

Information / How to Implement:

Before ground is broken, all parties that will be involved in lot development (i.e., the team) should understand that the lot will be developed as a green site. Team members may include staff, site superintendents, utilities, excavators, landscape architects, wildlife biologists, ecologists, and arborists. Once the green intent of the builder is communicated to the lot development team, the builder should work with the team throughout the development process to identify and delegate responsibilities of team members, as well as facilitate coordination between the members to achieve best green practices.

Resources:

- American Society of Consulting Arborists, www.asca-consultants.org/why.html
- American Society of Landscape Architects, www.asla.org/members/pigroups.cfm
- International Society of Arboriculture, www.isa-arbor.com/home.asp
- Society of American Foresters, www.safnet.org/certifiedforester/
- The Ecological Society of America, www.esa.org/

1.3 DESIGN THE SITE

Minimize environmental impacts; protect, restore, and enhance the natural features and environmental quality of the site.

1.3.1 Conserve natural resources.

- Complete a natural resources inventory used to drive/create the site plan.
- Create a protection and maintenance plan for priority natural resources/areas during construction. *(See Section 1.4 for guidance in forming the plan.)*
- Participate in a natural resources conservation program, e.g., Building with Trees.
- Provide basic training in tree and other natural resource protection to onsite supervisor.

Intent:

Onsite natural resources concern such features as solar energy availability, flora, fauna, water, soil, and geological formations. A natural resources inventory should be completed to identify the site's environmental attributes. A builder can then identify high-priority resources for conservation (e.g., trees, waterway, snags, and micro-habitats) and plan for the conservation of those resources during each stage of site development.

Information / How to Implement:

On complex sites, a natural resources inventory may be performed by a qualified professional such as an arborist, wildlife biologist, or landscape architect. Simpler sites, such as previously developed sites or farmland, might be adequately inventoried by knowledgeable, but less qualified, individuals. Whoever ultimately conducts the inventory should be able to discern between invasive and regionally appropriate vegetation, understand how to site a house to achieve maximum solar energy potential, be able to identify areas important to wildlife habitat, and understand how natural features can be used in managing storm water onsite.

A protection and maintenance plan should be drafted to detail how resources identified through the inventory will be protected throughout development. Section 4 of this module describes how to protect existing onsite vegetation and minimize soil disturbance and erosion through such means as installation of fencing, identification of specified washout and material storage areas, laying of mulch to reduce soil compaction, etc. In addition to protecting priority areas from intrusion during development, a maintenance plan should be created to ensure that priority vegetation survives development. Within the maintenance plan, include plans and information on fertilizing and watering trees as needed before, during, and after development.

One way to verify that the plan is implemented as planned is to create construction documents that explain how to implement the plan at each phase.

Resources:

- American Society of Consulting Arborists, www.asca-consultants.org/why.html
- American Society of Landscape Architects, www.asla.org/members/pigroups.cfm
- International Society of Arboriculture, www.isa-arbor.com/home.asp
- Society of American Foresters, www.safnet.org/certifiedforester/
- Article on preserving trees during construction:
www.umass.edu/bmatwt/publications/articles/preserving_trees_during_construction.html



1.3.2 Site the home and other built features to optimize solar resources (refer to Energy Efficiency module for guidance on solar resource optimization). (Note—do not include these points if you get points from 3.3.5.1.a or 3.3.5.1.b in the Energy Efficiency section.)

Intent:

Thoughtful orientation of a home can maximize solar heating potential in the heating season and minimize solar gains in the cooling season. Orienting a home to optimize its solar resource reduces energy use and, therefore, reduces the pollution caused by a home during its life.

Information / How to Implement:

A builder should consider such issues such as slope, storm water management, local solar angles, and high-priority vegetation when determining the optimum site for each home. The final decision in siting generally involves a compromise among these many factors.

Resources:

- See Sections 3.3.5.1.a or 3.3.5.1.b of this User Guide for resources.

1.3.3 Minimize slope disturbance.

- Limit development footprint on steep slopes (slopes greater than or equal to 25%).
- Complete a hydrological/soil stability study for steep slopes, and use this study to guide the design of all structures onsite.
- Align road or extended driveway with natural topography to minimize its grade and reduce cut and fill.
- Reduce long-term erosion effects through the design and implementation of terracing, retaining walls, and restabilization techniques.

Intent:

Leaving a slope undisturbed reduces the risk of disturbing natural hydrological drainage and causing long- and short-term erosion on the site, which can pollute water sources and damage local ecology.

