



Environmentally  
Responsible

# Landscape Services

**Best Management  
Practices Guide  
for Landscape Businesses**





# Environmentally Responsible Landscape Services

## A Best Management Practices Guide for Landscape Businesses

This manual was prepared by the Pollution Prevention Outreach Team, a multi-agency cooperative group working toward a cleaner environment.

The following program partners helped develop and review this document.

- American Society of Landscape Architects (ASLA)
- Association of Professionals in Landscape Design (APLD)
- City of Gresham
- City of Portland
  - Bureau of Environmental Services
  - Bureau of Parks and Recreation
  - Bureau of Planning and Sustainability
  - Bureau of Water Works
- Clackamas County
  - Water Environment Services
- Clean Water Services
- Energy Trust of Oregon
- Golf Course Superintendents Association of America (GCSAA) - Oregon Chapter
- Irrigation Association of America (IA)
- Metro
- Oregon Department of Environmental Quality
  - Pollution Prevention, Small Business Assistance, Water Quality,  
Solid Waste, Hazardous Waste, Air Quality
- Oregon Environmental Council
- Oregon Landscape Contractors Association (OLCA)
- Oregon State Fire Marshal
- Oregon State Landscape Contractors Board
- Oregon Occupational Safety and Health Division (Oregon OSHA)
- Oregon State University Extension Service
- Pollution Prevention Resource Center
- Portland Regional Water Consortium
- Washington County
- West Multnomah Soil and Water Conservation District

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**W**hat can you gain from using environmentally responsible practices as standard business procedures? Landscape-related industries directly affect air, land and water quality, in addition to impacting quality of life. This manual describes Best Management Practices (BMPs) for landscape professionals to help control and prevent pollution.

By evaluating and improving your practices, you will be able to:

- Comply with government-mandated environmental requirements. Environmental regulations can be complex and specific regulations may vary from one municipality to another. (This handbook does not cover all potential items.) Use this handbook in conjunction with the ordinances in your community.
- Save money by finding ways to create and maintain healthy landscapes while reducing and reusing your wastes.
- Show customers they have made a wise choice by selecting a business that protects the environment.
- Protect public health and the health and safety of your workers by eliminating, reducing, and controlling wastes.
- Join other landscape businesses in Oregon that take pride in creating and maintaining a clean and healthy environment.
- Be recognized by customers as a green and sustainable business.

This guide gives your firm guidance on actions needed to become one of the growing number of EcoLogical Business Program (EcoBiz) certified firms in Oregon. To become certified, firms need to fill out a program check list complying with 100% of the Legal and Program requirements, and 80% of the Elective options. Firms are required to complete only the sections of the check list that are applicable to their company activities; for instance design-only firms should concentrate on the General Business and Design sections only. Submittal of typical contracts, plan sets and documentation of items on the eligible menu of certification options menu will be required.

For more information about the marketing advantages of being certified and to obtain a certification checklist please visit [www.ecobiz.org](http://www.ecobiz.org)



# General Business Issues

**B**e sure you and your business meet all legal standards. Generally, this involves becoming a licensed landscape contractor [ORS 670.600], becoming a licensed landscaping business [ORS 670.600], and obtaining state and local business licenses [ORS 671.530]. It is also necessary to obtain adequate insurance coverage, and submit a surety bond to the state Landscape Contractors Board (LCB) [ORS 671.510 to ORS 671.710]. See the resource section at the end of this chapter for contact information.

1) Oregon law requires that anyone in the state who advertises, operates as, or uses the titles “landscape construction professional, landscape gardener or landscaper” or provides landscape services on residential and non-residential properties, must be licensed with the Landscape Contractors Board (LCB). Two licenses are required with the LCB:

- **A landscape contractor’s license** - applicant must qualify by passing a comprehensive exam, and paying an annual license fee. There are three license categories: all phases, standard (all items but irrigation and backflow installation) and irrigation, plus backflow.
- **A landscaping business license** - business applicants need to submit a completed application, obtain a bond relative to the cost of typical jobs, and have at least \$100,000 of public liability, personal injury and property damage insurance, and pay an annual license fee. A landscape business must also employ a licensed landscape construction professional.

2) Most cities require that businesses operating within their jurisdictions obtain business licenses. There may be exemptions if you make less than a certain trigger amount per year, such as less than \$50,000 in the Portland metropolitan area.

3) Your county may have additional tax-related requirements.

## DEFINITION OF A LANDSCAPE CONTRACTOR:

A landscape construction professional is a person who has a license and plans and installs lawns, shrubs, vines, trees and other nursery stock including the preparation of the property on which the plantings are to be installed. A landscape construction professional also constructs and repairs ornamental water features and drainage and irrigation systems; and plans and installs fences, decks, arbors, driveways, walkways, patios, landscape edging, and retaining walls. - Oregon Landscape Contractors Board

## Continuing Education

All landscape construction professionals must complete 20 hours of continuing education every two years. At least four hours are required in subjects related to landscape contracting business practice and at least eight hours are required in subjects related to the technical area of landscape construction. The remaining hours may be in either of the above subjects or in subjects including, but not limited to workplace safety, environmental and sustainable landscape practices, and community service. All programs must be approved by the Landscape Contractors Board. Records of training program attendance must be kept for at least two years.

## REGULATIONS

### State Regulations

There are a wide variety of state regulations concerning worker health and safety. Compared to other occupations in the United States, landscape services workers are more likely to die from falls, from being struck by falling objects, and from electrocution. In general, workers are required to be trained for the equipment they are using, have the equipment in good repair and operating properly, and wear hearing protection when using loud machinery (over 85 decibels in 8 hours). First aid kits and safety committees must be provided for workers. There are also specific requirements



for tree trimming operations and the general requirement to maintain a 10 foot clearance from any power lines. Worker regulations can be found in the Oregon Administrative Rules, Subdivision R (437-002-300 series).

**Although landscape services workers make up 0.8% of the US workforce, they account for 3.5% of the total occupational fatalities - NIOSH**

### Local Regulations

City and county ordinances may affect work on your company yard and a customer's site. Be sure your yard activities comply with local zoning regulations. Be aware of regulations related to exterior storage and materials processing, which may be prohibited in some areas. Check local regulations before starting work at a new location.

**1) Environmental zoning:** These zones are set up to protect sensitive resources from physical degradation and pollution. Environmental zones are most often near waterways or tree grove areas. Properties located in an environmental zone may be subject to impervious surface area limitations, or may be required to use native plants on the site.

**2) Tree requirements:** Trees intercept rainfall, filter air pollution, stabilize soils, cool stream temperatures, and increase human interaction with the landscape. For these reasons, many communities have enacted ordinances requiring planting or protection of trees in rights-of-way, parking areas, or along property lines. Check with your city's arborist or urban forestry division for ordinances affecting your site.

**3) Building requirements (if applicable):** If the job will involve designing, building or modifying an existing structure, or installing a new one

(especially using formed concrete), check with the city's building bureau for any applicable codes.

**4) Erosion control:** Most jurisdictions have a variety of requirements for prevention and control of erosion from a project. Be sure to look at all requirements, not just when permits or plans are required. Always be prepared for rain and wind events that could transport sediment off your site. If working under an erosion control plan prepared by someone else, like a prime contractor, assure that all workers understand their legal obligations to prevent erosion from leaving the site.

**5) Plumbing and electrical codes:** These may affect design and installation of irrigation, lighting, ponds, and water features. These trade permits are routinely offered over the counter or with quick reviews.

**6) Stormwater management requirements:** Most cities now have standards for dealing with stormwater runoff created by building impervious surfaces. Regulations may require incorporating swales, rain gardens, porous pavement, or other facilities into the landscape.

**7) Zoning regulations:** Local zoning regulations may affect how landscape plants need to be used, what types of plants are required, setbacks from property lines or structures, and the aesthetics of a landscape installation. Check jurisdictional maps to identify which zoning regulations apply to the property you are working with.



**8) Green waste storage regulations:** Both DEQ and Metro require permits for sites that compost green waste onsite. Storage time longer than seven days may be considered composting in place. Evaluate your need to store onsite. If you need to store onsite, prepare the applicable management plans and obtain applicable permits.

**9) Pesticide Waste Storage:** DEQ requires that all waste pesticides be stored in structurally sound containers compatible with the waste. They should be stored in original bottles when possible; otherwise the label must be stored with the product. Wastes shall be labeled with the words "Waste Pesticides" along with the date the pesticides were stored as a waste. Pesticides may be stored for up to one year.



## RESOURCES - General Business Issues

### State Licensing

- Landscape Contractors Board: 503-986-6561, [www.lcb.state.or.us/](http://www.lcb.state.or.us/)
- Business Information Center: 503-986-2200, [www.sos.state.or.us/corporation](http://www.sos.state.or.us/corporation)

### State Codes

- Oregon Revised Statutes, Chapter 671. Legal standards pertaining to Landscape Architects, Landscape Contractors, and Landscape Businesses: [www.leg.state.or.us/ors/671.html](http://www.leg.state.or.us/ors/671.html)
- Oregon Department of Environmental Quality (DEQ) – Solid Waste Requirements. Solid Waste duty office: 503-229-5263

### Regional Codes

- Metro Solid Waste Department: 503-797-1836

### Local Business Licensing

- Beaverton: 503-526-2255, [www.beavertonoregon.gov/departments/finance/licenses/aboutbuslicenses.aspx](http://www.beavertonoregon.gov/departments/finance/licenses/aboutbuslicenses.aspx)
- Small Business Development Center at Mt. Hood Community College (Fairview, Troutdale, Gresham): 503-491-7658, [www.bizcenter.org/gresham](http://www.bizcenter.org/gresham)
- Forest Grove: 503-992-3269, [www.forestgrove-or.gov/economic-development/resources-for-businesses.html](http://www.forestgrove-or.gov/economic-development/resources-for-businesses.html)
- Hillsboro: 503-681-6100, [www.ci.hillsboro.or.us/Finance/BusinessLicense.aspx](http://www.ci.hillsboro.or.us/Finance/BusinessLicense.aspx)
- Lake Oswego: 503-635-0260, [www.ci.oswego.or.us/home/business/busreq.htm](http://www.ci.oswego.or.us/home/business/busreq.htm)
- Portland: 503-823-5157, [www.pdxbl.org](http://www.pdxbl.org)
- Sherwood: 503-625-5522, [www.sherwoodoregon.gov/licenses](http://www.sherwoodoregon.gov/licenses)
- Tigard: 503-639-4171, [www.tigard-or.gov/business/business\\_license/default.asp](http://www.tigard-or.gov/business/business_license/default.asp)

## General Business Issues - EcoBiz Landscape Services Guide 2010

- Tualatin: 503-692-2000, [www.ci.tualatin.or.us/departments/finance/BusinessLicenses.cfm](http://www.ci.tualatin.or.us/departments/finance/BusinessLicenses.cfm)
- Vancouver, WA: 360-619-1079, [www.cityofvancouver.us/businesslicense.asp?](http://www.cityofvancouver.us/businesslicense.asp?)
- West Linn: 503-656-4261, [www.westlinnoregon.gov/business](http://www.westlinnoregon.gov/business)

### Building Departments

- Portland: 503-823-7526 (zoning) and 503-823-7357 (permitting). Visit [Portlandmaps.com](http://Portlandmaps.com), enter address to get zoning information. See web for development overview and information. [www.portlandonline.com/bds/index.cfm?c=35891](http://www.portlandonline.com/bds/index.cfm?c=35891) for guide to permits
- Beaverton: 503-526-2222 for general information or the permit website at [www.beavertonoregon.gov/government/permits\\_fees.aspx](http://www.beavertonoregon.gov/government/permits_fees.aspx)
- Gresham: 503-618-2845, <http://greshamoregon.gov/city/city-departments/community-development/building-development/> for zoning, land use, and building code compliance prior to the signing of leases or sales agreements, and before making any exterior or interior alterations.





# Site Design

**S**ustainable landscape design takes into account embodied energy: all energy (direct and indirect) used to extract, manufacture, transport, install, and maintain materials. Materials (including plants) with low embodied energy levels are preferred. Native plant species are desired and often required in certain areas because they require minimal inputs.

Instead of approaching site design with the goal of minimizing negative impact, think in terms of how to maximize positive impact. In addition to the traditional objective of creating an attractive outdoor space, sustainable landscape design can:

- Create beneficial insect and other wildlife habitat
- Incorporate pest and disease resistant plantings
- Restore native and multi-story landscapes
- Minimize water and chemical use
- Minimize green waste production
- Utilize non-toxic landscape and hardscape materials with low embodied energy
- Mitigate stormwater and air pollution, erosion, and noise impacts



**Good site design is a critical first step toward sustainable landscapes. A sustainable site thrives with minimal inputs of labor, water, fertilizer, and pesticides. While it isn't necessary to use only native plants, the landscape design should work aesthetically and practically as a whole and should be appropriate for local conditions.**

## LOCAL REGULATIONS

**1) Design Certifications** State and local laws require that design work for some sites be carried out by a licensed design professional. A Registered Landscape Architect must prepare or approve design work for the following types of projects:

- a) Design work for public properties.
- b) Design work in which technical specifications are made for structures/features that will be installed by a company or individual other than the designing company or individual.
- c) Sites that directly contribute stormwater or are adjacent to natural drainage channels, streams, wetlands, marshes, or other sensitive natural areas regulated by the local, state, or federal government.
- d) Design work for sites where slopes of 10% or greater make up at least 25% of the total site area.

In addition to Registered Landscape Architects, a number of other certifications denote different levels of site design experience. They include Landscape Designer, Professional Landscape Designer, and Certified Landscape Designer. Specific certifications include:

- Landscape Contractor (LC) –state board certification in a variety of topics, including plant propagation, plant identification, drainage, and irrigation design
- Certified Landscape Technician (CLT) - certification, as earned through the Oregon Landscape Contractors Association (OLCA)
- APLD Certified Professional Landscape Designer – a certification program offered by the Association of Professional Landscape Designers (APLD)

See Chapter 7, Training, for more information on these programs.

**2) Access requirements** All public properties must meet standards set forth in the Americans with Disabilities Act (ADA), and private property owners may wish to comply as well.

**3) Impacts to neighboring properties** are usually regulated by local zoning and development codes.

**4) Stormwater management features** Many local jurisdictions now require that new developments be built with stormwater management facilities either at the sub-division or property by property level. Some facilities require stamped design plans by a civil engineer, especially large facilities that impound water.

**Pollution Prevention - P2 Potential**  
**Solve problems before they start. Sustainable design of your landscape should reduce the amount of inputs (water, pesticides, and fertilizers) and the amount of maintenance (pruning) for your landscape, reducing the amount of pollution produced on your site. Good sustainable design is cost effective, increases the success rate of landscape plantings, reduces chemical and maintenance requirements, and lowers water pollution.**



**Site design examples:** design can include disconnected downspouts, swales, ecoroofs, planters, soakage trenches, and porous pavers for stormwater management as well as invasives removal and planting native plants and trees.



### SUSTAINABLE DESIGN

1) Sustainable design should create a landscape that provides as many of the following ecosystem services as possible:

- Local and global climate regulation
- Air and water cleansing
- Water supply and regulation
- Erosion and sediment control
- Hazard mitigation – reducing fire, flood, drought, etc.
- Pollination
- Habitat functions – such as refuge, rearing, foraging, etc.
- Waste decomposition and treatment
- Human health and well-being benefits
- Food and renewable non-food products
- Cultural benefits – chances to interact with nature



**Sustainably landscaped sites can have the following ecosystem benefits:**

- **Every square meter of vegetation can remove over 2.6 grams of particulate matter in the air annually.**
- **Over 18 pounds of CO<sub>2</sub> can be sequestered per square foot of soil. Over 0.076 metric tons of CO<sub>2</sub> can be sequestered per tree.**
- **Trees can reduce household energy use by an estimated average of 3.7%.**
- **Each tree can intercept over 572 gallons of rainfall every year.**
- **Buildings with high levels of vegetation have 48% fewer property crimes and 56% fewer violent crimes.**

Ecosystem Benefits of the Grey to Green initiative, City of Portland, Bureau of Environmental Services – spring 2010

2) Meet with or survey all parties involved to create a design theme that meets user expectations and goals. Include the client maintenance team, planning and construction groups, and future site users. Ensure that the degree of development and complexity of design do not exceed available maintenance staff and funding. Assess the needs of the landscape both immediately and in the future. Are there specific sustainability desires that should be incorporated, such as shading of buildings, pervious pavements, or food based plantings?

3) Educate yourself on sustainability issues and opportunities at each site.

a) Gather historical information. What are the property's past uses? Be aware that some sites may have residues of heavy metals, herbicides, petroleum or other chemical compounds. These can inhibit plant growth, affecting new landscape installations.

b) Thoroughly examine site conditions, including: soil structure and chemistry; topography; existence of springs; drainage patterns; solar angles; wind directions; and average rainfall, temperature, and humidity. Complete a detailed soils analysis and test soils from across the site. In general, if soil is brown or reddish it is likely well drained. Gray or mottled colored soils are usually compacted and wet.

c) Look at the condition of existing plantings, as they can indicate whether there are any current pest or disease issues to address.

d) Specify methods to prepare and enhance soils on site to support healthy plants. Specify use of compost amendments to support new plant installations. Compost provides nutrients, keeps plantings warm and moist controls erosion.

e) Consider wildfire issues with existing or new planting design proposals. Keeping high moisture content plants (such as sedums, wetland plants) nearest the foundation and irrigated plants from 10 to 30 feet from a structure reduces fire risk. Avoid plants that act as fire accelerants (such as scotch



broom, juniper, or eucalyptus) on slopes or near structures. Many of these plants have volatile waxes and oils and can be aromatic. Most deciduous trees and shrubs are fire-resistant. Plants that are fire-resistant have the following characteristics:

- Leaves are moist and supple
- Have little dead wood and tend not to accumulate dry, dead material within the plant
- Sap is water-like and does not have a strong odor
- Sap or resin materials are in low volumes

f) Determine if potential or routine flooding occurs on the site – it may alter the type of species to plant.

4) Maintain native species where they still exist. By maintaining a diverse community of plants suitable to the site, you can help retain soils onsite, prevent erosion, and preserve wildlife habitat.

5) Create habitats that attract beneficial insects and birds which help prevent pest problems by keeping bad bugs in check without the use of chemical products. Choose flowering plants that are rich with pollen and nectar to feed beneficial insects when pest populations are low. Examples of insectary plants include: aster, California poppy, chrysanthemum, coriander, cosmos, rosemary, sunflower, sweet alyssum, yarrow and zinnia.

6) Do a functional analysis of the need for turf. Limit the turf area when possible to just areas for child or pet active use – suggest turf as no more than 25% of total area. Choose grass species suited for conditions, like fine-leaved fescues in shady areas and bentgrasses or tall fescues for wet soils. Consider the sun conditions and slope conditions for turf. If the area is more than 50% shaded or over a 10% slope, consider alternate groundcovers. If you choose the correct species mix, and provide support for grass to be healthy, grass can out-complete most broadleaf plants with proper management.

a) Educate owners to let turf brown over the hot summers. For many species this is their natural state to survive hot Oregon summers.

b) Consider eco-lawns or other alternative ground-covers to gain the green carpet aesthetic. These mixes usually include clover, yarrow and other broadleaf species that provide quick land cover and an evergreen look. Clover species accept mowing well, are green year-round, fix nitrogen, and improve the soil.

7) Choose plants and infrastructure that require little pruning, mowing and other maintenance. Choose disease resistant cultivars when possible. Choose slow growing plants or plants that will fill up the desired site space at maturity. This helps avoid future pollution from mower and chemical use and green waste (prunings/clippings), which can end up in waterways or landfills. Try to occupy all root and shoot space with grasses and forbs to keep out weeds.

8) Separate the site into a variety of common plant type areas where species with similar environmental needs can be grouped together, and design the irrigation system to reflect these hydrozones. Consider keeping the wetter needs plants in the middle of the garden and the drought resistant plants at the perimeter and along building foundations.