Information / How to Implement:

Within these guidelines, steep slopes are defined as those slopes that are greater than or equal to 25%. Note: Points should be awarded only if there are developable steep slopes in the area.

Reduce cut-and-fill practices to help prevent unnecessary stripping of vegetation and loss of soils and reduce the need for additional resources to be brought in from offsite.

Resources:

- Prince George's County, Maryland, Department of Environmental Resources, Low-Impact Development Design Strategies: An Integrated Design Approach (EPA 841-B-00-003) (Largo, MD: June 1999), www.epa.gov/owow/nps/lid/lidnatl.pdf

1.3.4 Minimize soil disturbance and erosion. See Section 1.4 for further guidance.

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- A. Schedule construction activities to minimize time that soil is exposed.
 - B. Use alternative means to install utilities, such as tunneling instead of trenching, use of smaller equipment, shared trenches or easements, and placement of utilities under streets instead of yards.
 - C. Demarcate limits of clearing and grading.

Intent:

Sediment and the pollutants contained in it are recognized sources of water quality problems. Exposed soils should be minimized to reduce erosion, promote water quality, and reduce damage caused to native vegetation. Heavy equipment and excessive digging can result in compaction or loss of topsoil along with the introduction of invasive and problematic flora. Minimizing soil disturbance and erosion both reduces stressors on downstream water bodies and saves valuable topsoil for the site.

Information / How to Implement:

NAHB's *Storm Water Permitting: A Guide for Builders and Developers* contains information about the federal Phase I and II storm water permitting program and the equivalent requirements for state storm water permits (see Resources section). *Storm Water Permitting* also contains technical information, including recommendations for use and cost estimates, on over 50 of the most commonly used Best Management Practices; sample Storm Water Pollution Prevention Plans; and tips on compliance, including how to handle visits from inspectors.

Methods for preventing erosion include silt fences, sediment traps, vegetated buffer areas, and mulching. More permanent solutions include biomechanical devices such as swales and vegetated buffers. Another highly effective, environmentally responsible method for preventing erosion is to use compost filter berms, compost erosion socks, and/or surface application of compost erosion control. The compost should be from organic sources like bioshields, yard waste, and wood chips. Turf and plant material—which help to facilitate the re-establishment of a natural environment—are established more quickly when organic compost is used.

Resources:

- National Association of Home Builders (NAHB), *Storm Water Permitting: A Guide for Builders and Developers*, 2005, store.builderbooks.com or 800-368-5242 x8163
- King County Department of Natural Resources, King County, Washington Surface Water Design Manual Appendix D: Erosion and Sediment Control Standards (Seattle: September 1998), [ftp://ftp.metrokc.gov/ddes/acrobat/esa/kcswdm-d.pdf](http://ftp.metrokc.gov/ddes/acrobat/esa/kcswdm-d.pdf)
- Dr. James R. Fazio, National Arbor Day Foundation, *Trenching and Tunneling: A Pocket Guide for Qualified Utility Workers* (Nebraska City, Nebraska: 1998), www.arborday.org/shopping/merchandise/merchdetail.cfm?id=62

1.3.5 Manage storm water using low-impact development when possible.

- A. Preserve and utilize natural water and drainage features.
- B. Develop and implement storm water management plans that minimize concentrated flows and seek to mimic natural hydrology.
- C. Minimize impervious surfaces and use permeable materials for driveways, parking areas, walkways, and patios.

Intent:

Percolation through soil is one of the most effective means for filtering pollutants carried by storm water. By using natural water and drainage features, minimizing impervious surfaces, and distributing storm water flows, builders can reduce harmful pollutants carried off-site while safely and effectively managing much of their storm water load onsite.

Information / How to Implement:

Use open space and natural systems such as vegetative swales, french drains, wetlands, dry wells, and rain gardens that promote water quality and infiltration.

Resources:

- The Practice of Low Impact Development, U.S. Department of Housing and Urban Development (HUD); www.huduser.org/publications/destech/lowimpactdevl.html
- Tom Schueler, Center for Watershed Protection, Site Planning for Urban Stream Protection, Ellicott City, MD, 1995, www.cwp.org/SPSP/TOC.htm
- Lisa Austin, Washington State Department of Ecology Water Quality Program, Stormwater Management Manual for Western Washington (Publication 99-12), September 2001, www.ecy.wa.gov/pubs/9912.pdf
- Betty Rushton, Southwest Florida Water Management District, *Low Impact Parking Lot Design Reduces Runoff and Pollutant Loads: Annual Report # 1*, Brooksville, Florida, 1999

1.3.6 Devise landscape plans to limit water and energy demand while preserving or enhancing the natural environment.

- A. Formulate a plan to restore or enhance natural vegetation that is cleared during development. Within this plan, phase landscaping to ensure denuded areas are quickly vegetated.
- B. Select turf grass and other vegetation that are native or regionally appropriate species.
- C. Limit turf areas of landscaped area, selecting native and regionally appropriate trees and vegetation in a way that complements the natural setting.
- D. Group plants with similar watering needs (hydrozoning).
- E. Specify planting of trees to increase site shading and moderate temperatures (see also Energy Efficiency Guideline 3.4.1.c specifying siting of trees to reduce the energy consumption of the home).
- F. Design vegetative windbreaks or channels as appropriate to local conditions.
- G. Require onsite tree trimmings or waste of regionally appropriate trees to be used as protective mulch during construction or as a base for walking trails.
- H. Establish an integrated pest management plan to minimize chemical use in pesticides and fertilizers.

Intent:

Landscaping water use accounts for approximately 50% of a home's total water needs. Conservation of this valuable resource through such techniques as hydrozoning, reducing turf area, and selecting regionally appropriate plants is a key component to responsible building. Thoughtful selection and placement of plants can also reduce heating/cooling loads of a home, provide habitat for native fauna, and minimize the heat-island effect of developments.

Information / How to Implement:

Select landscaping materials and vegetation to fit site conditions. Regionally appropriate plants are hardy plants that can withstand local water and temperature conditions such as freeze, heat, drought, and rain. Regionally appropriate plants will also not be overly prolific or invasive, and will be able to coexist with other native plants over time.

Other benefits of landscaping with native plants: minimizes maintenance (reduces emissions of equipment), fosters wildlife habitat. See EPA's Mid-Atlantic Region Green Landscaping www.epa.gov/reg3esd1/garden/what.htm for more information.

When planning for the revegetation of a site, consider the multiple services that natural areas can provide: natural habitat, storm water processing, shading, windbreak, etc. Trees that shade the streets can keep a neighborhood cool while also increasing the neighborhood's attractiveness. Properly selected plants can be grouped to serve as a bioretention zone. Deciduous trees allow the sun's rays through in winter and provide shade in the summer. Evergreens can provide an effective windbreak. Careful selection and integration of trees and vegetation can reduce a developer's initial costs while providing value to a development or neighborhood later. When planting trees, several factors should be taken into account such as the value of shading (trees shading asphalt will mitigate a site's temperature more than trees shading landscaped areas), maintaining a safe distance from the house (especially in areas prone to natural disasters), ultimate tree size, etc.

Developers may wish to consider enforcing guidelines for the protection of onsite vegetation. Some developers even fine builders for damage to areas designated for protection.

If grinding and scattering cleared plants, care should be taken to grind only regionally appropriate plants. Grinding of invasive species can increase their propagation and result in the ultimate destruction of native species.

One of the best ways to reduce energy consumption is through passive solar design of a home—using orientation, overhangs, fenestration, etc. Landscaping to reduce energy consumption is only part of the whole effort.

It is good practice to limit ratio of turf area to total landscaped area due to maintenance requirements of turf versus native plants and regionally appropriate trees and vegetation. In some areas, there may be restrictions on the percentage of turf that the front yard must contain. Research has shown that homeowners are comfortable with having as little as 50% of the front yard composed of turf. Fewer regulations are imposed on turf-to-landscaping ratio in the backyard, so good gains might be made more easily there. For research on turf and landscape of front yard with native species, see *Nassauer, Joan. 1995. Messy Ecosystems, Orderly Frames. Landscape Journal, 14 (2), 161-170.*

In areas with low annual rainfall, one way to account for water usage is through the development and implementation of a water budget. Below is Built Green Colorado's water budgeting information.

Water Budgeting

Description

Calculate the water needs of irrigated landscapes based on plant types, land area, and irrigation system efficiency. Use the calculated water budget to apply water according to the needs of the plants and manage irrigation. Overall property water budgets can be developed to include both indoor and outdoor water requirements.