**Up to 80% of the world's food plant species are dependent on pollination by animals -**

**Sustainable Sites Initiative 2009**



## WILDLIFE FRIENDLY DESIGN

Home and commercial landscapes can support a variety of native species and can be important components of the regional habitat system. When creating a landscape design, consider the following:

1) Develop habitats for a variety of creatures – larger wildlife, birds, insects and amphibians. Think in terms of water, food and shelter for creatures big to small. Consider whether the wildlife need sun (many pollinators) or shade (amphibians). Also think about color and shape of flowers and plants in the garden. Certain species, especially pollinators, are attracted to specific color groups like blues, whites and yellows. Plant in clumps four feet or more in diameter when possible to maximize use by pollinators.

2) Provide habitats for a variety of life needs – resting, nesting, rearing, and hunting. Provide nesting boxes, downed wood or brush, and rock piles to provide nesting and resting cavities. Bats prefer boxes on poles or buildings. Choose wide varieties of plants to create habitats across the full height available in the yard to draw in different species. Provide grouping and not just single specimens to enhance use as habitat. Grasses are especially popular for a variety of bird species. Also remember to provide bare soil patches or mud banks in ponds for use by bird, insect, and amphibian species.

3) Provide resources for the varying life stages. For example, caterpillars need host plants to feed on and attach to, while adult butterflies need plants with nectar, fruit or sap.

4) Provide food and water sources for all types of wildlife. To avoid mosquito breeding, assure that water evaporates within 36 hours or is flowing and not stagnant. When in doubt, choose native and heirloom plants. There is usually native wildlife linked to any native plant. Provide plants with year around flowering as a pollen or nectar food source for pollinators.

5) Avoid insecticides. Many beneficial or desirable species are affected by horticultural chemicals.

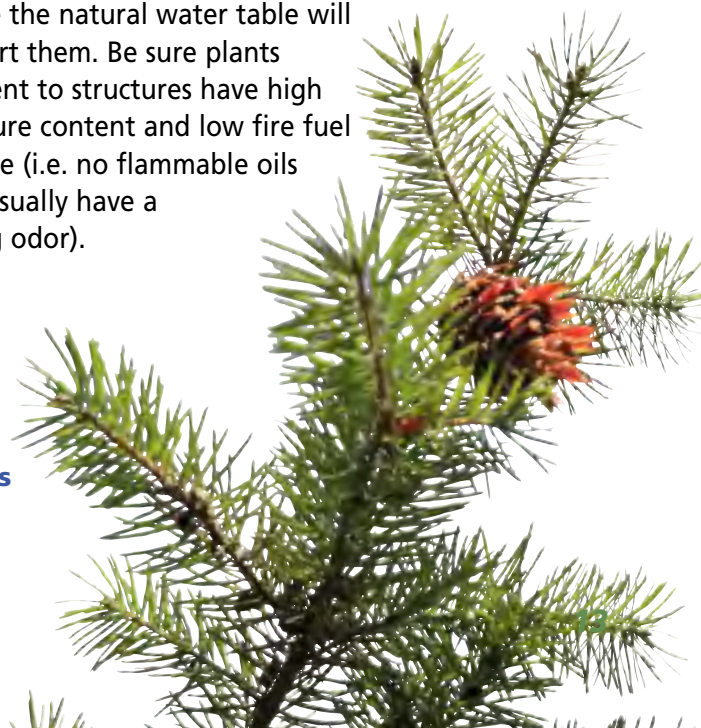
## PLANT SELECTION

Choose the right plant for the right location. Before selecting plantings, assess your site's characteristics and look for plants that will thrive in those conditions. Check: rooting habits; drainage requirements; sun vs. shade; temperature tolerance; soil temperature preferences; allelopathic characteristics; and size and shape at maturity. Mix plant species to create a diverse plant community that supports beneficial insects, birds, and soil life. Consider using native plants as a first alternative. Native plants are adapted to the local climate and soil conditions where they naturally occur. Native pollinators are generally adapted to the native plants found in their habitats. By using native plants on your site you can also provide important connectivity for native plant, insect, bird, and animal populations.

1) Select pest and disease resistant species, minimizing need for chemical application. Native species generally require less irrigation, fertilization, and pesticide application than exotic cultivars, especially for large areas. There are also a number of non-native plants that excel in this climate that need even less care than natives. Take individual plant needs and weaknesses into account.

2) Choose plants with low water needs. Limit plants with high water requirements to areas where the natural water table will support them. Be sure plants adjacent to structures have high moisture content and low fire fuel volume (i.e. no flammable oils that usually have a strong odor).

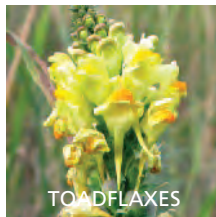
**A mature tree can catch an average of 760 gallons of rainfall per year, preventing stormwater from entering the storm sewer system.**



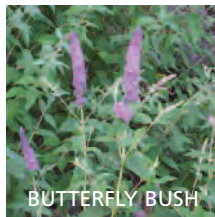
## Site Design - EcoBiz Landscape Services Guide 2010



HAWKWEEDS



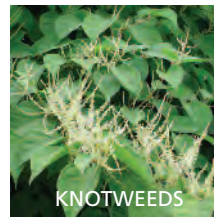
TOADFLAXES



BUTTERFLY BUSH



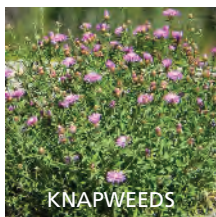
YELLOW FLAG IRIS



KNOTWEEDS



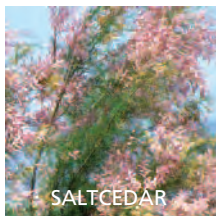
POLICEMAN'S HELMET



KNAPWEEDS



SPURGE LAUREL



SALTCEDAR



OLD MAN'S BEARD

**Remove and never plant all class A and B rank invasive species on the Oregon Department of Agriculture Noxious Weeds list- most common are:**

- ⊘ Bachelor's Button and Knapweeds (*Centaurea cyanus*, *C. macrocephala*, *C. pratensis*) – BEWARE these may be in grass species mixes.
- ⊘ Brooms and Gorse (*Cystisus scoparius*, *C. striatus*, *Spartium junceum*, *Genista monosperma*, *Ulex europaeus*)
- ⊘ Butterfly Bush (*Buddleia davidii* & *B. variabilis*)
- ⊘ English and Irish Ivy (*Hedera helix* & *H. hibernica*)
- ⊘ Garlic Mustard (*Alliaria petiolata*)
- ⊘ Himalayan Blackberry (*Rubus armeniacus*, *R. discolor*, *R. procerus*)
- ⊘ Hawkweeds (*Hieracium floribundum*)
- ⊘ Knotweeds (*Polygonum cuspidatum*, *P. sachalinense*, *P. polystachyum*)
- ⊘ Old Man's Beard (*Clematis vitalba*)
- ⊘ Policeman's Helmet (*Impatiens glandulifera*)
- ⊘ Purple Pampas Grass (*Cortaderia jubata*)
- ⊘ Spurge Laurel (*Daphne laureola*)
- ⊘ Spurge - Leafy and Myrtle (*Euphorbia myrsinites* & *E. esula*)
- ⊘ Tamarisk / Saltcedar (*Tamarix ramosissima*)
- ⊘ Toadflaxes (*Linaria dalmatica* & *L. vulgaris*)
- ⊘ Yellow Flag Iris (*Iris pseudacorus*)

**For alternatives to invasive species:**

**[www.portlandonline.com/bes/gardensmart](http://www.portlandonline.com/bes/gardensmart)**





3) Do not choose plants with invasive growth or seeding habits, such as English holly, especially those known to take over natural areas (e.g. English ivy, periwinkle). Note that different plant cultivars may have different invasive tendencies.

4) Incorporate plant species attractive to beneficial insects or that have positive influences on other plant types (companion planting). Many herbs including dill, fennel (non-bulb), and sage are good food sources for beneficial insects, while garlic repels many pests. Flowers such as petunia, nasturtium and yarrow support beneficial insects and are easy to interplant among other species. (See the Maintenance section for more information.)

5) Design planting beds that control or prohibit weed growth. In the long run, you will save money, energy, and reduce pollution by minimizing the need for mechanical weed removal or herbicide use. Curtail weed growth by spacing plants so that at maturity they shade unplanted soil. Most weed species will not survive in shaded conditions. Use a heavy mulch layer (4-6 inches) or shade cloth with bark mulch while permanent plantings become established to help prevent germination of weed seeds. Allow enough space between larger shrubs and trees to minimize pruning requirements when plantings mature, and to allow good air circulation. You may have to weed for the first few years until other plants reach full soil coverage.

### Groundcover

Groundcover is critical to the success of a low impact landscape environment. Spreading, low-growing plants offer the following environmental benefits:

- Soil retention and erosion control across a landscape
- Retention of soil moisture by providing a sun barrier for underlying soils
- Shading out weeds and other undesirable or invasive species
- Providing near-earth-surface habitat

- Providing infiltration and reducing the rate and volume of runoff

1) Your choice of groundcover should be based on the desired use for the site. If the site is going to be high traffic or used by pets, turf may be most appropriate (see section below). If the area is only for lush aesthetics, consider other groundcovers including:

a) Low growing native perennials - If the area is shady, consider the use of interplanted evergreen and deciduous perennials [e.g. sword fern (*Polystichum munitum*), waterleaf (*Hydrophyllum tenuipes*), and fringecup (*Tellima grandiflora*)]. Plant densely to reduce weed problems and apply several inches of mulch around the plants to reduce need for irrigation.

b) Native grasslands - Bunchgrasses, perennials and annual wildflowers are adaptable to a variety of site conditions, desired aesthetics and maintenance practices. If the site will be mowed occasionally, consider planting the nearly evergreen native bunchgrass California oatgrass (*Danthonia californica*) with a low growing perennial wildflower like self heal (*Prunella vulgaris* ssp. *lanceolata*) or with wildflowers that tolerate mowing like western yarrow (*Achillea millefolium*). Mow once yearly in the mid to late summer after grasses drop their seeds.

c) For a more naturalized look in dry areas where the native grassland will not be mowed, plant the taller blue wild-rye (*Elymus glaucus*), California brome-grass (*Bromus carinatus*), and June grass (*Koeleria micrantha*) with taller growing wildflowers like columbine (*Aquilegia formosa*), cinquefoil (*Potentilla gracilis*), blue flax (*Linum perenne*), and giant camas lily (*Camas leichtlinii*). In wetter areas, substitute tufted hairgrass (*Deschampsia caespitosa*), spike bentgrass (*Agrostis exarata*), soft rush (*Juncus effusus*) and common camas (*Camas quamash*).



### DESIGNING TURF

The term turf refers to a high-density coverage of various species of sod forming grasses. Because of this intense use, commercially developed and propagated species are usually the best. Native grasses do not hold up as well or have the same visual aesthetic normally associated with a turf surface. To maintain a healthy plant culture for these intense uses, inputs of water and nutrients are usually required. Most commonly used turf species require full sun for a full, healthy turf surface. Because of this need for additional support, limit turf areas to just those required by site users. If a green aesthetic is desired or you are working in a shady area, consider using other ground covers, which need fewer inputs and can provide desirable habitat. (See previous section.)

1) Plant a mix of grass species for greater disease and pest resistance. Use species adapted to local conditions and purchased from local sources. Check local nuisance plant lists (see resource section) to be certain that the seed you select is not considered invasive in your area.

2) Pick a mixture that meets your desired aesthetic and level of desired maintenance and inputs. Consider using low grow / no mow mixtures of groundcover species. Ask your grass seed supplier to help you pick the best mix for your site. OSU Master Gardeners recommend a perennial rye and red fescue mix (75 - 80% rye, 20 - 25% fescue).

**67 million pounds of synthetic pesticides are applied to U.S. lawns each year.**

F.H. Bormann et al. *Redesigning the American Lawn:*

*A Search for Environmental Harmony.*

Yale University Press, 1993

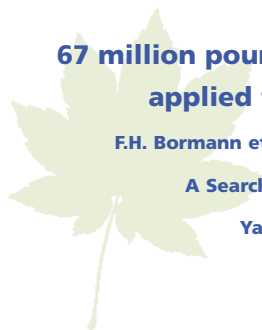
### Ecological Turf Alternatives

There are a number of turf alternatives for rough turf areas (slopes, etc.) and areas of less intensive uses. The mixes are sold through a variety of grass seed suppliers and are usually made up of drought resistant grasses and other low growing flowering plants such as yarrow, strawberry clover, shamrock, and sweet alyssum. These more broadleaf plants can be a good, lower maintenance alternative for aesthetic turf areas. New types of artificial turf products are also becoming increasingly popular. Do a thorough product review and inspection to assure that products are not constructed of recycled manufacturing materials that could have health impacts. Also discuss the specific maintenance and cleaning needs with your client that are unique to artificial turf type installations.

### DESIGNING HARDSCAPES (PATIOS, DECKS, FENCES)

Minimize pavement and other impervious surfaces (surfaces that don't allow water infiltration) in your design. Paving changes the natural flow of water in a landscape, causing it to move over the surface rather than soaking into the soil. Surface flow picks up sediment, nutrients, heavy metals, and other pollutants as it travels, especially over hardscape areas. The polluted water (stormwater runoff) drains into storm sewers that eventually discharge into our rivers and streams. The pollutants upset the delicate balance of these waterways, which become unhealthy for fish, wildlife, and people.

1) Be aware that adding an impervious area may trigger stormwater regulations. Always consider whether water can be infiltrated or otherwise reused on site. Any water running off a hardscape needs to be directed to a properly sized and located drain connecting to an approved disposal location. Runoff may be directed to bioswales, rain gardens, and other stormwater management designs and reused in these aesthetically pleasing surface features. Check with your local jurisdiction.



**2)** Choose paving materials that either have spaces within the paving mix or spaces between blocks to allow water to infiltrate into the ground. Consider crushed hazelnut shells, wood chips, gravel or another pervious natural material as an alternative to pavement.

**3)** Work with natural site conditions. Place patios in areas that are already nearly level, or use the existing slope to create a terraced outdoor space and minimize grading and fill. Allow space around existing trees. Avoid placing fences, decks or impervious patios where they will damage tree roots. Avoid all tree drip line areas.

**4)** Utilize materials already onsite or specifically request recycled and least-toxic materials.

**a)** Fences can be created from woven willow whips or branches from trees on the property. Incorporate boulders or stones already onsite.

**b)** When selecting wood for your design, consider using alternative wood products. If you need to use wood, specify salvaged lumber or naturally rot-resistant, sustainably harvested species such as cedar or redwood. Use treated wood only in areas that will receive minimal precipitation and where human and animal exposure will be minimal (chemicals used in the treatment process leach into surrounding soil with rainfall). Select the least-toxic option available.

### DESIGNING PONDS AND WATER FEATURES

Create habitat while minimizing energy use, water use, and maintenance requirements. Consider adding a low volume water feature or rain garden to your site. Work with existing topography to select an appropriate size and location that will be successful on your site.

**1)** Evaluate the type of water feature that is appropriate and desirable for the site. Low volume bubbler features may be more appropriate than

ponds, especially for smaller sites.

**2)** Research legal requirements that may affect your water feature design. Check electrical and plumbing regulations or fencing regulations for deeper ponds.

**3)** Place the water feature in existing soils or at least minimize the need for excess grading. Reuse excavated soils elsewhere in the water feature. Consider the impacts of choosing a low spot where runoff naturally collects. Do not add flows to areas that are continually wet or pool water. You may need to add a stormwater collection system around the water feature to avoid flooding problems and prevent polluted runoff from entering your water feature.

**4)** Check with your local jurisdiction for location recommendations based on size and type of water feature.

**a)** Locate the water feature at least 25 feet from natural waterways to help control and limit impacts on the natural environment, including spread of invasive species and increased stream temperatures from open ponds.

**b)** Do not locate water features under trees or within tree drip lines as root systems may be damaged.

**c)** Do not locate water features near your foundation, neighboring property, or sidewalk to avoid liability for overflow or freezing over.

**5)** Plan a buffer between turf and water features to reduce the possibility of fertilizer/herbicide pollution. Build up soil around the water's edge so that runoff flows away from the pond rather than into it, unless it is a treatment facility. Excavated soil can be reused for this purpose.



6) Meld your water feature into the natural environment. Avoid larger permanent open water ponds which can provide habitat for invasive species such as nutria, bullfrogs, algae, and invasive plants. Never modify an existing natural drainage without consulting local, state, and federal resource agencies.

### For Larger Ponds

The recommended minimum surface area for a healthy pond: 50 square feet (10 ft. x 5 ft. rectangle, or 8 ft. diameter round pond). Recommended depth: 18-36 inches. Depth greater than 3 feet may be unnecessary and could create maintenance difficulties and add safety concerns. If a smaller feature is desired, consider installing a barrel water garden or a small bog garden instead of small ponds.

7) Use recirculating pumps that move at least one half of the feature's volume of water each hour. If the feature includes waterfalls, place the pump or inlet as close to them as possible to increase efficiency. Use multiple valves to allow better flow control, and the ability to shut off or drain water from the system.

8) Design waterfalls to drop directly into a pool or catch basin. Keep the watercourse short and the drop length low to minimize creation of spray and reduce water loss. Use overhanging rocks to create a lip on waterfalls so the waterfall stays in contact with the already wet surface rather than falling through the air which can increase water loss from the pond.

9) Accept some algae. Smaller, shallow ponds and permanent pool water features are less stable overall, and more sensitive to temperature fluctuations. Ponds that are too shallow cloud quickly with excess algae and require enhanced filtration. Use shading, water movement, skimming, and filtration to reduce algae. Avoid chemical water treatments.

### Plant Selection

Use a variety of plant species and types - emergent, submergent, and floating to create a stable, diverse environment.

1) Don't use invasive plants of regional and national concern such as Purple Loosestrife (*Lythrum salicaria*) pictured here, Yellow Flag Iris (*Iris pseudacorus*), and Reed Canarygrass (*Phalaris arundinacea* var. *picta*). Select only regionally native or non-invasive exotic species. Ask if your vendor is aware of which species are regionally and federally listed, and verify that plant identification and scientific names are correct.




2) Select plants that are adapted to the conditions available. Consider water depth, temperature ranges, amount of sunlight, and pond size. For rain gardens, choose plant species with high tolerance for pollutant removal and the ability to survive both wet and dry conditions. Wetland plants are good choices.

3) To help control summer temperatures, plants should cover 60% of any open water surface. If you have an open water pond, be sure the overflow or pond outlet goes underground for at least 25 feet to cool these flows before disposal into any natural area.



### DESIGNING IRRIGATION SYSTEMS

An ecological approach to irrigation design will result in an energy efficient, water efficient, site-appropriate system. A good irrigation system design should provide the appropriate amount of water needed given the plant community, climate, and seasonal changes on a site. Design irrigation systems to supplement precipitation. Do not treat irrigation as the only water source. Ensure that water is distributed efficiently and uniformly in each hydrozone, minimizing puddles and dry spots. Over watering can increase plant susceptibility to pest and disease problems, which raises the cost of site maintenance.



**30% of daily water use is devoted to outdoor uses such as watering lawns and gardens. Over ½ of all irrigation water can be wasted as a result of evaporation, wind, improper system design and overwatering –**

**Sustainable Sites Initiative 2009**

**1)** Assess soil conditions for properties that will affect infiltration rates. Do a simple percolation test (dig a hole, fill with water, drain and fill again then time how quickly water level in hole drops) to get a rough infiltration rate in inches per hour. Visually check soil structure, texture, degree of compaction, and organic content. Be aware that slopes dry more quickly than flat areas. Amend soils, preferably with compost, when needed.

**2)** Design to accommodate microclimates and weather conditions. In general lawns west of the Cascades need 1 inch of water per week in hot, dry weather. Look at the amount of sun received onsite. In shady areas, evaporation rates will be lower. Consider reflective surface area impacts, such as plantings adjacent to a building wall. Evaluate wind flow, keeping in mind that it

changes according to season. Design systems to apply water slowly – generally not more than 1/2 inch per hour.

**3)** Break the site into irrigation zones. Base zones on:

**a)** Type of use. Residential lawn that supports intense child or pet use needs more water than other landscapes to assure health and viability of plants under heavy traffic.

**b)** Species culture. Designate separate zones for turf, seasonal color plantings, shrubs, and trees. Look at plant needs and design to meet, not exceed, those requirements.

**4)** Specifically address water conservation methods in your design. Consider the following water conserving design features:

**a)** Programmable system controllers that can adjust irrigation schedule and application rates based on rain, wind, and soil moisture content. Adjust systems for changing seasons.

**b)** Types of irrigation systems and appropriate supply pressures. Deliver water directly to each plant. Design low-volume irrigation for long, narrow landscape areas, small irregularly shaped areas, and landscape beds (sprinklers are generally preferred for turf). All systems should be designed and installed to avoid applying water to adjacent hardscapes.



**Trickle or drip irrigation systems can reduce water use from 50-80% compared to overhead irrigation**

**Oregon and Washington Master Gardener Handbook**

**c)** Explore possibilities like water harvesting with cisterns or rain barrels, as well as using non-potable water from other sources. Rain barrels or cisterns can be used to collect rainwater from downspouts for gravity-fed irrigation via soaker hoses. Currently grey water is heavily curtailed for landscape use.

### For Larger Systems

#### Legal Requirements

*The state of Oregon requires that a qualified professional perform irrigation system design work [ORS 671.615]. Any business doing irrigation design should have on staff either a Certified Irrigation Designer (CID) or a Landscape Architect (LA).*

5) Identify an optimum range of application rates for each zone, and design your system to achieve these rates. Provide sufficient water to wet the entire root zone.

6) Select components according to supply pressure, soil properties, slope, wind conditions, and desired application rates.

a) Use low-angle sprinkler heads to mitigate the effects of wind. Specify pressure compensating and matched precipitation rate nozzles for individual zones.

b) Specify swing joints with pop-up spray heads, and check valves on all sprinkler heads to prevent low head drainage. Be aware that check valves will require the use of an air compressor to appropriately expel water for winterization.

c) Select a water meter that has (or is upgradable with) an electronic flow rate output signal for interfacing to controllers that can perform leak detection, and to water management sensors.

d) Specify an irrigation system controller that helps eliminate runoff. Specify environmental sensors that allow automatic system shutdown in excessive wind and during rain events. The controller should interface with rain and wind sensors to avoid watering during rainy or windy weather, and allow cyclic set day watering schedules to meet regulatory requirements during drought periods. In addition, choose a controller that schedules water application using historical or real-time data or soil moisture sensors.

e) Local plumbing authorities require a backflow prevention device. Specify an insulated housing for this assembly to prevent freeze damage. Place any

pressure-reducing apparatus downstream of the backflow valve.

f) Include a valve before the irrigation backflow device to allow emergency water shut off and drain valves on all irrigation zones to drain the system for winter. All valves should be ASSE or IAMPO approved and insulated to protect from freeze damage.

g) Avoid using automatic drain valves on irrigation lateral lines since they may add to overall system water loss. Do consider master valves at the water source to allow for full system cutoff and to enhance the ability for leak detection in other system components.

h) Assure there is adequate pipe size to minimize pressure differences across the system. Keep the variation to 10-15% of working pressure.





### DESIGNING SITE LIGHTING SYSTEMS

Be sure that any design plan that uses lighting only has the amount of lumens you actually need.

Sustainable design will focus on working with the client to identify lighting needs for security versus those for aesthetics. Discussions should include the feel or mood that lighting should provide and a discussion of materials, placement, color and glare. Consider not only the placement, but use of the most efficient equipment located where one source can provide the maximum coverage.

1) Design for the least amount of light coverage needed or desired. While it depends on the purpose of lighting, aesthetic lighting should stagger fixtures to provide lighting where desired with a minimum of overlap. Evaluate whether shadows between fixtures is acceptable to the client.

2) Direct all fixtures only where needed. Use hoods, slide panels or other features to direct lighting sources and minimize light spillage into the surrounding environment. Consider mounting lights closer to the desired target to limit the lumens needed and expand the type of low pressure lighting sources that can be used. Uplights should be avoided and when used have low enough lumens to not brighten the surrounding sky.

a) All exterior fixtures should emit no light above horizontal or be Dark Sky certified. Visit [www.darksky.org](http://www.darksky.org) for a list of fixtures approved by the International Dark Sky Association.

3) Choose the most efficient lighting available. While LED lights are the most efficient lamps, they may have limitations. Consider fluorescent, high-intensity discharge (HID), or low pressure sodium lamps as alternatives. New high pressure sodium lights, which are highly efficient, now come in whiter deluxe colors.

a) Lighting should be Energy Star, photovoltaic or 12-volt for outdoor building and site fixtures.

b) Lighting fixtures should not use more than 80% of the transformer capacity.

4) Consider alternative energy sources like solar powered lighting. With the advent of photovoltaic technology, solar lighting can be very practical and a great solution to dark areas without electricity.

5) Use photo sensors, motion sensors or timer controls on all fixtures to limit the time of wasted light use. Be sure to adjust the schedule of these fixtures during daylight savings time and between seasons.

a) Astronomical control clocks / relay panels replace photo cells and adjust for daylight savings automatically. You can program events at specific times, unlike photo cells that typically leave the lights on when it's dark.

**Exterior lighting alone represents  
an estimated 1.34% of California's  
total energy use**

**Sustainable Sites Initiative 2009**



### RESOURCES

#### Site Design

- **Backyard Conservation: Bringing Conservation From the Countryside to Your Backyard** - USDA Natural Resources Conservation Service, National Association of Conservation Districts, and Wildlife Habitat Council. 1999.
- **Creating Habitat for Wildlife at Home, School, Work, and in Communities** - Backyard Wildlife Habitat. National Wildlife Federation.
- **Planting Native Trees and Shrubs for Healthy Watersheds: A How-to Book for Community Groups** - East Multnomah County Soil & Water Conservation District, Oregon. 2000.
- **Turfgrass Culture** - And other turf articles by Tom Cook, OSU.
- **Bay-Friendly Landscape Principles and Practices** - [www.bayfriendly.org](http://www.bayfriendly.org)
- **The Sustainable Sites Initiative** - ASLA, Lady Bird Johnson Wildflower Center, and US Botanic Garden. Draft 2008 Guidelines.

#### Certification

- Association of Professional Landscape Designers: [www.apld.com/index.asp](http://www.apld.com/index.asp)
- American Society of Landscape Architects, Oregon Chapter: [www.aslaoregon.org/](http://www.aslaoregon.org/)  
National: [www.asla.org/](http://www.asla.org/)
- Oregon Landscape Contractors Association: [www.oregonlandscape.org](http://www.oregonlandscape.org)
- Irrigation Association: [www.irrigation.org/](http://www.irrigation.org/)
- Oregon State Landscape Contractors Board: [www.lcb.state.or.us/](http://www.lcb.state.or.us/)
- PLANET-Professional Landcare Network: [www.landcarenetwork.org/cms/home.html](http://www.landcarenetwork.org/cms/home.html)
- Oregon State University Extension Service: <http://extension.oregonstate.edu/>, or call your local extension office or Master Gardener hotline for information or referrals:
  - Clackamas County: 503-655-8631
  - Multnomah and Washington County: 503-821-1150
- International Erosion Control Association: [www.ieca.org](http://www.ieca.org)

#### Site History

- Contact the Oregon Historical Society: 503-222-1741 or [www.ohs.org](http://www.ohs.org)

#### Invasive Plants

- **GardenSmart, Oregon** - [www.portlandonline.com/bes/gardensmart](http://www.portlandonline.com/bes/gardensmart)

#### Compost Use

- OSU Extension Service: <http://extension.oregonstate.edu>
- Washington Organics Recycling Council: [www.compostwashington.org](http://www.compostwashington.org)

#### Site Assessment for Hazardous Materials

- Contact Oregon DEQ, Northwest Region: 503-222-1741 [www.oregon.gov/DEQ/](http://www.oregon.gov/DEQ/)



### Soils Information

- National Resources Conservation Service – Soil Survey: 503-326-3941, <http://websoilsurvey.nrcs.usda.gov/app/>
- Soil and Water Conservation Districts
  - Clackamas County: 503-655-3144, [www.conservationdistrict.org/](http://www.conservationdistrict.org/)
  - East Multnomah: 503-222-SOIL (7645), [www.emswcd.org](http://www.emswcd.org)
  - West Multnomah: 503-238-4775, [www.wmswcd.org](http://www.wmswcd.org)
  - Tualatin: 503-648-3174 ext. 5
- Soils For Salmon: [www.soilsforsalmon.org](http://www.soilsforsalmon.org)
- Soil Testing Resources: contact extension office, <http://extension.oregonstate.edu/>

### Naturescaping/Native Plants

- National Wildlife Federation landscaping to attract and support native wildlife: [www.nwf.org/backyardwildlifehabitat/](http://www.nwf.org/backyardwildlifehabitat/)
- Three Rivers Land Conservancy has information on natural gardening and backyard certification programs: [www.trlc.org/BYHCP](http://www.trlc.org/BYHCP)
- Naturescaping: [emswcd.org/naturescaping](http://emswcd.org/naturescaping)
- Metro Natural Gardening Program: 503-234-3000, [www.oregonmetro.gov/garden](http://www.oregonmetro.gov/garden)
- Oregon Native Plant Society: [www.npsoregon.org](http://www.npsoregon.org)
- Washington Native Plant Society: [www.wnps.org/](http://www.wnps.org/)
- Portland Plant List: [www.portlandonline.com/bps/plantlist](http://www.portlandonline.com/bps/plantlist)
- Soil and Water Conservation Services
  - Clackamas County: 503-655-3144, [www.conservationdistrict.org/](http://www.conservationdistrict.org/)
  - East Multnomah: 503-222-SOIL (7645), [www.emswcd.org](http://www.emswcd.org)
  - West Multnomah: 503-238-4775, [www.wmswcd.org](http://www.wmswcd.org)
  - Tualatin: 503-648-3174 ext. 5
- Hoyt Arboretum: 503-865-8733
- Urban Forestry Division of Portland Parks and Recreation: 503-823-4489 (for street tree planting, pruning, and removal permits)
- Friends of Trees: [www.friendsoftrees.org](http://www.friendsoftrees.org)
- Tree Care industry Association: [www.tcia.org](http://www.tcia.org)
- Water Web Consortium: [www.waterweb.org/](http://www.waterweb.org/)
- Hardy Plant Society of Oregon: 503-224-5718, [www.hardyplantsociety.org](http://www.hardyplantsociety.org)

For help selecting a tree appropriate for your project, or to find out which ordinances will apply to your site, call the City Arborist / Urban Forestry Department in your area.

# Installation

**P**romote healthy plant growth by using appropriate site preparation and installation practices. Plants need the largest amount of nutrients when they are growing the most rapidly, such as during the installation and plant establishment phases.

Poor installation methods can cause erosion by disturbing large areas of soil, often damaging existing trees and other vegetation in the process. Inappropriate or over application of pesticides often results in chemicals washing into storm sewers. When installing new landscapes, be gentle to the site, the plantings, and surrounding areas. Manage materials and soils to keep them protected and on-site, avoiding erosion and the spread of pollution. Protect existing trees and shrubs from damage. Use planting practices that encourage fast establishment. Grade as little as possible, and when you do grade, protect graded areas and soils from eroding and being carried into storm sewers.

**Research shows that nearly 80% of plant problems are related to poor soil.**

**Healthy soil should be at least 50% pore space. — Oregon and Washington Master Gardener Handbook**

## Create a Construction Plan

Planning how you will phase work, store materials, provide erosion control, and provide trash and drainage controls is critical to keeping an installation site working efficiently and limiting environmental impact. All installers should do a site walk-through with staff and discuss all of the following issues. Consider preparing your own plan or modifying as needed others' construction plans to meet your crew's needs.

- 1) Clearly identify a construction plan with:
  - a) Project boundary and limits of grading
  - b) Footprint of existing and proposed structures
  - c) Existing and final grades of the site including

approximate locations of cut-and-fills


- d) Outline of the site drainage area. Show drainage patterns before and after grading activities are completed. Include location where runoff will enter the temporary or permanent drainage facility.
- e) Plant preservation or plant salvage areas

2) Set a schedule. Wait until the dry season to grade, or set up wet weather erosion control measures. Schedule project completion with enough time before rainfall begins to stabilize soil with vegetation or by other means.

3) Avoid damaging utilities during construction. Breaking a utility line can damage your site and cost thousands of dollars in lost services to neighboring properties and the utility company. Call 811 / Call Before You Dig to request a utility locate for your site.

4) Avoid construction near existing trees and vegetation. Large equipment disturbs roots and compacts soil. The appropriate root protection area will depend on the location, species, size, and age of vegetation, as well as potential impact on vegetation of adjacent construction activities or permanent improvements. At a minimum leave the area within drip lines plus an additional five foot buffer undisturbed. Provide construction fencing or some other form of demarcation to assure construction personnel are alerted to stay out of the site. Establish construction traffic routes and material piles where they won't adversely affect existing vegetation.

5) Plan locations to support site operations. Your site will likely need a soil stockpiling area and a place to stage materials for installation. Will you be storing or fueling equipment on-site? Will you be washing equipment or materials on-site? Include a covered receptacle for solid waste, and designate an appropriate area in which to contain excess or waste concrete. Assure that you have specified a location for all of these activities.



**Over 50% of erosion can be prevented by simply roughening bare soil surfaces to help slow and trap runoff - EPA**

### **Prepare/Review and Modify the Site Erosion Control Plan**

A good erosion control plan endeavors to minimize any dirt movement on the site, and should detail how site measures will limit erosion. Include a maintenance and removal schedule for erosion control measures. Consider potential causes of erosion (i.e. wind and rain exposure), as well as the areas your site's erosion will affect. Verify that your staff can meet the requirements of any existing site erosion control plan.

- 1)** Schedule projects to disturb only small portions of the site at any one time (this may not be necessary for small projects). Immediately stabilize any disturbed section before grading the next. Avoid grading in wet weather and protect stockpiles of soil and other materials from wind and water transport.
- 2)** Prevent off-site movement of soils. Stabilize construction entrance roadways to prevent sediments from being deposited into public ways. Sweep up accidental depositions immediately instead of hosing them down.

### **PREPARING SITE AND SOIL FOR INSTALLATION**

Healthy landscapes depend on healthy soil. Amending soil with organic matter (fully matured compost) and nutrients before plants are installed will ultimately provide a great economic and workload advantage. Future plantings will become established more quickly and grow more vigorously, out-competing weeds and preventing erosion. Use caution when amending soils for pocket planting of shrubs and trees. Plants may not root into surrounding natural soils. The best practice is to

amend the entire planting area, tilling in amended soils to allow for better transition between soil types.

**1)** Determine which plants will be saved or salvaged onsite. Demarcate areas of no disturbance with orange construction fencing, tape or some other method. Repot/replant plants to be salvaged for replanting later in the completed site. Determine an appropriate storage area for these plants.

**2)** Remove undesirable plants.

**a)** Remove invasives both within and adjacent to your work area. Be sure that all seeds and roots are removed from the soil. The most common invasive species are Himalayan blackberry, English ivy, deadly nightshade, Reed canarygrass, Canadian thistle, and some forms of aggressive clematis and bamboo. Don't compost invasive plant materials onsite because seeds can survive site drying and freezing temperatures. Take them to a commercial composting facility. Completely dry plants and incinerate or add to garbage that will not be composted.

**b)** Remove unwanted lawn to clear areas for other plantings. Fertilize area and cover with black plastic, four sheet thick cover of newspaper, or six to 12 inches deep of compostable material (cardboard, burlap, other natural fibers) for at least two months to fully kill weeds and grass. Be sure to amend before new plantings go in. If the area is overly-large and herbicides are chosen for use, use glyphosate products which work best on actively growing plants. Be sure to keep children and pets out of the areas for at least two days.

**3)** Control weeds before planting to reduce maintenance requirements later on. Identify nuisance weed species in the area, particularly perennial weeds and invasive species. Evaluate their life cycles, and use this information to select methods that are most effective and have the least environmental impact. Loosen soil to at least 12 inches to help remove weeds. Consider mechanical or biological



cal means rather than chemical application. Evaluate your site for the risks associated with your choice of practices.

**4)** Make sure you are aware of soil characteristics onsite, and if specified plants seem to be a bad match, tell the designer and owner:

- a)** Always have at least one foot of permeable soil over hardpan, dense clay or gravelly subsoil. Eight inches is the minimum for plant establishment.
- b)** Loosen compacted site soils to the point where a 160 pound person only sinks in ½ inch.
- c)** Be aware that crop plants have specific needs, such as at least 5% organic matter and lower soil pH – from 6.2 to 6.8 is best.
- d)** Most turf needs 20 to 25% finished organic content for planting. Two inches of compost can usually supply a sufficient amount of nutrition for growth and development for the first year of grass growth.

**5)** Use the designer's soil analysis and amendment specifications to determine which nutrients or minerals are needed, if any. If these are not available, either test the soil yourself or request that the designer have it done, especially if there are indications that the prescribed plants will not thrive in existing conditions. Submit samples to commercial testing organizations, or purchase test kits at landscape supply centers. Test for detailed fertility, sulfate content, bulk density, and percent organic matter. In general, soils should have 10% organic matter for planting beds, 5% for turf areas and a pH between 6 and 8. Make sure the site is prepped before planting.

### Pollution Prevention

Using mechanical weed removal eliminates the need to purchase, mix, apply or dispose of horticultural chemicals. Chemical manufacture, use and disposal can pollute the environment. But be aware that mechanical measures have environmental and personal safety issues too.

#### 1) Tilling/cultivation

- a)** If tilling is part of the site preparation, add fully matured compost to increase soil organic matter that is lost when exposing soil to sun and water.
- b)** Do not till slopes with grades equal to or greater than 20%, as erosion becomes a problem.
- c)** Protect existing trees. Do not till to within 5 feet outside the drip line to the tree trunk, unless an arborist or city forester (see resource section for contact information) approves an exception.

**2)** Consider lining planting areas with weed control fabric or liners. Explore other maintenance issues associated with these products. Landscape fabric is especially helpful on soil under pavers or stones and around new plantings. Use a layer of 1 - 2" of mulch over the fabric to prevent weeds from establishing themselves and protect the fabric from sunlight. Do not use plastic in place of landscape fabric. It will block exchange of air and water necessary for the survival of your landscape plantings.

- a)** Mulch or sow a cover crop over planting beds to discourage weed growth while new plants become established. Bark chips, due to acidity, can help limit weed growth and retain moisture for your new plantings. Beware of wood chips and sawdust products that can deplete valuable soil nitrogen as they break down. Remember to check for and supplement plants with nitrogen as needed, preferably with an organic product. Be careful not to place mulch where water flow will carry it to local storm drains.



straw mulch used to prevent erosion



3) Consider use of growth hormones. A variety of hormone and growth regulator products can support new plantings to help them through the establishment period. Evaluate whether your site or planting palette warrants use of these products.

Using compost on your site can have many positive impacts including:

- Retaining soil moisture
- Providing insulation from freezing
- Slowly releasing plant nutrients
- Controlling erosion
- Suppressing weed growth

**Always use fully composted materials.**

**Look for compost with the following specifications:**

- **30 - 50% moisture content**
- **Carbon to nitrogen (C:N) ratio below 30:1**
- **Large quantities of phosphorous, potassium, calcium, and magnesium.**
- **Favorable pH is between 6 and 8.**



## PLANT INSTALLATION

Complete initial site evaluation and design, and prepare soil before installing plants.

**A healthy plant is 75 to 90% water –**

**Oregon/Washington Master Gardener Handbook**

1) Obtain plants locally, where similar soils, conditions, and habitats will promote a healthy transplant. When possible, salvage plants already in existing landscapes. Timing for plant salvage is important – evergreens in early to mid-autumn, and deciduous in late fall to early spring when they are dormant.

2) Choose healthy plants:

a) For bare root plants, be sure root ball is solid (little or no movement of trunk or stalk).

b) Avoid plants with signs of disease or pest infestation.

c) Pick plant materials with the desired physical appearance and good potential growth habit. Annuals should have few sets of true leaves.