Basic Practice Guidelines

- A. The landscape design process should incorporate a general outdoor annual water budget as a guideline for irrigation design and long-term landscape management. The water budget should be developed by the landscape architect or designer as part of the plant selection and grouping process (turf, trees, shrubs, ground covers, etc.).
- B. The irrigation maintenance process should be based on calculation of a monthly and annual water budget for exist-

ing sites.

- C. Calculate the site landscape water budget by summing the water requirements calculated for each hydrozone of the landscape using either of these general formulas:

Approach #1, when Reference ET is known:

$$\text{Water Budget} = \frac{(ET_o)(K_c)(LA)(0.623)}{E}$$

Where:

Water Budget = Water Needed for Plants (gallons per year)

ET_o = Reference evapotranspiration (inches per year) for bluegrass in your area

K_c = Crop coefficient for plant type (See Appendix E for more information.)

LA = Landscaped Area (square feet)

0.623 = Conversion Factor (to gallons per square foot)

E = Irrigation Efficiency (varies based on irrigation system)

Approach #2, when Reference ET is not known:

$$\text{Water Budget} = \text{Land Area (sq. ft.)} \times \text{Estimated Plant Water Use (gallons/sq. ft.)}$$

Where:

Estimated Plant Water Use = Estimated water use in gallons/sq. ft. for the metro-Denver Front Range area. For other areas, water use estimates may need to be increased or decreased based on climate and location characteristics. Water use estimates may also be reduced when more efficient irrigation systems such as drip irrigation are used.

- D. The water budget provides the annual irrigation that the site needs in order to thrive in addition to natural precipitation. The annual water budget assumes a normal year of natural precipitation (14 inches of annual precipitation for the Front Range area). In either wetter or drier years, the water budget will need to be adjusted.
- E. The rate at which plants lose water to the surrounding air is called evapotranspiration (ET). Temperature, humidity, wind, and light all influence the ET rate. When watering, it is only necessary to replace the amount of water that has been lost due to ET.
- F. In order for water budgets to be accurate, it is necessary to provide accurate information on factors such as crop coefficients. See the GreenCO Web site www.greenco.org and Appendix E for recommended crop coefficients to be used in calculating water budgets.
- G. It should be noted that the ET_o (reference ET) in the water budget equation does not reflect that Kentucky bluegrass can be attractive and viable at much lower ET rates and can be very drought tolerant. For properly established turf, the actual irrigation water needs of turf can vary, depending on desired appearance.
- H. The water budget does not apply to the initial establishment period for plantings, which can vary from two to four weeks for annuals to several growing seasons, depending on plant type and the timing of planting. One year is typical for many perennials and shrubs to become established.
- I. Water features, outdoor pool(s), and/or any other outdoor water uses should be included in the water budget.
- J. If a property manager/landscaper knows the water budget for each month, he/she can compare actual use to the site water budget and adjust irrigation practices accordingly. Excessive water use may also be attributed to irrigation system deficiencies, which should be corrected.

- K. Evapotranspiration (ET) or “smart” irrigation controllers can facilitate landscape irrigation according to the needs of the plants (and therefore the water budget).
1. Low-water-use plants don’t automatically save water (they are easily, and frequently, over-watered). Using a “smart” controller can ensure the proper irrigation is applied to low-water-use plants.
 2. High-water-use plants (such as turf) don’t automatically waste water. They are also often over-watered. Using a “smart” controller can ensure the proper irrigation is applied to high-water-use plants.
- L. Often the retrofitting of poor irrigation systems and the use of “smart” controllers will provide a payback in saved water. To calculate the payback time, use the water budget to measure how much water is actually needed, versus how much has historically been used, along with local water rates and irrigation system cost.
- M. GreenCO provides a simple water budget calculator on its Web site www.greenco.org. Green industry professionals can use this calculator with customers to demonstrate that water budgeting is a manageable approach to understanding water needs for a given property and adjusting watering practices accordingly.

Regional or Industry Considerations/Adaptations

- A. Water budgets can be used by water utilities to determine how much water is needed versus how much the utility sells or has.
- B. Water budgets can be used by water utilities to determine how much water they need versus how much they sell or have. The difference is how much water could be saved, or how much more water needs to be purchased.
- C. Water budgeting approaches adopted by utilities typically include ET-based irrigation scheduling combined with tiered pricing for increasing water usage. Tiered pricing, by gradually increasing the price of water as consumption rises, provides incentive to conserve. At the time of this manual’s publication, this approach had been adopted in other water-limited states such as California and Arizona. See Centennial Water and Sanitation District in Highlands Ranch, Colorado, for information on their program <http://www.highlandsranch.org/6/6-1a.html>.
- D. Colorado’s Water Efficient Landscape Design Model Ordinance (see www.dola.state.co.us/smartgrowth/) is based on water budgeting with a goal of 15 gallons/square foot/year of water required for a landscaped area.
- E. Check the GreenCO Web site (www.greenco.org) for more information on water budgeting techniques.