3) Plant in optimum weather:

a) Fall is generally best. Roots establish themselves during winter, preparing for spring growth.

b) Late winter / early spring planting can also succeed, especially for bare root plants, if roots have some time to establish before summer temperatures rise.

c) Don't try to plant in extreme weather, summer and winter temperatures will stress transplants. Always try planting on shady days in late afternoon or early evening. Consider cover crops of erosion control grasses or nitrogen fixers if there will be delay before final plant installation.

d) Be aware that seeds and seedlings are very susceptible to drying out – so store in shade and take other measures to retain moisture, such as misting roots, prior to planting.

**e)** Bulbs should not be planted in dry soil. Wet planting hole, let drain, and then plant bulbs.

**f)** Soak clay pots to wet them before planting or consider use of a painted sealant on the inside of the pot. Clay pottery dries out easily.

**4)** Dig a sufficiently sized planting hole:

**a)** Generally two to three times the size of the root ball or container (a minimum of 18 - 24 inches wider), and slightly shallower. In compacted or poor soil, the hole should be 3-5 times the width of the root ball or container. In general, the hole should be wider at the top than at the bottom, with roughed sloped walls.

**5)** Follow proper procedures to remove plants from their shipping containers.

**a)** For containers, lay plant on side, container end near planting hole and then tap bottom and sides of container to loosen root ball or growing medium. Gently remove container.

**b)** For bare root plants, remove wire or string holding wrapper in place. Take off plastic or burlap wrapping. If wire basket surrounds root ball, the upper rows must be cut when planting (interference with mowers or rakes is eliminated, and roots can then grow into the surrounding soil).

**c)** Remove all tags and labels. Some tags have the potential to girdle the trunk as a tree grows.

**6)** Plant materials appropriately.

**a)** Gently separate circling roots from root ball or container media. Trim extremely long roots, place root ball in prepared hole and guide shortened roots downward and outward

**b)** Place the root ball or container in the hole so it sits 2-4 inches above the surrounding soil grade (2-3 inches of mulch will cover the planting area when you are finished planting).

**c)** Backfill with the same soil that came out of the hole or mix in compost. Commercial soil amendments do not generally improve tree establishment

or growth, and can actually harm the transplant. When the planting hole is filled with amended soil, pore sizes are different from those in the surrounding native soils, creating problems with water movement and root growth.

- If soil must be brought to the site, or the backfill amended, make the planting hole extra wide and try to closely match imported soil with surrounding soil.
- Mixes of 80% topsoil and 20% compost work well as planting mix.

**d)** Work soil around the ball so that no air pockets remain and the plant is vertical and adequately supported, but do not pack soil. Water thoroughly (and slowly) while backfilling.

**e)** Form a temporary water basin around base (create a dam) to encourage water penetration over root zone. Water thoroughly after planting, slowly enough that moisture can be absorbed rather than running off. New transplants require more irrigation than established plants, so plan to irrigate accordingly.

**f)** After filling planting basin with water and letting it drain, fill basin with 2-3 inches of organic mulch (less if the material used is very fine, more if it is coarse). Mulch the basin area to help retain soil moisture. Be careful to keep mulch from touching tree base to prevent bark decay, crown rot, winter injury and rodent damage.

**g)** Provide stakes for stabilization only when necessary (large crowned, top-heavy trees/shrubs; windy areas; or where there is a danger of people pushing the plant over). Take care not to damage the tree by tying supporting cords/wires too tightly, girdling the trunk. Stake so that the trunk is allowed movement, which promotes healthy rooting patterns and stabilizes the plant. Protect from mowers and weed-eaters that can damage roots and trunk.

**h)** For plantings from seed, spread ½ seed in one direction and the other ½ in the opposite direction.

7) Fertilization is not recommended at the time of planting by some sources, citing the tendency for excessive fertilizer in root zone to damage plant health by promoting growth of small feeder roots, at the expense of larger, deeper stabilizing roots. Other sources recommend use of a slow release, granular fertilizer (avoid fast release agronomic fertilizers, which will dehydrate roots) if soil testing indicates a deficit of one or more nutrients. If fertilizer is used, distribute it a distance from the root ball (outside drip line) to avoid damaging the roots. See the resource section for more information.

a) Consider adding compost as a mulch and nutrient for new plants. Compost aids soil structure to allow for better root development in clay soils and is beneficial to organisms in the soil which help feed plants and discourage diseases. Corn gluten meal is an especially good source of nitrogen and under ideal conditions may even help with pre-emergent weed control.

### INSTALLING TURF

Analyze soil content and structure. Healthy and productive soil will mean the difference between poor and healthy stands of grass turf. Consider use of soil tests to determine need for nutrients.

1) In general, turf grows best in sandy loam containing a maximum of 20% fine particle organic matter by volume. Use soil analysis results to make amendments and prepare for seeding. Amend soil to achieve organic content between eight and 13% by volume. Add compost to increase soil permeability, water holding capacity, and nutrient content. Compost should be mixed half and half with topsoil within the first four inches of soil. Avoid creating sharp layers of materials within the soil, which can limit depth of root development.

2) Adjust soil pH. If no soil test is available, 100 lb. of dolomite lime per 1,000 square feet can be tilled in to enhance turf growth.

3) Plan for adequate irrigation, rainfall and temperatures. Your installation schedule should consider

that turf takes between nine and 12 weeks to germinate. The critical first two to three weeks should not be too wet, dry, or cold. New grass can go approximately two days without water.

4) Control disturbance and compaction to protect drainage. Avoid creating low spots where water will puddle. Assure that water can percolate to below the root zone.

a) Do not add sand to soils with high clay content. It will not improve drainage and it will generally increase compaction and decrease infiltration. Consider adding compost, which improves overall soil texture and structure and provides valuable plant nutrients.

b) If necessary, erect temporary barriers around the area to be seeded.

### INSTALLING HARDSCAPES (PATIOS, DECKS, FENCES)

1) It may be necessary to compact the gravel layer to form a solid base for setting materials. When doing this or inserting sand or gravel between pavers, be careful not to over-compact. Ideally, allow enough space that surfaces are permeable and will allow water to infiltrate.

2) Control trench and hole spoils and leftover paving materials. Dispose of them appropriately. Spread or rinse concrete wastes into an approved area, or onto a surface where the materials may dry, be dug up and then disposed of appropriately. Never rinse concrete wastes onto undeveloped property, into waterways or grates in the street.

3) Recycle concrete and other materials and wastes. Many construction landfills have recycling programs for woods, metals and concrete.



4) If finishing concrete aggregates with a salt or other solution to expose the surface, collect and neutralize the solution before disposal. Collect the solution by plugging a drainage inlet and then pumping runoff out, or by collecting rinsate on a tarp or other material. Sandbags or straw bales can be used to divert flow into a collection basin.

### INSTALLING PONDS AND WATER FEATURES

In proper numbers, fish can help keep a pond clean by eating algae and will supply nutrients for aquatic plants.

1) Reuse excavated materials. Provide berms around the edge of the water feature, or use these native materials to help build up feature waterfalls.

2) Slowly fill your feature to the desired water level. Leave the feature alone overnight and measure the amount of water lost over a 24-hour period. If more than 1/2 inch of the water is lost over 24 hours, it is likely that the liner is leaking somewhere and the pond should be repaired. Double check the splash zone of any waterfall to assure all flows stay within the water feature system.

3) Rinse all plants in a light colored bucket of tap water until clean. Inspect water for plant fragments of other species and snails. If other species are present on emergent plants, use a chlorine dip (this will harm submergent species such as water celery). Dip plant in 10% chlorine solution, swish, remove, and shake it off. After 30 seconds, rinse plant with tap water.

#### For Larger Ponds

4) Line all ponds with an impermeable liner, even in clay soils. Even minimal water loss through tight soils can mean large volumes of water lost over time. Choose a liner that is resistant to punctures

and ultraviolet light breakdown and consider whether the materials will be toxic to fish (concrete is toxic). Overlap and seal all seams.

a) Contain excess or waste concrete. Do not wash it into any street or drainage system. Retain concrete wastes on site until they dry out and can be appropriately disposed of.

### INSTALLING IRRIGATION SYSTEMS

1) Obtain applicable permits. Some agencies require plumbing or erosion control permits and plan checks.

2) Install according to design specifications, and test to verify that the system meets design criteria. Provide as-built drawings for the maintainer of the system. If deviations from design are required (i.e. running pipe around a tree), consult the system designer and redline the plan drawing to note the change.

a) Install a master valve to allow full system shutoff and to help discover mainline leaks and zone valve failures.

3) Calibrate the system to supply water at the following levels according to Irrigation Auditor (IA) calibration standards:

a) 55% or greater lower quarter distribution uniformity for fixed spray systems

b) 65% or greater lower quarter distribution uniformity for part circle rotary systems

c) 70% or greater lower quarter distribution uniformity for full circle rotary system

4) Provide the end user with product warranties and operating instructions for all equipment, as well as a system specifications and zone performance summary report (including individual zone precipitation rates in inches per hour).

a) Explain location and operation of controller, valves, sensors, pressure regulators, backflow device, and sprinkler heads. Educate on features and capabilities of the system, including maintenance requirements.

b) Reference data for each zone's precipitation rate should be posted at controller.

5) Flush main line and laterals before installing sprinkler heads.

6) Make sure that swing joints are installed on sprinkler heads. Install sprinkler heads with check valves on lowest heads to avoid low head drainage.

7) Consider installation of a dedicated deduct meter for irrigation lines. The meter measures how much water is used to irrigate your site, which will help determine when leaks are present and can provide valuable information on actual water usage. There may also be billing advantages to having a meter installed.

## RESOURCES

### General Construction

- Utility Notification Center: 811 or 1-800-332-2344, [www.digsafelyoregon.com](http://www.digsafelyoregon.com)

### Erosion Control

- City of Portland Office of Planning and Development Review: 503-823-7300
- Soil and Water Conservation Districts
  - Clackamas County: 503-655-3144, [www.conservationdistrict.org/](http://www.conservationdistrict.org/)
  - East Multnomah: 503-222-SOIL (7645), [www.emswcd.org](http://www.emswcd.org)
  - West Multnomah: 503-238-4775, [www.wmswcd.org](http://www.wmswcd.org)
  - Tualatin: 503-648-3174 ext. 5
- International Erosion Control Association (IECA) - Erosion certifications: [www.ieca.org](http://www.ieca.org)

### Soil Analysis

- Soil and Water Conservation Services
  - Clackamas County: 503-655-3144, [www.conservationdistrict.org/](http://www.conservationdistrict.org/)
  - East Multnomah: 503-222-SOIL (7645), [www.emswcd.org](http://www.emswcd.org)
  - West Multnomah: 503-238-4775, [www.wmswcd.org](http://www.wmswcd.org)
  - Tualatin: 503-648-3174 ext. 5

### Compost Tea

- Compost Tea Industry Association: [www.composttea.org](http://www.composttea.org)



### Weed Identification and Control

- Oregon State University Extension Master Gardeners
  - Multnomah County: 503-445-4608
  - Washington County: 503-821-1150
  - Clackamas County: 503-655-8631
- Oregon Department of Agriculture: 1-866-INVADER, [www.oregon.gov/ODA/PLANT/WEEDS/index.shtml](http://www.oregon.gov/ODA/PLANT/WEEDS/index.shtml)
- Pacific Northwest Exotic Pest Plant Council: [www.invasive.org/species/list.cfm?id=127](http://www.invasive.org/species/list.cfm?id=127)
- Forest Park Ivy Removal Project: 503-823-3681, [www.noivyleague.com/](http://www.noivyleague.com/)
- Invasive Weeds Program: [www.wmswcd.org/content.cfm/What-We-Do/Invasive-Weeds](http://www.wmswcd.org/content.cfm/What-We-Do/Invasive-Weeds)

### Naturescaping

- Metro Natural Gardening Program: 503-234-3000
- Naturescaping: <http://emswcd.org/naturescaping>
- Oregon State University Cooperative Extension Agency: <http://extension.oregonstate.edu>
  - Multnomah and Washington County: 503-725-2300
  - Clackamas County: 503-655-8631
- Hardy Plant Society of Oregon: 503-224-5718, [www.hardyplantsociety.org](http://www.hardyplantsociety.org)





# Maintenance

**S**ite maintenance activities have the potential for severe environmental impact. Use responsible maintenance practices to make your impact a positive one. Use Integrated Pest Management (IPM) techniques to maintain landscape health.

Practice preventative management - keep plantings healthy by providing appropriate cultural care. Most plant problems are caused by inappropriate growing conditions rather than pests or diseases. If a plant requires substantial inputs of fertilizers or pest control, consider replacing it with a species better suited to existing site conditions. Minimize green waste, and reuse any that you create onsite as compost or mulch. Reduce expenses by minimizing irrigation and chemical input requirements.

## Checklist for Discouraging Plant Diseases:

- 
- ✓ **Select suitable location for planting**
  - ✓ **Practice annual rotation**
  - ✓ **Select disease resistant varieties, disease free seeds and transplants**
  - ✓ **Use correct soil structure, fertility and pH**
  - ✓ **Don't overcrowd plants**
  - ✓ **Water properly**
  - ✓ **Control insect pests**
  - ✓ **Destroy or remove diseased plants**
  - ✓ **Be alert to leaf diseases**

- Oregon/Washington Master Gardener Handbook

## INTEGRATED PEST MANAGEMENT (IPM)

IPM is a coordinated decision-making and action process that uses the most appropriate landscape management methods and strategies to achieve maintenance program goals and objectives in an environmentally-sound manner. IPM seeks to prevent pests by fostering a healthy garden environ-

ment where individual plants have the strength to resist disease and insect infestations, and to out-compete weeds.

- Monitor landscape condition regularly.
- Determine acceptable plant injury levels and set action thresholds. It is critical to have clients accept some pest presence to supply food sources to support beneficial insect populations.
- Identify and learn the life cycle of pests so that you can minimize their reproduction and damage. You can also use beneficial insects that naturally target these pests.
- Use proper timing of maintenance efforts. Use beneficial insects or apply pesticides when pests are most susceptible, not after they have flown away.
- Select the least disruptive control and most effective revegetation tactics.
- Evaluate and revise efforts.

Start with an evaluation of site needs. Consider soil testing every 3-5 years to see if soils have enough nutrients and the proper pH to support desired plant communities. Use mechanical means to control pests and disease. If mechanical means aren't feasible, consider biological methods of control. As a last resort, IPM practitioners use chemical control that has the least environmental impact.

**1) Raise pest tolerance.** Encourage your customer to accept a higher level of pest presence and plant damage. Set the expectation that a yard should always have some pests to keep beneficial insects fed. Educate customers about the level of damage a plant can take and still thrive. Identify key pests, key plants, and key locations that incur greatest pest damage and drive costs.

**2) Establish thresholds for action.** Work with your customer to identify triggers for various activities. Thresholds can be based on visual observations such as amount of plant damage, overall health of plants or general appearance of plants. Some actions, like applying fertilizer, may be based on

measurement results from soils tests or atmospheric conditions like amount of rainfall. It is likely that you will be inspecting the site more and providing corrective actions less often. Ask these questions when faced with a pest or disease:

- a) What can be done to reduce the need for future intervention?
- b) How can you prevent or avoid these losses and expenses?
- c) Can hardier plants replace susceptible species?

3) Monitor the site to confirm the type of pest or weed present and its appropriate life cycle stage. If the pest is in the flying stage, and the larval stage is really what harms plants, you may be too late to prevent plant damage. You may need to consult a master gardener, botanic specialist or diagnostic lab for specific pest identification and information. Many pests can be controlled by manipulating their habitat – making it wetter, dryer, sunnier, shadier etc.

- a) Living organisms (insects, diseases or pathogens) usually damage leaves or needles in a random pattern. Frost or toxic chemicals produce more regular damage patterns.
- b) Signs of viral diseases include vein clearing (lack of chlorophyll), growth inhibition or distortion.
- c) Soft bodied insects are generally more easily controlled than hard bodied insects. Immobile insects are easier to control than flying ones.
- d) Beware of misidentifying larger pest species. The mole, not the vole or gopher, is the most common yard pest. Reducing their desired habitat area, such as lawns, will often help eliminate the pest.
- e) A good rule of thumb for distinguishing between pests and beneficial species is to look at parts of the mouth. If the insect's jaws point down, they eat plants. If the jaws point out, they are predators and a beneficial species worth protecting.

4) Keep records. Monitor regularly, and document observations. Regular record keeping that is convenient to use and easily accessed is critical to the long-term success of an IPM program.

**Less than 1% of insect species are serious pests that affect humans –**

**Oregon/Washington Master Gardener handbook.**

**Stable natural ecosystems control more than 95% of the potential crop pests and carriers of human disease –**

**Sustainable Sites Initiative Guidelines and Performance Benchmarks 2009.**

### Mechanical Practices

1) Keep plants healthy with preventative care.

a) Prune plants to remove diseased, damaged, or dead wood. Prune in the correct season (for trees, choose the dormant season; usually January and February) it also helps prevent disease to:

- Improve air circulation, helps inhibit the growth of some rusts and fungi, and
- Maximize light penetration to plants to dry leaf surfaces, discouraging many fungal diseases.

b) Don't let machinery compact areas around plant root zones.

c) Suggest replacement of plants needing large amounts of pruning with plants that can grow to a stable size and shape.

d) Don't prune more than ¼ of a tree in a year; bringing a tree back to proper health if it's never been pruned or has been improperly pruned can take several years. The amount of pruning for a tree depends on your objective for pruning and the tree's age, size and species.


e) Do not paint tree wounds with house paints or wood preservative. Don't apply heavy coats of any material (i.e. wrap the trunk) which can enhance the infection in the tree and make any damage worse. Remove injured bark with a sharp knife making cuts as shallow as possible. Don't enlarge the wound, or leave sharp points of bark. Work to maintain optimum health by providing appropriate water, pruning as needed, and fertilizing if necessary. Treat plant wounds quickly since they can be entry points for plant pathogens. Check the wounds

## Maintenance - EcoBiz Landscape Services Guide 2010

from pruning from the previous year. Proper cuts should have bark surrounding the cut from all sides sealing the wound and healing the tree. Contact a qualified arborist for additional information.

**f)** Don't burn pruning debris; use a chipper or shredder on site to save money and energy by eliminating the need to transport larger debris. Chipped debris can be composted and recycled into the same landscape without the additional environmental and public health issues related to burning. In some areas, burning is illegal.

**2)** Consider alternative removal equipment, such as propane torches, boiling water applicators, etc. Cultivators with curved tines that loosen and aerate soil can dislodge weeds and cause die off from root disturbance.



**Weed seeds can remain viable for 7 years or longer if conditions are right for growth – Oregon/Washington Master Gardener Handbook**

**3)** Remove weeds by hand pulling and hand clearing before they go to seed. Water the area before trying to hand pull so that soil is damp, but not wet. Know which species are present; use knowledge of their flowering habits and seed dispersal method to select the most appropriate control techniques. Minimize future weed growth by preventing seed drop and germination. Be careful not to completely till under soils to remove weeds. Tillers can compact soils and bury the organic matter so deeply insects and microbes cannot easily break it down.

**4)** Use barriers to prevent pest infiltration.

**a)** Use wood ashes, sharp rocks, and diatomaceous earth over small areas to deter slugs. Consider alternative products for remaining issues.

**b)** Copper or zinc wire and sheeting (not powder forms), plastic, or other barriers can prevent pests from entering plant areas. Floating row covers are a good option for newly planted specimens or crop plants. Do one final check before install to be sure

slugs and other pests are not trapped inside where they can accelerate plant damage.

**c)** Use landscape edging to help control undesired plant spreading (i.e. lawn into planting bed). Ideally, use recycled plastics, wood, concrete, bricks, or rocks from an excavated area. But be sure to check that the wood is not treated or coated with products that may be harmful to human and environmental health (i.e. creosote in railroad ties, pressure treated woods).

**d)** Consider lining planting beds with landscape fabrics to minimize weed seed germination and rooting. Cardboard sheets are good weed barriers under paths.

**e)** Prickly plants can deter large animals (including humans) from entering an area.

**5)** Use mechanical traps to control a wide variety of insects and small mammals. Traps can be home-made - like the beer baited margarine carton for slugs - or commercially developed like the yellow jacket hanging trap. Traps can use sticky paper, trap design, food sources, hormone baits or other methods to entice and trap pests. Molasses is another good sticky residue that can immobilize insects. Yellow is often used in traps to mimic plant color and be attractive to pests.

**6)** Physically remove pests by hand or with a stream of water. A steady water stream (most easily applied with a hose) can be used to wash pests from plants – especially aphids, mites, and mealy bugs. The best time to collect insects is early morning or after nightfall with flashlights.

**a)** Be sure to clean nesting boxes annually, suet feeders once a month and bird baths regularly.

**7)** Keep erosion control materials with you. There may be times when you unexpectedly come upon bare earth and need to provide immediate controls. A small supply of straw, wattles, silt fence, erosion control matting, or other materials could help you answer the immediate topsoil loss concern.

### Biological Practices

- 1) Time your maintenance work to support beneficial insects and protect habitat for other animals. Wait for spring to do a big garden cleanup on perennials, groundcovers, and grasses. Let seed pods form so they can be food for birds and their fluff can be used for nesting materials. For large areas, walk through the site before late spring mowing to avoid ground nesting birds.
- 2) Use mulch to suppress weed growth, insulate soil from drastic temperature changes, and retain water. Mulch twice a year – in spring after weeding and fertilizing to help retain moisture, and again in the fall for winter protection and weed suppression. Select mulch that also improves soil structure or supplies nutrients (like compost). Mulches with coarse texture can also shelter beneficial beetles and other insects from predators. If you are composting onsite, be sure to give any plant materials from herbicide treated grass clippings at least a year to reduce their herbicide residues. Be careful of using plant materials that have been treated with horticultural chemicals for compost around food crops (some chemicals can survive the composting process and harm crop plants). Do not compost diseased plant material. Be cautious about putting weeds in compost bins. If it doesn't get hot enough (i.e. active compost instead of passive), the weed seeds/heads won't die and you may spread weeds to your area when you apply finished compost. Use a compost thermometer to ensure your pile is hot enough to kill seeds (about 120 degrees).

#### The recommended thickness of the mulch layer depends on type of material used

Type of Mulch	Recommended Depth
Dry grass clippings	2 inches
Shredded hardwood	2 - 4 inches
Straw or wood chips	2 - 4 inches
Compost	3 - 4 inches
Dry leaves	6 inches

3) Add nutrients by topdressing with compost or applying compost tea, (best if within 24 hours of brewing). Teas including molasses, kelp, rock dust or other ingredients can enhance soil microbial growth. Plants need the largest amount of nutrients when they are growing the most rapidly. Be careful not to encourage growth late in the growing season which may make a plant susceptible to winter injury. Add 1-2 inches of compost every year to help grow a productive garden soil structure. Every 1% of increase in soil organic matter increases water absorption capacity to 16,000 gallons per acre, down one foot deep.

4) Rotate annual plants with other flowers or vegetables to help break up disease cycles that are more plant specific.

5) Install a companion plant. Fertilizer, pesticide, and other weed management requirements can be reduced through this technique. Specific plant combinations can help prevent or control pest and disease damage. The most common benefits are:

a) Symbiotic nitrogen fixation – cover cropping can help limit weed growth. Some legumes (peas and beans) are capable of fixing nitrogen from the air through their symbiotic relationship with rhizobium bacteria; nitrogen is released in the soil and made available to surrounding plants. Legumes are typically used as a cover crop and tilled into the soil at least 3-4 weeks before replanting with the desired species. This method of soil preparation replenishes nitrogen in the soil, reducing fertilization requirements for new landscape plantings.

- Crimson clover, hairy vetch, Austrian chick pea, buckwheat, and annual rye grass are good cover crop species.

b) Biochemical pest suppression - Some plants release chemicals that suppress or repel pests, protecting neighboring plants.

- Marigolds release thiopene - a nematode and slug repellent. Plants must be in place for a whole season over the entire planting area to protect the subsequent year's crop.

- Sunflowers and walnuts release allelochemicals, all but eliminating understory plant growth and providing natural weed control, especially for the nightshade family. Plan for bare soils accordingly. Many weed species such as Canada thistle, quackgrass, smartweed and pigweed also are allelopathic.

**c) Physical spatial interactions / nurse cropping**

- Underplant tall-growing, sun-loving plants with lower growing, shade-tolerant species. This will promote greater plant coverage and protect bare soil from wind and rain. Use tall, densely canopied plants to provide shade or a wind-break for more vulnerable species. Plan for coverage during all seasons.
- Use a fast growing “nurse crop” such as sterile grains and grasses to prevent weeds from taking over while the desired plants become established.

**6) Consider adding purchased beneficials to the existing site populations. Be aware that beneficial insects take longer to rebuild their populations than pest species after die offs related to pesticide application or climate conditions.**

**a) Provide habitat for predatory and parasitic species, which can help to reduce both pest damage and pesticide use. Identify beneficial insects already existing on your site and evaluate factors that limit their successful control of undesirable plants and pests.**

- Examples of predatory arthropods include ladybugs, lacewings, hover flies, mantids, robber flies, and non-insects such as spiders and predatory mites. Spiders are one of the best predators since they eat a large variety of species and are very common throughout any garden.
- Parasites include a wide range of fly and wasp species such as tachinid flies, and trichogramma and ichneumonid wasps. Nematodes are active against more than 200 insect species.

**b) Examples of border plants which can host beneficial insects: Plants native to the area. Sweet alyssum (Lobularia Maritima) and golden**

marguerite (Anthemis Tinctoria) are especially good at protecting roses from aphids. Be wary of using fennel, borage, and bachelor’s button or cornflower, which are non-native invasive species and are not recommended. See resource list for invasive plant information.

**c) Provide houses and other protected nest spaces to encourage bird and bat presence.**

**d) Some fungus products, like Beauveria Bassiana, destroy a large range of pests.**

**\$700 million is spent annually on pesticides for U.S. lawns. - Wisconsin Partners for Clean Air**

**An inert ingredient is any ingredient in the product that is not intended to affect a target pest. Since neither the federal law nor the regulations define the term “inert” on the basis of toxicity, hazard or risk to humans, non-target species, or the environment, it should not be assumed that all inert ingredients are non-toxic. -EPA**

### Chemical Controls

Use chemical controls only as a last resort. Prior to taking this approach, be sure that damage thresholds and action levels for specific pest problems have been set. Pesticides can be of a natural or synthetic origin. Additionally, some classes of pesticides can be characterized as synthetically derived naturally occurring substances. Herbicides can act as a pre-emergent (preventing growth) or a post-emergent (when weeds are leafed out). The most important component of horticultural chemical use is knowing your chemical - how it is to be used and its impacts on the environment. Avoid using pesticides with “warning” or “danger” labeling.

**1) Fertilizer - Apply only nutrients plants can use. Nitrogen is the most commonly needed for most plants. Test soil (separate tests should be applied**



for lawn and garden) to determine what is needed. In general, lawns need fertilizer in the fall. Other signs for need of fertilization include:

- Smaller than normal leaves
- Light green or yellowish leaves
- Shorter than average root growth
- Dead twigs and branch tips

Be aware that some plant diseases also display similar characteristics.

**a)** Place fertilizer near plants rather than spreading it over the entire garden. You may need to break up applications for plants surrounded by grass that may be easily burned by applications.

**b)** Use slow-release fertilizers to minimize leaching into groundwater. Consider using compost teas. If you must use a fertilizer, consider organic blends with slow release properties.

**c)** Use fertilizer to help repair plants that are partially or fully defoliated by insects or disease.

**d)** Regardless of product used, don't fertilize in the late fall right before or during the rainy season when fertilizer will likely wash away and can contaminate surface and ground waters.

**2) Pesticides** (including herbicides, fungicides, insecticides and rodenticides) If pesticides are needed, consult resources listed for alternatives with the lowest toxicity and environmental impact.

**a)** Alternative products (i.e. horticultural oil, insecticidal soap, diatoms, and dish soap slurry) may be appropriate for control of pest problems at your site. Contact chemicals and alternatives are more limited because effects occur from only a single application. They work by affecting the cuticle (skin) or breathing passages or the pest species:

- BT products can be chosen that are specific to the target pest. Avoid BT use in butterfly garden areas.
- Consider sulfur-based dormant sprays for fungal diseases like black spot, powdery mildew and rust.

- Acid-based herbicides are good for controlling weeds in gravel and paved areas.
- Neem oil disrupts feeding and mating of insects and is an effective fungicide.
- Horticultural oils smother and horticultural soaps dry out a variety of pest species.
- Corn meal is good for worms, because it expands in their stomach and kills them.

**b)** Do not use products that accumulate in plant tissue and prohibit future use of composted materials (e.g. Clopyralid and Picloram). In general avoid the following products that have higher toxicity to non-select animals: Metaldehyde, Disulfoton; Carbaryl, Malathion, and Pyrethroids (Bifenthrin, Cypermethrin, Cyfluthrin, and Permethrin).

**c)** Always follow the manufacturer's label for mixing, using and disposing of the pesticide or fertilizer product.

**d)** Match product type to plant stage – such as sprays for plants in leaf out and granules for emergent conditions.


**e)** Use spot treatments versus full cover sprays and only mix as much as you need. Spot treatment can reduce pesticide use up to 90%.

**f)** Never spray a product over a water source or water feature. If possible, get onto a waterway and spray back toward the bank to reduce drift.



### Pollution Prevention - (P2) Potential

Before you spray check list:

- 
- ✓ Have you identified the pest?
  - ✓ Is the level of damage enough to warrant treatment?
  - ✓ Is the appropriate stage of the target pest lifecycle to spray (i.e. usually not after hatch out)
  - ✓ Is action needed to make the problem go away or will it disappear on its own?
  - ✓ Have you tried other IPM efforts?
  - ✓ Is pest present and at a vulnerable stage for effect?
  - ✓ Are plant type and pest species on the label for the product you wish to apply?
  - ✓ Have you chosen the least toxic pesticide?

1) Know the physical characteristics of any product you consider using, including: the length of residual effect, decomposition rates, breakdown products, volatility at different temperatures, product and package size and form, leachability (solubility, surface and soil bonding capability), flammability, and ease of cleaning equipment after use. Don't assume that a high percentage of inert ingredients means the product is not hazardous. Always limit the amount applied. Many times painting a leaf or a cut stem is much more effective than a general spray application.

2) Understand how the chemical will impact the target and any surrounding non-target plants or pests.

a) Smooth-leaved plants absorb chemicals better than plants with waxy or hairy leaves.

b) Many bulbs and flowers do not thrive well with pre-emergents, which can inhibit plant shoots and growing roots.

c) Avoid pesticides with carbaryl, metaldehyde, or rotenone, which are significantly more toxic to

beneficial insects or fish. Cats are also sensitive to pyrethrums.

d) In general, iron phosphate products have less mammalian toxicity than other aldehyde based products.

Use Metro's *Grow Smart, Grow Safe* guide to evaluate various chemical products [http://library.oregon-metro.gov/files/gsgs\\_11-5\\_web.pdf?78,150](http://library.oregon-metro.gov/files/gsgs_11-5_web.pdf?78,150)

3) Consider the application site conditions.

a) Short term application considerations:

- Application equipment availability and method of delivery, check and calibrate all equipment
- Protective clothing and equipment
- Mixing location and methodology-mix only as much as you need. Apply using designated, self-contained spraying equipment. If a hose based applicator must be used, assure that an appropriate backflow prevention device is between the chemical and the drinking water supply.
- Current and anticipated weather conditions such as wind, rain, and temperature
- Site conditions such as soil type, slope, grade, drainage patterns, and presence of open or seasonal water. Do not apply materials over open waters or in windy or rainy conditions that will divert materials away from the target site before they can do their work. Eight hours of dry weather is usually enough. Application should be made in calm wind conditions to prevent drift and adjustment should be made to droplet size and pressure if marginal conditions exist – less than five miles per hour is best. Many soil-applied herbicides need moderate moisture to move into soil layers.
- Access by unwanted species. Baits should be applied in tamper proof containers that are rooted in or attached to the application area so they cannot be moved.

### b) Long term considerations:

- Planned use for treated area; Is there potential for pet or child contact? Barricade the site or post signage when using materials that are harmful within the first few hours after application. Pesticide labels specifically outline the appropriate and national legal requirement for posting a site and associated entry restrictions. Additional local, site-specific posting requirements may apply, especially for schools and parks. These legal requirements and site policies should be followed. In general follow these guidelines:
  - ✓ Remove children's toys and lawn furniture from the application area.
  - ✓ Post the site with caution signs that notify the public of pesticide use and re-entry conditions.
  - ✓ Notify community centers and schools in writing before an application is made to adjacent properties. Make follow-up calls to give application information and answer questions as they arise.
  - ✓ Post parks and rights-of-way with notification signs prior to pesticide application.
- Know your pesticide. Sometimes when the same pesticide is used repeatedly, pest populations can develop resistance. Properly rotate products or control techniques to minimize risk of resistance build-up.
- Positive and negative synergistic effects of combining pesticides; compatibility of different pesticides may be of concern both regarding their physical traits, as well as their effects on the target pest or beneficials.

4) Is your pesticide of choice a Restricted Use Pesticide? If yes, the applicator must be educated and certified by passing the appropriate State Department of Agriculture examination. If using a General Use Pesticide without powered application equipment, no license is needed; but use careful

application techniques regardless of the material.

a) Avoid use of old, canceled or restricted pesticides including products recently phased out for consumer use:

- Chlorpyrifos (Dursban) – not sold after 2001
- Diazinon – not sold after 2004
- Chlopyralid – not for residential use after July 2003
- Other older pesticides such as DDT, Aldrin, Chlorodane, Kepone, Toxapene should never be used and taken to a household hazardous waste collection event or site for proper disposal.

5) All applications should be, and in some cases are mandated to be, documented, which includes information on application conditions (date, time of application, wind condition, temperature, humidity, volume applied and method of application). See specific state record keeping requirements at [www.oregon.gov/ODA/PEST/purs\\_index.shtml](http://www.oregon.gov/ODA/PEST/purs_index.shtml)

**Researchers found that gardening satisfaction was the highest for people who didn't use chemicals – American Horticultural Association.**

## MAINTAINING TURF

Use IPM practices to maintain healthy turf that provides full coverage of the desired area. Healthy turf is much less susceptible to disease and pest damage and out-competes weeds. Careful maintenance, good irrigation, thatch removal, aeration, and mowing, is the best way to control pest damage to turf. Use maintenance techniques that create conditions that more closely match the needs of grass, allowing it to become more competitive, and out-perform weeds. Moss is a sign of weak grass establishment.

### Mechanical Practices

1) Let grass brown out. Many species of lawn turf are adapted or naturalized to summer drought

conditions. There are also a variety of tools you can use to easily spot treat or remove weedy areas that become more visible in brown grass.

**2) Mowing:** Limit mowing when possible, since mowing may stress the grass blade and accelerates water loss from the turf. Raise mowing heights to 2 1/2 inches on most lawns to keep down weed growth, encourage deeper root development and improve resistance to drought stress. Mowing too short limits the ability of grass to keep up photosynthetic production of food and increases susceptibility to diseases, such as red thread. Short cuts increase weed invasion, as weak grass cannot out-compete plants like chickweed, moss, and dandelions. Mow during the coolest hours of the day to limit moisture loss.

**a) Avoid mowing wet grass.**

**b) Cut no more than 1/3 blade height with each mowing (1/4 to 1/3 of blade height is recommended). Mow frequently, following the 1/3 blade height guideline. Change direction of mowing periodically to prevent "washboard" effect.**

**c) Mow shady lawns 1/4 to 1/2 inch higher, and less frequently, than normally recommended for a grass species. More leaf area compensates for lower light levels in production of food through photosynthesis, and deeper, more extensive rooting results.**

**d) Consider using a push or electric mower, especially on Clean Air Action Days or when air pollution is high or air movement is low. Clean Air Action days are called on stagnant summer days, when sunlight and high temperatures mix with nitrogen oxide pollutants, which come from sources such as cars, lawn mowers, paint and aerosol sprays. The mixture forms a rich and irritating ozone stew, more commonly known as smog.**

**e) Use mowers that mulch or leave grass clippings on the turf (grass cycling) for nutrient, moisture and heat retention benefits. Grass clippings are about 4% nitrogen. One study shows that grass cycling reduces mowing time by 38% over traditional bagging of clippings.**

**3) Aerating.** Compaction is a main cause of poor lawn appearance, whether from heavy wear or over-use of chemicals. Aerate to reduce compaction and improve nutrient cycling, drainage, and moisture holding capacity. Aeration should occur only when the desired grasses are growing vigorously. Aerating in summer when most grasses are semi-dormant can improve growing conditions for undesirable plants like crab grasses and dandelions.

**a) Aerate at least once every four years (more frequently for highly compacted areas) when roots are growing - generally in spring and fall.**

**b) Remove soil cores that are 1/4 to 1/2 inches in diameter and approximately three to four inches deep. Small, hand-used tubular tine forks work for small jobs. In larger areas, a mechanical tractor-pulled unit will be more efficient. Equipment with solid tines or spikes should not be mistaken for aerating equipment. Aeration requires removal of a soil core, which solid tine spikes do not accomplish. Spikes increase compaction by displacing soil to all sides of each tine and creating a denser soil mass.**

**c) Apply a layer of compost topdressing (up to 1/2 inch) before aeration. This allows nutrients from the compost to move easily into the root zone, promoting healthy turf and substantially reducing the need for fertilizer input. If fertilizer is to be used, apply just following aeration.**

**Pollution Prevention - (P2) Potential Limit the amount of water and fertilizer to just what turf needs. Not only does the excess run off the site, potentially creating pollution problems, but too much water and fertilizer can contribute to excess turf growth, which requires more mowing and can grow more thatch.**

**4) Thatching.** A moderate thatch layer (<1/2 inch) can protect soils from erosion, bind plants together to resist wear, and cushion falls on the turf.

Excessive thatch (> 1 inch) restricts movement of air, water, and plant nutrients into the soil and weakens the grass. Thatch is usually a sign of over-fertilization, over-watering or frequent shallow watering, compacted soils or over-use of chemicals. Turf grass roots also begin to grow into thatch rather than in the soil beneath, which leaves the turf extremely susceptible to drought. Healthy lawns are maintained by earthworm castings, which speed fungal and bacterial breakdown of thatch.

**a)** Remove thatch during spring or fall when precipitation rates are high and lawn is actively growing. Do not dethatch during periods of high temperatures or dry weather, when grasses are dormant. If tilling for thatch removal, rototill over three to four weeks in dry weather.

**b)** Maintain soil pH between 6.5 and 7. That pH will encourage microbial activity, helping to break down thatch, and eliminate the necessity of mechanical thatch removal.

**5)** Irrigation. The goal of proper turf irrigation is to sustain a healthy plant community without causing runoff. Dull color and slight wilting of grass blades is the sign of insufficient watering. Frequent or over-watering can produce shallow root systems and can lead to oxygen depletion and nutrient leaching in the grass root zone. The most environmentally-friendly option, especially for lower use turf areas, is to allow turf to go dormant and brown out (meaning deep watering once a month). An un-watered lawn is more prone to weed infestation, especially from deep-rooted weeds like dandelions. Un-watered lawn will also need rejuvenation in the fall (aeration, topdressing, etc). If you desire a green turf surface, follow these irrigation recommendations:

**a)** Consider whether cultural practices, such as mulching and shading, will help limit water needs. Assure your systems are not watering pavement.

**b)** In general, if soil feels moist at the 3-inch depth, delay irrigation. Infrequent, deep watering will help establish deeper roots, making grass more drought and pest resistant.

**c)** Frequency of irrigation should be determined using the following factors: slope (sloped areas are drier), water holding capacity of the soil, effective rooting depth of grass, weather conditions, and traffic level/type of use. Watering in the early morning is ideal as standing water from night watering can encourage fungal disease.