Key References

- Ash, T. 1998. *Landscape Management for Water Savings: How to Profit from a Water-Efficient Future*. Orange County, CA: Municipal Water District of Orange County.
- California Department of Water Resources. 1993. Model Water Efficient Landscape Ordinance. www.owue.water.ca.gov/landscape/ord/ord.cfm.
- Centennial Water and Sanitation District. 2004. Water Conservation Program. www.highlandsranch.org/06_wsan/06_3watercons.html. Highlands Ranch, CO: Centennial Water and Sanitation District.
- Colorado Department of Local Affairs. 2004. Water Efficient Landscape Design Model Ordinance. www.dola.state.co.us/smartgrowth/. Denver, CO: Colorado Department of Local Affairs, Office of Smart Growth.
- Colorado State University Cooperative Extension Drought Task Force. 2004. www.drought.colostate.edu/.
- Design Studios West, Inc.; J.M. Knopf; HydroSystems KDI, Inc.; The Restoration Group, Inc.; and G. A. White. 2004. *WaterWise Landscaping Best Practice Manual: A Companion Guide to Water Efficient Landscape Design*. www.dola.state.co.us/smartgrowth/. Denver, CO: Colorado Department of Local Affairs, Office of Smart Growth.
- GreenCO. 2004. Water Budget Calculator at www.greenco.org.

- McStain Neighborhoods. 2003. *Water Conservation Standards for Common Areas and Open Space Landscapes*. Boulder, CO: McStain Neighborhoods.
- Mecham, B. 2004. Scheduling Methods Using ET as a Management Tool. www.ncwcd.org/ims/ims_info/scheduli.pdf. Loveland, CO: Northern Colorado Water Conservancy District.
- Northern Colorado Water Conservancy District. 2004. Turfgrass Irrigation Management Program. www.ncwcd.org/ims/scheduler.asp. Loveland, CO: Northern Colorado Water Conservancy District.
- Slack, E. 2001. Case History: Irrigation on a Water Budget, *Irrigation Business and Technology*, March/April. (www.irrigation.org).

Resources:

- Center for Plant Conservation, www.mobot.org/CPC/
- Lady Bird Johnson Wildflower Center, Native Plant Information Network National Suppliers Directory. www.wildflower2.org/NPIN/Suppliers/suppliers.html
- New England Wildflower Society, Native Plant Societies of the United States and Canada, www.newfs.org/nps.htm
- NAHB Research Center Inc., *Onsite Grinding of Residential Construction Debris: The Indiana Grinder Pilot*, February 1999

1.3.7 Maintain wildlife habitat.

Intent:

As the frontier of home building continues to expand, sharing the land with wildlife becomes an increasing challenge to builders. Through individual initiative or participation in a wildlife conservation program, home builders can work to create a habitat where both wildlife and humans can thrive—whether in an urban, suburban, or rural setting.

Information / How to Implement:

(Extra points) Participate in a wildlife conservation program.

Examples of programs: USDA National Resources Conservation Service's Backyard Conservation Plan, the Audubon Cooperative Sanctuary System's Treasuring Home Initiative, or the National Wildlife Federation's Backyard Wildlife Habitat Program.

Enhance quality of habitat, including food sources, diversity of habitat, and protective areas, through selective plantings and site design.

Leave snags (dead tree or portion that's left for habitat). Provide birdhouses.

Resources:

- Audubon International, Audubon Cooperative Sanctuary System. www.audubonintl.org/programs/acss/. Audubon Cooperative Sanctuary System's Treasuring Home Initiative.
- Become a certified participant in the National Wildlife Federation's Backyard Wildlife Habitat Program.

1.4 DEVELOP THE SITE

Minimize environmental intrusion during onsite construction.

1.4.1 Provide onsite supervision and coordination during clearing, grading, trenching, paving, and installation of utilities to ensure that targeted green development practices are implemented (see 1.3.4).