**d)** Normally-maintained turf grasses utilize about 80% of open-pan evaporation (ratio of plant water use to evaporation 0.8:1). Unclipped grasses will have a higher rate of evaporation. Use a 70% efficiency factor unless a specific test has been made.

**6)** Barriers, such as lawn edging, can prevent the need for using chemical herbicides later. Ideally, use edging products made of recycled materials - plastics, wood, concrete, etc. Evaluate true need before choosing edging products impregnated with pesticides.

**7)** Pet waste should be collected and disposed of in the garbage. Do not add pet waste to compost piles – many of the viruses, bacteria and other parasites in animal waste survive composting and can be a public health problem. Do not flush down the toilet either; wastewater treatment plants typically don't effectively treat pet waste.

### Biological Practices

**1)** Use natural predators to control pests. The biggest issues with turf, especially in the Pacific Northwest, are weed invasion, moss, diseases and pests. Red thread and crane flies are the most common turf disease and pest issues in our region.

**a)** Be sure soil nutrients are sufficient. Red thread, which shows up as wet, dark or pink patches 2 to 24 inches in diameter, is temporary and does little damage and commonly occurs in low nitrogen situations. Proper calcium levels, compost topdressing and grass cycling can help prevent this disease, while mowing infested areas and fertilizing appropriately can remove flare-ups in turf. Do not apply chemicals to solve this problem. It will disappear on





its own as the weather warms and the grass grows out of the diseased area.

**b)** Provide water to encourage the presence of birds that feed on adult and emerging insects like European crane flies. Birds can consume half the larvae present between fall and spring. Be sure there is adequate drainage to keep out crane flies, especially letting soils dry out in late summer when adults are trying to lay eggs.

**c)** Look for crane fly larvae in February to control outbreaks, because the larvae stop feeding by May. To help identify crane fly infestations, aerate on a cloudy day when the 1 to 1 ½ inch grey-brown larvae are feeding to bring them to the surface. You can use a soapy solution (1 oz liquid soap per gallon of water) to drench soils and make larvae come to the surface. Control with parasitic nematodes when temperatures are above 55°F. Nematodes are most effective when more than 15 larvae per foot are present. Damage appears as sparse or brown patchy lawn damage in May or June, when it is too late to take preventive measures and too late for chemicals to help.

**d)** Consider allowing grasses to grow higher to allow for more use by earthworms and other beneficial species. Leave moss raked out of lawns in small piles for birds to use as nesting materials.

**2) Fertilizing Turf.** Turf needs nutrients (especially calcium, phosphorus and potassium) to sustain plant health and support turf growth. This is especially true west of the Cascades. Calcium can be deficient in areas of high rainfall due to leaching, and is critical to stabilizing soil pH, which affects a plant's ability to uptake available soil nutrients and keeps earthworm populations in place. The presence of clover can indicate the need for nitrogen. The best time to fertilize is in the fall to support the plant's root system over the winter. Spring growth robs nutrient reserves for plant growth and increases the amount of mowing. Irrigated lawns may also need another application in June. Never fertilize during the rainy season when products can

be washed into local streams. Fertilizers are often best applied after aerating to get products to the root zone more quickly. Consider these biological methods for adding nutrients to turf and keeping earthworms active in turf support:

**a)** Leave grass clippings on lawn to reduce fertilizer requirements by as much as 25%. A good rule of thumb is to cut fertilizer use in half when grass cycling. Studies show that grass on sites using grass cycling grows faster, greens up earlier, stays green longer into the fall, and has fewer weeds than bagged turf areas. Grass cycling also increases nitrogen uptake by over 40% and provides cover and habitat for earthworms that break down the clippings into nutrients for the soil. Bagging clippings also doubles the total mowing time for turf.

**b)** Use compost that has been screened to 3/8 inch particle size and has a 30-50% moisture content as a topdressing to a depth of ¼ to ½ inch, or approximately 1 cubic yard per 1,000 sq. feet of lawn. A 1-2 inch layer of compost or an application of compost tea can also be incorporated through aeration into the top 4-6 inches of soil. Drier composts can create dust and tend to float on the soil surface rather than being integrated. Composts with less than a 30:1 carbon/nitrogen ratio are best since only 10% of nitrogen can be used during the first growing season. Avoid high concentrations of soluble and sodium-based salts, which can reduce turf water absorption and is toxic to grasses. Top dress when grass is growing vigorously in early to mid-spring and early fall.

**Earthworm activity provides benefits comparable to topdressing turf with topsoil. When worms are killed off due to strong insecticides, infiltration falls to over 40% within a year. – Seattle Public Utilities**



c) Apply fertilizer only when needed, not according to an arbitrary schedule. Work to establish healthy grass by mechanical means (thatching, aeration, proper mowing height, and efficient irrigation). Test soil to gauge nutrient levels before applying fertilizer. Generally, apply fertilizer in the spring or fall after thatching and aerating. Use slow-release fertilizers, and calibrate the spreader correctly. Do not allow fertilizer to fall on sidewalks or driveways where it can be washed into storm sewers, polluting streams and rivers. When possible, use organic grain type fertilizers (ground corn, blood meal, soy, alfalfa) at 10-20 pounds per 1,000 square feet of lawn area. These products are best applied before mid-October.

3) Neem tree oil and other biological based products can reduce larvae issues in turf. Many of these products are not as affected by temperature fluctuations as other chemical products.

### Chemical Controls

When chemical control is necessary, follow all the rules highlighted earlier in this section. In general, many perennial grass weeds cannot be controlled with selective herbicides in turf. Avoid weed and feed products which may apply chemicals that turf does not need.

1) Chemical herbicides should be applied no more than twice a year – in winter and in spring. Pre-emergents should be applied 10-14 days prior to expected germination. Weed seeds sprout at around 50 to 55 degrees Fahrenheit. Spot treat when weeds exceed 30% coverage in the lawn, and don't full spray unless over 50% coverage. Post-emergents are only applied when the plants are present and work best when plants are actively growing (spring and fall) and temperatures are above 70 degrees F. In general, post-emergent herbicides are applied on the plants themselves, where pre-emergent herbicides are applied on the soil surface and should be watered into the soil.

2) Chemical fertilizers should be applied only when roots are growing and irrigation is available, up to the end of November or before the rainy season. Be wary of commercial products which have been shown to decrease populations of earthworms and soil pH, and increase thatch accumulation, soil compaction and turf diseases. These products also create nutrient swings that can favor weedy plant growth. Many products also encourage shoot growth, which increases mowing and reduces carbohydrate reserves needed during dormant periods. Look for slow release products, preferably from natural or organic sources with a N-P-K ratio of 3-1-2.




### MAINTAINING HARDSCAPES (PATIOS, DECKS, FENCES)

Patios usually need minimal maintenance to maintain their function and appearance. Remove any undesirable plant growth through mechanical means when possible.

1) Use dry cleaning techniques when possible. Sweep rather than hose off surfaces. Using water loosens pollution and dirt particles that can escape notice.

2) Avoid using gas-powered vacuums and blowers to clean surfaces. They emit large amounts of air pollution, and noise levels are hazardous to your staff and a nuisance to customers. Consider using electric vacuums or blowers as an alternative. If gasoline engines must be used, use equipment with a four-stroke instead of a two-cycle engine if possible.



**Pollution Prevention - (P2) Potential Evaluate life cycle costs of machinery use. Is it really cheaper to buy, maintain, fuel, clean and store that mechanical equipment rather than pay for a few more hours of hand-sweeping labor?**

3) Clean decks and fences by scrubbing with a soft bristle brush. If detergent is used, choose one that is biodegradable and phosphate free. If power washing larger surfaces, use low pressure (less than 1500 PSI) and minimize runoff.

a) Use straw bales, sandbags, or other diversion measures to prevent runoff from entering storm drains.

b) Collect paint or wood chips.

4) When sealing hardscapes, choose low solvent, low volatile organic compound (VOC) and the least toxic products available. Prepare surfaces before applying any product to maximize effectiveness. Use protective equipment, including safety glasses, respirators, gloves and all-over skin protection.

5) When maintaining hardscapes constructed of chromium copper arsenate (CCA) treated wood, inspect sealant condition regularly. Reseal immediately when sealant is losing effectiveness. If repair or replacement is required, use alternative products rather than replacing with CCA-treated wood which need little or no maintenance.

a) Wear appropriate safety gear (respirator, safety glasses, and skin protection) when handling or cutting CCA treated wood. Dispose of scraps and sawdust in a lined landfill. Do not burn, as this releases arsenic.

6) Use hand-pulling or heat from boiling water and propane torches for weed removal. While burning may not be effective on grasses, it is a good way to kill off other undesirable plants growing through hard surface areas. Be sure to plan adequate fire protection into burning practices. Do not burn on Clean Air Action Days.

### MAINTAINING PONDS and WATER FEATURES

Maintaining water features is very system-specific. Typical maintenance should include:

1) Clean out the leaf/debris collection basket every two weeks depending on seasonal leaf drop issues.

2) Inspect the structural integrity of skimmers, pumps and disinfection units monthly.

3) Wash or replace filters according to manufacturer's schedule, or at least monthly.

4) Provide aeration or other means of water movement to keep mosquitoes from breeding in the water feature. Mosquitoes are more likely to breed in clogged building downspouts than in active, flowing water features.

### MANAGING / MAINTAINING IRRIGATION SYSTEMS

Some planting areas can only be maintained with adequate irrigation systems to sustain plant health. Water-stressed landscape plants may be more susceptible to disease, insects and winter injuries.

- 1) Determine whether cultural practices such as mulching, shading, close plant spacing, or wide bed planting can meet some of the site's irrigation needs.
- 2) Create an irrigation schedule with the owner/maintainer of system. Review the rationale for the schedule and how to set it: irrigation days, application duration, start times, advanced programming features, multi-cycle irrigation to prevent runoff. Small plants and flowers may need more frequent watering in hot weather – up to twice a week. Be sure to check for broken or misaligned heads. Overspray onto sidewalks and buildings can waste more than 20 gallons of water a day.
- 3) Irrigate in early morning when plants have the least stress and can take up water efficiently and can dry before nightfall. If morning watering is not possible, water in the evening or during the night but not during the heat of the day (except for newly-installed plantings) to minimize evaporation and sunburn damage on plant leaves. Make sure water reaches the entire root zone of plants that need irrigation – usually 12 to 18 inches deep. Apply water only as fast as it can be absorbed. Higher application rates will form runoff, wasting water and transporting pollutants. You can reduce runoff by applying water in several short intervals rather than one longer period. Do not overhead water and get foliage wet; instead, water at the base of the plant to ensure water reaches the root zone.

**Residential landscapes are regularly  
overwatered by 30-40% -**

**Bay-friendly Landscape Principles and Practices.**

**A six to eight inch layer of organic mulch  
can reduce water needs by as much as half,  
by smothering moisture-using weeds and  
reducing evaporation – Oregon/Washington Master**

**Gardener Handbook**

- 4) Apply water slowly to avoid runoff. Water infrequently, for long periods to allow water to soak deeply rather than multiple short watering periods (this may not apply to young fruit trees). If mulch gets waterlogged, spread it to allow it to dry or replace it to avoid plant and mulch rot.
  - a) Run each of the stations to determine at what point runoff or standing water occurs (usually four to seven minutes). Soaker hoses and drip irrigation systems may need longer periods – such as 40 to 60 minutes to inundate soils.
  - b) Schedule watering cycles about one-half hour to one hour apart. Irrigate in three or more cycles, especially on uneven or sloping ground. Wet soils allow more water to infiltrate and minimize runoff. This results in more deeply rooted turf, which is less susceptible to drought, pests and disease.
- 5) Provide your client with recommendations for landscape water conservation.
  - a) Emphasize the importance of maintaining system components for proper operation.
  - b) Emphasize the benefits of landscape practices, such as mulch and soil amendments.
  - c) Let the owner know if there is room for improvement in the design of planting areas to increase drought tolerance and landscape success.
- 6) Properly shut down and drain the system for the winter season to avoid freeze/thaw pipe breakage. This may include the use of an air compressor to expel water from irrigation lines, especially where check valves are installed.



### RESOURCES

#### Solid Waste/Disposal

- Metro: 503-234-3000, [www.oregonmetro.gov/recycling](http://www.oregonmetro.gov/recycling)
- City of Portland: 503-823-7202, [www.portlandonline.com/bps/index.cfm?c=41461](http://www.portlandonline.com/bps/index.cfm?c=41461)
- Clackamas County: 503-557-6363, [www.clackamas.us/transportation/recycling/](http://www.clackamas.us/transportation/recycling/)
- Clark County, WA: 360-397-6118 ext. 4352, [www.clark.wa.gov/recycle/](http://www.clark.wa.gov/recycle/)
- Washington County: 503-846-8609, [www.co.washington.or.us/HHS/SWR/](http://www.co.washington.or.us/HHS/SWR/)

#### Invasive Plants

- Oregon Department of Agriculture: [www.oregon.gov/ODA/PLANT/WEEDS/](http://www.oregon.gov/ODA/PLANT/WEEDS/)
- **GardenSmart Oregon** - [www.portlandonline.com/bes/gardensmart](http://www.portlandonline.com/bes/gardensmart)
- Nature Conservancy: [www.nature.org/initiatives/invasivespecies/](http://www.nature.org/initiatives/invasivespecies/)
- Forest Park Ivy Removal Project offers ivy removal information: Call 503-823-3681
- METRO Natural gardening information and educational opportunities: 503-234-3000
- Naturescaping: [emswcd.org/naturescaping](http://emswcd.org/naturescaping)

#### General IPM Resources

- Database of IPM Resources: <http://attra.ncat.org/attra-pub/ipm.html>
- OSU Extension Offices: see contact info below
- Northwest Coalition for Alternatives to Pesticides, NCAP: [www.pesticide.org/](http://www.pesticide.org/)
- Mt. Hood Community College Horticultural Program: 503-491-7447, *IPM Solutions*
- *Ecologically Sound Lawn Care for the Pacific Northwest* - David McDonald, Seattle Public Utilities, 1999.
- *Using Composts to Improve Turf Performance*, Penn State University, 1996.
- *Bay-Friendly Landscape Principles and Practices*: [www.stopwaste.org/home/index.asp?page=8](http://www.stopwaste.org/home/index.asp?page=8)
- Metro Natural Gardening Guides: [www.oregonmetro.gov/garden](http://www.oregonmetro.gov/garden)
  - *Grow Smart Grow Safe* (chemical guide) - [http://library.oregonmetro.gov/files/gsgs\\_11-5\\_web.pdf?78,150](http://library.oregonmetro.gov/files/gsgs_11-5_web.pdf?78,150)

#### Pesticide Resources

- EXTOWNET (The EXTension TOXicology NETwork): <http://extownet.orst.edu>
- National Pesticide Information Center (NPIC) – out of Oregon State University: 800-858-7378, fax 541-737-0761 or [www.npic.orst.edu](http://www.npic.orst.edu)
- Oregon State University Extension Service: (information and links) <http://extension.oregonstate.edu> or call your local extension office or Master Gardener hotline for information or referrals.
  - Multnomah and Washington County: 503-821-1150
  - Clackamas County: 503-655-8631
- EPA, *Healthy Lawn, Wealthy Environment*: [www.epa.gov/oppead1/Publications/lawncare.pdf](http://www.epa.gov/oppead1/Publications/lawncare.pdf)
- NW Coalition for Alternatives to Pesticides: [www.pesticide.org](http://www.pesticide.org)

# Equipment and Vehicles

**A**irborne pollutants damage plant life, including crops and forest. Air pollution (including carbon monoxide, nitrogen oxide, volatile organic compounds, and particulate matter) generated by combustion of fossil fuels affects the environment by contributing to the formation of ground-level ozone, haze, and acid rain.

**Gas powered tools contribute 5% of the US air pollution - EPA**

**Air pollution causes agricultural losses of over \$2 billion each year- costs that are eventually passed on to consumers - US EPA**

**A 3.5 hp gas mower can emit the same amount of smog causing air pollution in an hour as a new car driving 340 miles. - US EPA**

## 1) Purchasing New Equipment

### a) Choose the least polluting equipment available.

- Manual or hand-propelled equipment is ideal for small yards and small jobs; is lightweight, quiet, and easy to use, and produces no air pollution.
- Electric equipment is available in both battery-operated and corded models; doesn't pollute the air because it requires no gasoline or oil; eliminates fumes from fuel evaporating and the potential for fuel spills. Electric equipment is about half as noisy as gas equipment and easier to start.
- Some types of equipment are solar powered. No air pollution is produced.
- Some types of equipment can be powered by propane or biodiesel. Propane and biodiesel burn cleaner than gasoline and produce less of many air pollutants. Some gasoline equipment

(especially trucks) can be modified to run on biodiesel.

- Gasoline equipment made after 1997 meets higher emissions standards mandated by EPA. Gasoline equipment sold in California after 1999 meets even higher emissions standards mandated by the California Air Resources Board. Emission standards for handheld gasoline equipment made after 2002 are even stricter. The EPA adopted additional rules for non-handheld gasoline equipment.
- Four stroke engines are more efficient than two stroke engines.
- Overhead valve engines are better at reducing the potential for fuel spills than side valve engines.

**b) Look for equipment that mulches instead of bagging grass clippings.**

**Mulching grass clippings saves 25% - 30% more time than conventional bag mowers. (eliminates time spent getting rid of clippings)**

**c) Look for equipment that produces low noise levels. Provide adequate hearing protection for all equipment operators. A hearing protection program is required when workers are exposed to 85 decibels for over 8 hours.**

**d) Recycle old equipment rather than selling it (see resource section for recycling facilities).**

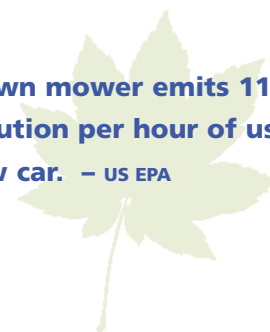
**e) Select the right-sized mower for the job. A mower with a larger mowing deck for a large job will reduce total mowing time, saving fuel and reducing air pollution.**

## 2) Equipment Operations

**a) Always operate equipment according to the manufacturer's recommendations.**

- b) Inventory activities performed, including the typical equipment used and any possible alternatives.
- c) Inventory all gas-powered equipment and rank in terms of emissions potential.
- d) Check the daily weather forecast or with DEQ to find out if it is a Clean Air Action Day. If it is, reduce activities that add to air pollution.

**A gas-powered lawn mower emits 11 times more air pollution per hour of use than a new car. – US EPA**



### 3) Equipment Maintenance

#### **All Equipment** \_\_\_\_\_

- Keep equipment tuned up.
- Keep all moving parts properly lubricated.
- Store equipment under cover and in areas or on pads that collect and store any leaked materials.
- Follow applicable OSHA guidelines for inspecting equipment (like electrical cords).

#### **Gasoline Equipment** \_\_\_\_\_

- Turn engines off when stopped for more than a minute.
- Inspect regularly for leaks and repair them.
- Use the proper fuel/oil mixture.
- Change the oil regularly.
- Clean or replace air filters regularly.
- Clean and reset the gap on spark plugs every 100 hours of operation. If the porcelain insulator is cracked or the plug is badly burned, replace it. Keep the cables clean and free of oil to prevent shorting out. Ensure that connections are kept tight.

#### **Mowers** \_\_\_\_\_

- Keep mower blades sharp.
- Keep the height adjustments tight.
- Keep all blade bolts tight.
- Use a properly balanced blade on rotary mowers.
- Keep the underside of the mower deck clean.

#### **Sprayers** \_\_\_\_\_

- Use manufacture-recommended nozzle disk size openings.
- Check frequently for wear.
- Check engine and pump for the proper speed settings.
- Check all belts to the fan and pumps for the proper tension settings.
- Before mixing sprays, be sure you are using compatible chemicals.
- Designate product-specific sprayers to avoid the need for washing out equipment. When you need to wash out equipment, use clean water after completing spray applications and discharge to the sanitary sewer.

### 4) Vehicle Operations and Maintenance

- a) Keep tires inflated and vehicles tuned.
- b) Use recycled products when possible, such as re-refined oil and retreaded tires.
- c) Use replacement materials with the lowest toxicity and impact to the environment. Look into low-toxicity antifreeze or bio-based hydraulic fluids as an alternative. Use environmentally-friendly carburetor cleaners and water-based parts cleaners instead of standard cleaners with methylene chloride, toluene and other toxic materials.
- d) Wash vehicles in a designated area to manage wash water properly or use a commercial facility that does the same.
- e) Investigate alternative fuel vehicles such as those operated by compressed natural gas or electric or hybrid engines.
- f) Use biodiesel, ultra-low sulfur diesel fuel and diesel traps to reduce soot emissions.

### 5) Fueling

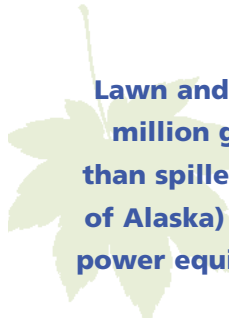
Transfer fuels with attention to avoiding leaks and spills.

- a) If hand transferring, use a transfer container that can be handled easily and securely and pour slowly and smoothly.
- b) Use a funnel or a spout with an automatic shut-off device to prevent over-filling. Fuel vehicles in an area that minimizes the impact of a spill. Make sure the fueling area has immediate access to a spill kit and secondary containment. If possible, fill your gas containers at a gas station that has a vapor recovery system.

### 6) Spill Prevention and Cleanup

- a) Have a spill kit in your service vehicle, including absorbent materials like spill pads or kitty litter, a small broom or vacuum, and reporting information.
- b) Follow federal, local, and state regulations for spill notification, cleanup, and disposal.


- c) If a spill does occur, use absorbent materials instead of hosing it down or burying it. Remove absorbent materials promptly and dispose of them properly.



**Lawn and garden equipment users spill 17 million gallons of fuel (more petroleum than spilled by the Exxon Valdez in the Gulf of Alaska) each year when refilling outdoor power equipment. -California Environmental Protection**

**Agency Air Resources Board**

- d) Use secondary containment for all liquids stored or transported in your service vehicle, such as double-walled or double-tanked containers, drip pans or plastic drums for single-walled containers, or bed liners designed to contain small leaks. All containers should be securely tightened when possible.



**Pollution Prevention - (P2) Potential**  
**Secondary containment can be a variety of tubs, pallets or bermed areas sized to hold 110% of the total volume of liquids being stored. Many times simply berming the entire work area to contain flows is sufficient. As a general guideline, you need at least 0.54 sq. feet (round to 0.60 sq. ft to include a safety factor) of floor space with a 3" berm per gallon of material stored.**

- e) Train employees and contractors in proper operating, maintenance, fueling, and spill cleanup procedures.



## RESOURCES

### Spill Notification

- City of Portland, Pollution Reporting hotline: (24/7) 503-823-7180
- Oregon Emergency Response System(OERS): 1-800-452-0311
- Recycling/Disposal information - Metro Resource Information Center: 503-234-3000



**REPORT  
ALL SPILLS**  
that threaten or enter  
the sanitary or storm  
sewer systems

**503-823-7180**  
24 hours a day - 7 days a week

For Police, Fire or  
Medical Emergency Services **911**

 ENVIRONMENTAL SERVICES  
CITY OF PORTLAND  
working for clean rivers 

City Code 17.34.090 PP 0811

# Materials Handling and Storage

**Provide safe and legal storage facilities for materials and equipment.**

## **MATERIAL STORAGE**

**1)** Control inventory and limit solid waste from supplies. Purchase supplies that use minimal packaging. Buy supplies in bulk when possible. Choose items with reusable packaging. Check with nurseries about returning their empty plastic pots for reuse; otherwise recycle. Wood plant containers can also be reused or recycled; cut them up for stakes or grind up to make mulch.

**2)** Follow good housekeeping methods:

- a)** Clean all work areas at least weekly. Dry sweep floors to keep free of debris.
- b)** Clean up leaks and spills as soon as possible after discovery. Place drip pans and other containers under leaking valves, couplings, or pumps until repaired.
- c)** Cover liquid storage and fuel can areas.
- d)** Reuse or properly dispose of excess or waste pesticides and their containers. Empty containers can be recycled or put in the trash only after the following actions:
  - All the original material or waste material is completely removed. Turn containers upside down until they stop dripping.
  - Containers shall be rinsed at least 3 times with rinsate going into usable spray solutions or proper disposal systems.

**3)** Control the amounts of green waste that accumulate onsite. Storage of green waste materials may be considered composting in place by state and regional regulators. Avoid storage onsite by either mulching on the job site or using a licensed composter for daily or weekly hauled loads.

**4)** Keep incompatible materials physically separated from one another:

**a)** Store flammable and combustible liquids in separate areas.

**b)** Separate potentially reactive materials from other materials by some physical barrier.

**c)** Designate a disposal area for surplus pesticides and empty containers being held for disposal. All pesticide wastes must be in the original container or a container with the full and legal product label. Always store container within secondary containment structures.

**5)** Designate a building exclusively for chemical storage: only pesticides, fertilizers, other greenhouse chemicals, and application equipment should be kept in the facility. Store pesticides by hazard class and function; herbicides separated from fungicides and insecticides. No food, drink, tobacco products, personal protective equipment, livestock feed, living plants or seeds should ever enter the storage facility.

**a)** Separate storage areas from general work areas and locate away from environmentally-sensitive areas such as waterways, flood zones, or natural resource areas.

**b)** Construct a storage area of fire-resistant construction materials. Include:

- Impermeable facility floor with no floor drain - any concrete should be inspected routinely and damage repaired promptly. Expansion joints should all be sealed. All spills should be contained within the building.
- Spill cleanup material (vermiculite, adsorptive clay, pet litter, sawdust, or commercial product) that is readily available and employees trained in proper use of these materials - shovel, dustpan, broom, and empty bags or buckets should be on hand.
- Anti-spark electrical components - including shutoff switches as appropriate. Explosion-proof electrical lighting should be included. Provide lighting sufficient to view into all cabinets and areas within facility.
- Consider needs for mechanical ventilation. Assure that all shutoff switches are located outside storage areas, and that appropriate breathing or spill cleanup apparatus are available.

- Assess the need for a temperature control system. In general, no direct heat sources such as sunny windows, steam pipes, and furnaces, should feed into the storage space.
  - c) Provide security for this storage space. Doors should be locked at all times with no access through windows.
  - d) Protect spaces from pests or vandals. Be sure there are no holes or entrances for rodents and other pests.
  - e) Weatherproof warning signs and post emergency contact information on every window and door.
- 6) Comply with the following safety protocols:
- a) Fire extinguishers are readily available and sprinkler systems are installed when practicable.
  - b) Have Material Safety Data Sheets for each chemical available, and preferably posted within the storage facility. Consider storing hydrated lime or high pH detergent for material neutralization. Ensure that the local fire department is notified annually of current inventory.
  - c) Have eyewash, deluge shower, first aid kit, telephones, emergency phone numbers available.
- 7) Keep appropriate inspections and records in a designated location. Develop a records retention schedule. Consider keeping records for:
- Staff-reported maintenance problems and concerns
  - Routine inspections through use of facility checklists
  - Periodic visual inspections of drainage around structure

### Hazardous Waste Control

You will also need to determine if you trigger federal and state hazardous waste generator requirements. If you generate more than 220 pounds of hazardous waste (about half of a 55-gallon drum) per month or store over 2,200 pounds of waste at

any one time on site, the DEQ considers you a hazardous waste generator. You will need to register with the state. Typically by using up most pesticide and herbicide products, and recycling other items, most landscape businesses will not trigger these thresholds. The items below do not count toward monthly hazardous waste generation if managed properly:

- 1) Appropriately managed waste pesticides as per DEQ requirements at:  
[www.deq.state.or.us/lq/pubs/factsheets/hw/ManagingWastePesticide.pdf](http://www.deq.state.or.us/lq/pubs/factsheets/hw/ManagingWastePesticide.pdf)
- 2) Recycled fluorescent light bulbs (they contain mercury)
- 3) Recycled used oil
- 4) Solvents and other substances that are in active use. These materials are not wastes until the day they are no longer usable and are ready for disposal. At that time, they must be weighed and a determination made as to hazardous waste code and volume. Contact DEQ at 1-800-452-4011 to schedule a free, non-regulatory consultation to assess your regulatory responsibilities relating to your waste stream.

### SPILL CONTROL

Spills must be cleaned up immediately and some spills (especially those going off site or reaching waterways) must be reported to state and local sewage authorities.

- 1) Be prepared to immediately clean up accidental spills. Use dry cleanup methods whenever possible.
- a) Dry sweep rather than hose down wastes into storm drains or onsite dry wells. If you must hose down your site, try to direct runoff into the landscape or a collection area, from which it can be collected and pumped into the sanitary system or another approved disposal area.
- b) Use pet litter or other absorbents to stop and clean up spills. Be sure that you dispose of these materials in an approved location. If you are unsure

where to dispose of the materials, contact your local solid waste department or Metro.

2) Keep chemicals and other materials off exposed surfaces where they can easily flow to the street when it rains. Dry sweep up materials. Don't hose down the pavement, which can wash the material into storm sewers that drain to rivers and streams.

3) Provide secondary containment for all liquid materials in collection tanks or other storage areas. Size the containment area to be 10% of the total volume stored or 110% of the biggest container stored, whichever is bigger. Containment can be

through tubs, spill pallets or bermed areas.

Consider using the entire shop area floor for containment by berming the bay and person door entries. Berms need not be very tall - 2-3" usually suffices. For a 3" berm you need about 0.60 sq. feet (includes a small safety factor) of floor space for every gallon of material stored. So you need approximately 33 feet with a 3" berm to hold a 55 gallon drum's worth of material.

## RESOURCES

### Solid Waste/Other Waste Management

- METRO Recycling Information Center: 503-234-3000, [www.metro-region.org/recycling](http://www.metro-region.org/recycling)
- Clackamas County: 503-353-4400, [www.clackamas.us/transportation/recycling/](http://www.clackamas.us/transportation/recycling/)
- City of Gresham: 503-618-2656, <http://greshamoregon.gov/city/city-departments/environmental-services/recycling-division/>
- City of Portland: 503-823-7202, [www.portlandonline.com/bps/index.cfm?c=41461](http://www.portlandonline.com/bps/index.cfm?c=41461)
- Washington County, Solid Waste and Recycling: [www.co.washington.or.us/HHS/SWR/](http://www.co.washington.or.us/HHS/SWR/)
- Agriplas for recycling of landscape plastics: [www.agriplasinc.com/](http://www.agriplasinc.com/)





# Training

**T**raining is the most important component to achieving the best environmental results. Only a knowledgeable work crew can assure best practices are being used.

## FORMAL TRAINING

A number of trade group associations offer basic and advanced horticultural practices training and certifications. Many of the curricula already stress environmental regulation and negative environmental impact issues. Here are the most common:

### 1) Certified Landscape Technician Programs

**a) Oregon Landscape Contractors Association (OLCA) Certified Landscape Technology (CLT)** - A testing program administered by OLCA with testing in three disciplines: construction, irrigation and maintenance. Certification is designed to enhance your Oregon landscape contractor's license by recognizing proficiency in the landscape work force.

**b) Washington Association of Landscape Professionals (WALP) Certified Landscape Technician (CLT)** - An applicant must pass the Common Elements plus a core test. WALP offers three core tests: installation, maintenance, and irrigation in addition to advanced specialties in carpentry, concrete, and irrigation management. Future advanced specialties are planned for horticultural management and low voltage landscape lighting.

**2) Irrigation Specialist (IS)** - To plan an effective, efficient irrigation system, the Irrigation Specialist must have experience and education — the cornerstones to effective water management. To that end, the Irrigation Association strives to provide comprehensive programs and services to Irrigation Specialists in the rapidly changing technology of the water resource field.

**a) Certified Irrigation Contractor (CIC)** - Specialty contractors whose principal contracting business is the execution of contracts and subcontracts to install, repair, and maintain irrigation systems in such a manner that projects can be executed in an

acceptable way, meeting all specifications and requirements. They are involved in the layout, installation, maintenance and repair of irrigation systems used for landscape and turf irrigation.

**b) Certified Irrigation Designer (CID)** - Engages in the preparation of irrigation designs to meet the needs of a particular project, selecting the most effective irrigation equipment or materials for the application and utilizing the information in such a manner that efficient and cost-effective irrigation designs are produced which meet the watering requirements for the plant or crop material being irrigated. CIDs engage in the preparation of irrigation plans, details and specifications, onsite observation of the installation when requested to ensure that design intent is fulfilled, and discussion with the end user regarding system use, particularly as it relates to scheduling and maintenance concerns.

**c) Certified Landscape Irrigation Auditor (CLIA) and Certified Golf Irrigation Auditor (CGIA)** - Individuals who are involved in gathering irrigation water use data and testing golf irrigation systems. Auditors compile water records, perform water use studies, measure irrigated sites, identify plant materials by general groups, determine irrigation water requirements, estimate potential dollar and water savings, and rank sites by net benefits.

**d) Certified Landscape Irrigation Manager (CLIM)** You must meet the following requirements: hold a CLIA, CGIA, CIC, and all three Landscape/Turf specialty CID certifications (Commercial, Golf Course, Residential) in good standing.

**e) Certified Agricultural Irrigation Specialist (CAIS)** - Individuals who are involved in the management and operation of on-farm irrigation systems. These systems include surface irrigation methods as well as pressurized systems like micro-irrigation and sprinklers.

**3) ALCA Certified Landscape Professional (CLP) (Exterior and Interior)** - The CLP exam is a multiple choice format covering business management topics. Ideal for interior and exterior landscape

company owners and managers who want to establish themselves (and their companies) as leaders in the industry.

**4) Certified Arborists through the International Society of Arboriculture** - There are six certification types possible depending on desire and need. Local exams are offered to achieve certification. All certifications come with the requirement for continuing education units.

**5) Accredited Tree Care Firm through the Tree Care Industry Association (TCIA) Accreditation Council** - TCIA accreditation gives the commercial tree care company a means of evaluating itself against industry standards and best business practices, pinpointing areas of excellence and areas where improvement is needed.

**6) International Erosion Control Certified Professional in Erosion and Sediment Control (CPESC)** - The CPESC exam is based on six years experience with erosion control measures and completion of a certification exam.

### **7) College Coursework**

Landscape technology classes and degrees are available at many Oregon colleges. Check with institutions for landscape design and technology-specific classes.

#### **a) Clackamas Community College**

- Classes in Greenhouse, Landscape, and Nursery Management
- Urban Watershed Institute short courses in Wetland Plant Identification, Integrated Stormwater Management
- Oregon Health Division approved certification courses in Backflow Assembly

#### **b) Mt. Hood Community College**

- Associate of Applied Science in Horticulture
- Greenhouse and Nursery Management
- Landscape Design and Management

- One-year certificate in Horticulture

#### **c) Portland Community College**

- Associate of Applied Science in Landscape Technology.
- One year Certificate: Landscape Services Technician
- Two year Certificate: Landscape Construction
- Two year Certificate: Landscape Management
- Two year Certificate: Landscape Design
- Two year Certificate: Plant Propagation

#### **d) Portland State University**

- Environmental Professionals Training Program - college level course work specifically designed to maintain professional expertise.

#### **e) Oregon State University**

- Degrees and course work in Horticulture, Botany and Plant Physiology, Soil Science, and other related disciplines.

#### **f) University of Oregon**

- Bachelor of Landscape Architecture (BLA) and Master of Landscape Architecture (MLA) programs. Degree programs focus on planning and design: Tutorial studio classes that focus on the development and communication of solutions to site and other environmental design problems, especially through specific physical design proposals. This area also addresses the physical/spatial implications of planning and management policies and programs.
- Five main subject areas are emphasized, including: landscape architectural technology; plants; landscape analysis and planning; history, literature and theory of landscape architecture; and landscape architectural media. Course work in these areas includes both required and elective classes that encourage students to tailor an individualized program.

### WORKSITE TRAINING

- 1) All employees responsible for design, installation, or maintenance should be thoroughly trained in the activity and in precautions to prevent personal accidents and environmental releases.
- 2) All employees should have a basic understanding of biological cycles and how their work alters or enhances natural processes.
- 3) All employees who apply pesticides shall be appropriately licensed.
- 4) All employees must be trained in spill response and spill notification procedures.

### RESOURCES

#### Certification

- PLANET-Professional Landcare Network: [www.landcarenetwork.org/](http://www.landcarenetwork.org/)
- Oregon Landscape Contractors Association: [www.oregonlandscape.org](http://www.oregonlandscape.org)
- Irrigation Association of America: [www.irrigation.org](http://www.irrigation.org)
- International Society of Arboriculture: [www.isa-arbor.com/](http://www.isa-arbor.com/)
- International Erosion Control Association: [www.ieca.org](http://www.ieca.org)

#### Education

- Clackamas Community College: [www.clackamas.cc.or.us](http://www.clackamas.cc.or.us)
- Mt. Hood Community College: [www.mhcc.edu](http://www.mhcc.edu)
- Portland Community College: [www.pcc.edu](http://www.pcc.edu)
- Oregon State University: <http://oregonstate.edu/>
- University of Oregon: [www.uoregon.edu](http://www.uoregon.edu)



# Customer Education

**O**ne of a landscape professional's biggest challenges is meeting client needs. You are often in a position to influence what is installed and maintenance practices on your customer's site. There are a variety of issues you should discuss with your customer to help limit the environmental impact from their site.

**1) Encourage customers to have pest tolerance.**

**a)** Large numbers of insects will be present in a healthy landscape. Teach them about some common insects that are a good (i.e. beneficials) to have in their landscape.

**b)** Educate your customer about the amount of damage a landscape can take and still be healthy. Even generally healthy plants will have some bite marks and leaf drop.

**2) Reinforce that early action against pests is the most cost-effective method of eradication.** Customers have a vital role in early identification of a pest, weed or other plant damage issue.

**3) Provide basic education on the main elements of your Integrated Pest Management (IPM) strategy:**


**a)** The goal of IPM is using the least toxic maintenance action first.

**b)** The value of monitoring based visits. By keeping a careful watch on (and accurate record of) landscape condition, maintenance actions taken, and the landscape responses, overall plant damage can be minimized. These visits will give insight for future management decisions, and allow for early response to potential problems

**c)** The basics of insect, weed, and disease life cycles for problems that are occurring at their site. Demonstrate your knowledge and show them how it is saving them money; for instance, you choose not to spray immediately for crane flies because they are in their dormant stage, protected in cocoons and not likely to be affected by chemical products.

**d)** The value of mechanical methods. Use mulch, hand tools, and cultivation instead of spraying to control weeds.

- Using compost, mulch, and other organic materials to improve soil tilth reduces the need for fertilizer.
- The value of grasscycling for increasing soil fertility and preventing the need to bag and dispose of clippings.



**A recent EPA study found that the top 5 pollutants in northwest streams are main ingredients in the top selling lawn and garden chemicals.**

**e)** Why you should limit chemical use and very carefully select any chemicals you do use.

- Test soils before fertilizer application to make sure the plants or lawn actually need it. Too much fertilization actually weakens plants.
- Water Pollution: When fertilizers and pesticides are applied to landscaped areas, stormwater runoff can wash chemicals through storm sewers into local streams and rivers.
- Hazard to landscape users, especially children, pets, wildlife: Studies have shown links between cancer rates and household chemical application. Know the potential impacts of your pesticide. Check resources like EXTOWNET to fully understand what health and safety or environmental issues relate to your pesticide.
- Pest resistance and the indiscriminate use of pesticides: Applying the wrong chemical, or using a chemical at the wrong time, can add toxins to the environment without reducing the pest population.
- Not all pesticides are selective. They can be toxic to beneficials, eliminating the natural system of checks and balances, and actually



making it easier for pest species to multiply. Use of these types of pesticides is often the beginning of a vicious cycle.

- Over-fertilizing lawns promotes thatch build-up. More work is created, as the grass will begin growing faster than normal and require more frequent mowing. Lawns that receive too much fertilizer develop weak, shallow root systems that increase susceptibility to drought and disease.

**4)** Too much water can lead to disease and poor plant health. Lawn and garden watering makes up more than 30% of summer water use, much of which is wasted through over-watering.