Intent:

The noblest intentions when designing a site are practically achieved through onsite supervision during the lot development phase. A qualified member(s) of the builder's team should be onsite as these activities progress to ensure that each objective is achieved according to targeted green lot specifications.

Information / How to Implement:

See documents line item 1.3.4.

Resources:

Information will be added in Version 2.

1.4.2 Conserve existing onsite vegetation.

- A. Minimize disturbance of and damage to trees and other vegetation designated for protection through installation of fencing and avoidance of trenching, significant changes in grade, and compaction of soil and critical root zones.
- B. Prepare designated existing trees and vegetation for the impact of construction by pruning, root pruning, fertilizing, and watering.

Intent:

After a builder has identified (during the planning stage) the existing vegetation that will be conserved onsite, practical steps must be taken during the development stage to achieve the intended conservation. Such steps include pre-development preparation of the vegetation and protection of the foliage, soil, and root system of designated vegetation.

Resources:

- National Arbor Foundation, Building With Trees. www.arborday.org/programs/Buildingwithtrees/index.cfm
- Phillip A. Pratt and Michael W. Schnelle, Oklahoma State University, Oklahoma Cooperative Extension Service, Site Disturbance and Tree Decline (OSU Extension Facts F-6429), September 2003.
<http://osuextra.com/pdfs/F-6429web.pdf>

1.4.3 Minimize onsite soil disturbance and erosion.

- A. Demarcate limits of clearing and grading.
- B. Create construction "no disturbance" zones using fencing or flagging to protect vegetation and sensitive areas from construction vehicles, material storage, and washout.
- C. Install and maintain sediment and erosion controls.
- D. Stockpile and cover good soil for later use.
- E. Reduce soil compaction from construction equipment by laying mulch, chipped wood, or plywood sheets.
- F. Stabilize disturbed areas within the 14-day period recommended by the EPA.

G. Improve the soil with organic amendments and mulch.

Intent:

This guideline seeks to ensure the field implementation of conservation plans. Each measure identifies a practical way to foster water quality and conserve onsite ecological habitat by reducing soil disturbance and erosion.

Information / How to Implement:

Soil stabilization may be temporary or permanent.

Keep in mind that, while the use of stockpiled onsite soil is a preferred method, excavation, stockpiling, grinding, and screening destroy the ecological microsystem of the soil. Rejuvenation of the unimproved soil to its original form will take several years. To offset this phenomenon, the incorporation of compost and sand is an effective method for more rapidly rebuilding the structure and ecosystem of the topsoil and allowing turf and plants to establish more quickly. As indicated above, compost is recommended for this purpose.

When additional soil must be brought in, there are environmental advantages of using industrial by-products as ingredients in topsoil including foundry sand, biosolids compost, and other EPA-approved by-products. In addition to keeping these materials out of community landfills, processing techniques produce superior topsoil.

The use of organic mulch is an excellent way to conserve water in landscape beds and to build soil quality. Ideally, use mulch that results from onsite recycling efforts such as yard waste, processed pallets, and other clean wood from construction waste.

Resources:

- King County Department of Natural Resources, King County, *Washington Surface Water Design Manual Appendix D: Erosion and Sediment Control Standards* (Seattle: September 1998), <ftp://ftp.metrokc.gov/ddes/acrobat/esa/kcswdm-d.pdf>

1.5 INNOVATIVE OPTIONS

Seek to obtain waivers or variances from local development regulations to enhance green building.

1.5.1 Share driveways or parking.

Intent:

Sharing driveways or parking can reduce the amount of impervious material on a lot, thereby decreasing storm water and pollution runoff.

Information / How to Implement:

Information will be added in Version 2.

Resources:

Information will be added in Version 2.

1.5.2 Other (specify).

Information will be added in Version 2.

(A note regarding defining “low maintenance” materials: For certain types of building products, the buyer should be on the lookout for materials that have below-average maintenance needs compared with other products in that same material category (e.g., composite decking or treated lumber). Although existing green builder programs provide good information for builders to emphasize the long-term advantages and savings of more durable, lower-maintenance products, there is no standardized method to assess the durability of residential construction materials or systems or to define “low maintenance.” A possible approach that green home building program administrators can use at this time is to give credit for extended warranties on materials and workmanship. The person choosing the building product should consider using manufacturer claims, warranty duration, third-party certifications, and sources such as GreenSpec Directory, and Life-Cycle Assessment (LCA) tools that are under development as proxies to identify “low maintenance” or “durable” materials during the purchasing process.)