**a)** Using organic mulch to help retain valuable water in sandy conditions: As organic mulch breaks down, it also provides nutrients for the soil ecosystem.

**b)** Using a controlled irrigation system that has a system of shutoffs when conditions are not right for irrigation: Irrigating in high wind, rainy weather and in the middle of the day when water evaporates faster, are all undesirable. A controlled system should also have low volume irrigation where appropriate, like drip systems in shrub beds. Low volume systems deliver water directly to the plant that needs it.

## RESOURCES

- Naturescaping: [www.emswcd.org/naturescaping](http://www.emswcd.org/naturescaping)
- Metro Natural Gardening Hotline: 503-234-3000  
EXTOXNET(The EXtension TOXicology NETwork) [www.extoxnet.orst.edu](http://www.extoxnet.orst.edu)
- NW coalition for Alternatives to Pesticides: [www.pesticide.org](http://www.pesticide.org)



# Glossary

## **Action threshold**

The point at which pest control is implemented, as opposed to preventing damage through cultural practices.

## **Aeration**

Removal of soil and thatch plugs (usually in turf) to reduce compaction and improve water infiltration, drainage, and nutrient cycling.

## **Allelopathy**

The inhibition of growth in one species of plants by chemicals produced by another species.

## **Backflow prevention device**

A safety device which prevents the flow of water from the water distribution system back to the water source.

## **Beneficials**

Organisms that benefit landscapes, most used to describe natural enemies of pests and pollinators such as bees. Predators, parasites, or pathogens that are considered beneficial because they attack and kill organisms that we normally consider to be pests.

## **Bioaccumulation**

The process by which organisms absorb chemicals or elements directly from their environment.

## **Biological control**

The action of parasites, predators, or pathogens in maintaining another organism's population density at a lower average level than would occur in their absence. Biological control may occur naturally in the landscape or result from manipulation or introduction of biological control agents by people.

## **Check valve**

Valve used in a pipeline that allows flow in only one direction.

## **Companion planting**

The practice of planting certain plant species in close association with landscape plants to repel pests.

## **Compost tea**

A liquid made by steeping compost in water, ideally using aeration and added nutrients. Prolific microbial communities form in the liquid, which can be applied directly to soil or as a foliar spray. These microbes feed beneficials, enriching soil and helping to keep pathogens in check.

## **Controller**

An automatic timing device that sends an electric signal for automatic valves to open or close according to a set irrigation schedule.

## **Cover crop**

Any crop grown to cover and protect the soil surface. Some cover crops are used as "green manures" and tilled into the soil to add nutrient value.

## **Decomposition rates**

(referring to insecticides, herbicides):

The length of time a material or chemical takes to revert to its most basic natural components - such as water, nitrogen and carbon molecules.

## **Drip line**

The edge of the area under the full canopy of a tree.

## **Ecosystem services**

Oxygen production, water purification, pollination, soil formation and nutrient recycling and other services provided by ecosystems that benefit humans and are necessary for a healthy planet.

## **Embodied Energy**

A measure of all energy (direct and indirect) used to extract, manufacture, transport, install, and maintain a material.

**Evaporation**

Water movement from a wet soil or plant surface, which does not pass through the plant.

**Evaporation pan /  
Open pan evaporation**

(ratio of plant water use to evaporation)

Pan or container placed at or about crop canopy height containing water. Water levels are measured daily in the pan to determine the amount of evaporation.

**Invasive species**

Species that out-compete native species for certain ecological niches.

**Integrated pest management (IPM)**

Landscape IPM is a systems-based decision-making approach that uses biological, cultural, physical, regulatory, and chemical tactics to manage disease, weed, insect, and other pest problems in the maintenance of ornamental plants and their health, and does so in a way that minimizes risks to human health, society, and the environment.

**Hydro-Zone**

The various areas of the landscape site which each require different degrees of watering.

**Mulch**

Any protective substance that covers the soil. Organic and synthetic materials used to block light, limiting weed seed germination and growth. Other benefits of mulch include addition of nutrients and organic matter (when organic mulches are used); erosion prevention; and the insulation of soil.

**Native species**

A species that occurs naturally in a particular region, ecosystem and/or habitat without direct or indirect human actions.

**Naturescaping**

Landscaping with native plants to limit water quality impacts and provide habitat for native species.

**Organic matter**

Vegetated materials that have decayed into a mixture rich in plant nutrients.

**Perennial**

A plant that can live three or more years and flower at least twice.

**Pesticide**

Any substance or mixture intended to prevent, destroy, repel, kill, or mitigate problems caused by insects, rodents, weeds, nematodes, fungi, or other pests; and any other substance or mixture intended for use as a plant growth regulator, defoliant, or desiccant.

***Restricted Use Pesticide (RUP)***

A pesticide that may cause injury to people, animals or the environment, even when used according to label directions. For this reason, RUPs are sold only to licensed applicators for their use or for use by individuals under their supervision. These products are identified by the words "Restricted Use Pesticide" displayed prominently on the front panel of the labeling. If a pesticide label does not identify the product as Restricted Use, it is classified as General Use.

***General Use Pesticide***

A pesticide that is not expected to cause injury to man, animals, or the environment (other than the target pest) when used according to label directions. For this reason, these products are available for purchase and use by the general public. There is no special designation on the labeling of General Use Pesticides.

***Selective Pesticide***

Pesticides that are toxic primarily to the target pest (and perhaps a few related species), leaving most other organisms, including natural enemies, unharmed.

**pH**

Measure of acidity or alkalinity.

**Rain gauge or rain sensor**

Device used to detect or measure rainfall.

**Root zone**

Depth of soil that plant roots readily penetrate and in which the predominant root activity occurs.

**Sensitive resources**

Natural waterways, streambanks, and other vegetated habitat areas. May be specially designated by a state or local authority.

**Stormwater runoff**

Precipitation, snowmelt or irrigation that flows over impermeable surfaces.

**Structure (soil)**

Combination of various soil particle types into a uniform mixture that behaves as a single unit. Structural classes include granular, blocky, and columnar massive, platy, and prismatic, among others.

**Sustainable**

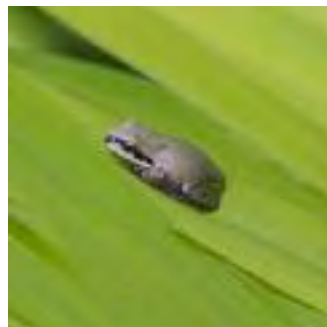
To maintain a living and productive landscape with minimal natural resource, labor and time inputs and with minimal generation of waste.

**Target pest**

A pest species that a control action is intended to destroy.

## RESOURCES

- Glossary of Irrigation Terms, 2001 - The Irrigation Association, Version 4/17/01. Ed. Eugene W. Rochester
- OOnline Medical Dictionary
- UC Pest Management Guidelines: Floriculture And Ornamental Nurseries - Glossary,(Reviewed: 12/98, updated: 2/01)



# Appendix

Resource Materials (books, papers and other publications used in creating this BMP manual)

## PUBLICATIONS

### Erosion Control

- City of Portland Erosion Control Manual: [www.portlandonline.com/bds/index.cfm?a=94539](http://www.portlandonline.com/bds/index.cfm?a=94539)
- Soils For Salmon: [www.soilsforsalmon.org](http://www.soilsforsalmon.org)

### Invasive Plants

- Noxious weed list available through Oregon Department of Agriculture: [www.oregon.gov/ODA/PLANT/WEEDS/lists.shtml](http://www.oregon.gov/ODA/PLANT/WEEDS/lists.shtml)
- *GardenSmart Oregon*: [www.portlandonline.com/bes/gardensmart](http://www.portlandonline.com/bes/gardensmart)
- The Nature Conservancy offers information regarding the control of various weed species: [www.imapinvasives.org/GIST/ESA/index.html](http://www.imapinvasives.org/GIST/ESA/index.html)
- *Sustainable Gardening: The Oregon-Washington Master Gardener Handbook* - WA/OR Extension. 2008, [www.extensionoregonstate.edu/catalog/pdf/em/em8742.pdf](http://www.extensionoregonstate.edu/catalog/pdf/em/em8742.pdf)

### Integrated Pest Management

- Metro Natural Gardening Guides: [www.oregonmetro.gov/garden](http://www.oregonmetro.gov/garden)
  - *Grow Smart Grow Safe* (chemical guide) - [http://library.oregonmetro.gov/files/gsgs\\_11-5\\_web.pdf?78,150](http://library.oregonmetro.gov/files/gsgs_11-5_web.pdf?78,150)
  - Gardening naturally tips: [www.oregonmetro.gov/index.cfm/go/by.web/id=25926](http://www.oregonmetro.gov/index.cfm/go/by.web/id=25926)
- *Landscape and Grounds Management Guidelines: Environmental Stewardship* - City of Seattle. [www.cityofseattle.net/environment/documents/groundsmanagement.doc](http://www.cityofseattle.net/environment/documents/groundsmanagement.doc)
- *Conservation and Environment* - Seattle Public Utilities: [www.seattle.gov/util/directory/conservation\\_index/index.asp](http://www.seattle.gov/util/directory/conservation_index/index.asp)
- *Environmental Stewardship Guidelines* - Oregon Golf Course Superintendents Association, [www.gcsaa.org](http://www.gcsaa.org)

### Insect/Pest Management

- *Insect Pest Management for Organic Crops* - Fouche, Calvin (et al). University of California Division of Agriculture and Natural Resources Publication 7251, 2000.

### Companion Planting

- *Insect Control: Companion Planting* - Winnipeg Bugline [www.winnipeg.ca/cms/bugline/](http://www.winnipeg.ca/cms/bugline/)
- *Beneficial Borders: Beautiful Beds and Borders That Help Control Pests* - Rodale Organic Gardening. [www.organicgardening.com/feature/0,7518,s1-2-10-90,00.htm/](http://www.organicgardening.com/feature/0,7518,s1-2-10-90,00.htm/)
- *Companion Planting* - Cornell University Department of Horticulture [Online]. Ecogardening Factsheet #10. Winter 1994. [www.gardening.cornell.edu/factsheets.html](http://www.gardening.cornell.edu/factsheets.html)



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### Irrigation Resources

- Irrigation Association: [www.irrigation.org](http://www.irrigation.org)
- **Turf and Landscape Irrigation Best Management Practices** - Water Management Committee of the Irrigation Association. DRAFT Version: 9 (10-26-2000). Irrigation Best Management Practices.
- **Establishing a Waste Efficient Landscape** - [www.ciwmb.ca.gov/Organics/Landscaping/KeepGreen/Design.htm](http://www.ciwmb.ca.gov/Organics/Landscaping/KeepGreen/Design.htm)
- **Watering Home Gardens and Landscape Plants**, Washington State University Extension [cru.cahe.wsu.edu/CEPublications/eb1090/eb1090.pdf](http://cru.cahe.wsu.edu/CEPublications/eb1090/eb1090.pdf)

### Native Plants

- **Portland Plant List** - [www.portlandonline.com/bps/plantlist](http://www.portlandonline.com/bps/plantlist) (see also the Planning Bureau's Environmental Handbook)
- Various Documents, East Multnomah County Soil & Water Conservation District, [www.emswcd.org/document-library](http://www.emswcd.org/document-library)

### Pesticide Resources

- NW Coalition for Alternatives to Pesticides: [www.pesticide.org](http://www.pesticide.org)
- Beyond Pesticides: National Coalition Against the Misuse of Pesticides, [www.beyondpesticides.org](http://www.beyondpesticides.org)
- EXTOWNET (The EXTension TOXicology NETwork): <http://extownet.orst.edu>
- National Pesticide Information Center (NPIC) – out of Oregon State University: 800-858-7378, fax 541-737-0761 or [www.npic.orst.edu](http://www.npic.orst.edu)
- Oregon State University Extension Service: (information and links) <http://extension.oregonstate.edu> or call your local extension office or Master Gardener hotline for information or referrals.
  - Multnomah and Washington County: 503-821-1150
  - Clackamas County: 503-655-8631

### Planning and Design

- **Site Analysis - Questions You Should Ask. Landscape & Garden Design Tips - Design Basics** - [www.landscapusa.com/tips/design8.htm](http://www.landscapusa.com/tips/design8.htm)
- **Xeriscape-To-Go: Plan Your Water Wise Landscape While Conserving Our Natural Resources** - City of Corpus Christi, [www.cctexas.com/files/g17/xertogo.PDF](http://www.cctexas.com/files/g17/xertogo.PDF)
- **Backyard Conservation: Bringing Conservation From the Countryside to Your Backyard** - USDA Natural Resources Conservation Service, National Association of Conservation Districts, and Wildlife Habitat Council, 1999, [www.nrcs.usda.gov/feature/backyard/](http://www.nrcs.usda.gov/feature/backyard/)
- **Creating Habitat for Wildlife at Home, School, Work, and in Communities** - Backyard Wildlife Habitat. National Wildlife Federation, [www.nwf.org/get-outside/outdoor-activities/garden-for-wildlife.aspx](http://www.nwf.org/get-outside/outdoor-activities/garden-for-wildlife.aspx)
- **Low-Maintenance Landscaping** - Schrock, Dennis. Department of Horticulture, University of Missouri-Columbia. Agricultural Publication G6902, [muextension.missouri.edu/xplor/agguides/hort/g06902.htm](http://muextension.missouri.edu/xplor/agguides/hort/g06902.htm)
- **The Sustainable Sites Initiative** - ASLA, Lady Bird Johnson Wildflower Center, and Us Botanic Garden, [www.sustainablesites.org](http://www.sustainablesites.org)

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### Pollution Prevention Practices

- *Landscape Waste Prevention* - [www.ciwmb.ca.gov/Organics/Landscaping](http://www.ciwmb.ca.gov/Organics/Landscaping)
- *Water Quality and Use: Integrated Pest Management* - Arizona Master Gardener Manual Ch. 16. [ag.arizona.edu/pubs/garden/mg/water/ipm.html](http://ag.arizona.edu/pubs/garden/mg/water/ipm.html)
- *Keep Your Shop in Tune* - P2O Team, 2004, [www.EcoBiz.org/keepshoptune%20auto%20\(11-204\).pdf](http://www.EcoBiz.org/keepshoptune%20auto%20(11-204).pdf)
- *Improved Pesticide Application BMPs for Groundwater Protection from Pesticides* - Seelig, Bruce. North Dakota State University Extension Service [www.ext.nodak.edu/extpubs/h2oqual/watgrnd/ae1113w.htm](http://www.ext.nodak.edu/extpubs/h2oqual/watgrnd/ae1113w.htm)

### Pond Planning and Installation

- *National Wildlife Federation pond building* - Marks, Anita. [nwf.org/get-outside/outdoor-activities/garden-for-wildlife/build-a-backyard-pond.aspx](http://nwf.org/get-outside/outdoor-activities/garden-for-wildlife/build-a-backyard-pond.aspx)

### Soils Information

- National Resources Conservation Service – Soil Survey: 503-326-3941, <http://websoilsurvey.nrcs.usda.gov/app/>
- Soil and Water Conservation Districts
  - Clackamas County: 503-655-3144, [www.conservationdistrict.org/](http://www.conservationdistrict.org/)
  - East Multnomah: 503-222-SOIL (7645), [www.emswcd.org](http://www.emswcd.org)
  - West Multnomah: 503-238-4775, [www.wmswcd.org](http://www.wmswcd.org)
  - Tualatin: 503-648-3174 ext. 5
- Soils For Salmon: [www.soilsforsalmon.org](http://www.soilsforsalmon.org)
- Soil Testing Resources: contact extension office, <http://extension.oregonstate.edu/>

### Tree Resources

- *An Oregon Homeowner's Guide to Tree Care: Are You Your Tree's Worst Enemy?* - Urban and Community Forestry Assistance Program. Oregon Department of Forestry, [www.oregon.gov/odf/urban\\_forests/docs/other\\_publications/guidetotreecare.pdf](http://www.oregon.gov/odf/urban_forests/docs/other_publications/guidetotreecare.pdf)
- *Guidelines for Mature Tree Care* - Portland Parks & Recreation, Bureau of Environmental Services. City of Portland, Oregon, [www.portlandonline.com/parks/index.cfm?c=39712&a=179897](http://www.portlandonline.com/parks/index.cfm?c=39712&a=179897)

### Turf Resources

- *Ecologically Sound Lawn Care for the Pacific Northwest: Findings from the Scientific Literature and Recommendations from Turf Professionals* - McDonald, David. Community Services Division, Resource Conservation Section, Seattle Public Utilities. 1999, [www.sustainability.tufts.edu/downloads/ecologicallysoundlawncare.pdf](http://www.sustainability.tufts.edu/downloads/ecologicallysoundlawncare.pdf)
- *Turfgrass Soil-Water Relationship* - Brauen, Stan and Stahnke, Gwen. Washington State University Cooperative Extension Bulletin EB 1280. Revised 1991.
- *Managing Lawns on Heavy Soils* - Harivandi, M. Ali and Gibeault, Victor University of California Division of Agriculture and Natural Resources Publication 7227, 1997, [www.ucanr.org/freepubs/docs/7227.pdf](http://www.ucanr.org/freepubs/docs/7227.pdf)

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- **Using Composts to Improve Turf Performance** - Penn State Agricultural Sciences [pubs.cas.psu.edu/FreePubs/pdfs/uc123.pdf](http://pubs.cas.psu.edu/FreePubs/pdfs/uc123.pdf)
- **Aeration of Turfgrass Areas** - Harper, John C. Penn State Agricultural Sciences, Special Circular 159. <http://turf.psu.edu/extension/factsheets/aeration>
- **Mowing Turfgrasses** - Harper, John C. Penn State Agricultural Sciences, Special Circular 147 <http://turf.psu.edu/extension/factsheets/mowing>
- **Lawn Management Through the Seasons** - Harper, John C. and Landschoot, Peter Penn State Agricultural Sciences. Extension Circular 201. <http://turf.psu.edu/extension/factsheets/seasons>
- **Principles of Turfgrass Irrigation** - Penn State Agricultural Sciences <http://turf.psu.edu/extension/factsheets/irrigation>
- **Common Turfgrasses in the Pacific Northwest** - Cook, Tom. Horticultural Department Oregon State university. [http://hort.oregonstate.edu/files/Research\\_Extension/Turf\\_Information/Homelawns/2008IdentifyingCommonPNWTurfgrasses.pdf](http://hort.oregonstate.edu/files/Research_Extension/Turf_Information/Homelawns/2008IdentifyingCommonPNWTurfgrasses.pdf)

## RESOURCES

### Building Departments

- Portland: 503-823-7526 (zoning) and 503-823-7310 (permitting). Visit [Portlandmaps.com](http://Portlandmaps.com), enter address to get zoning information. See web for development overview and information. [www.portlandonline.com/bds/index.cfm?c=35891](http://www.portlandonline.com/bds/index.cfm?c=35891) for guide to permits
- Beaverton: 503-526-2222 for general information or the permit website at [www.beavertonoregon.gov/government/permits\\_fees.aspx](http://www.beavertonoregon.gov/government/permits_fees.aspx)
- Hillsboro: 503-681-6144, [www.ci.hillsboro.or.us/building/default.aspx](http://www.ci.hillsboro.or.us/building/default.aspx)
- Gresham: 503-491-7658, Contact the Gresham Building department at 503-618-2191 or <http://greshamoregon.gov/city/city-departments/community-development/building-development/> for zoning, land use, and building code.

### Certification

- PLANET-Professional Landscape Network: [www.landcarenetwork.org/cms/home.html](http://www.landcarenetwork.org/cms/home.html)
- Oregon Landscape Contractors Association: [www.oregonlandscape.org/](http://www.oregonlandscape.org/)
- Irrigation Association of America: [www.irrigation.org](http://www.irrigation.org)
- APLD website Information regarding certification standards and application procedures: [www.apld.com/index.asp](http://www.apld.com/index.asp)
- American Society of Landscape Architects, Oregon Chapter: [www.aslaoregon.org/](http://www.aslaoregon.org/)
- Oregon State Landscape Contractors Board: [www.lcb.state.or.us/](http://www.lcb.state.or.us/)
- International Erosion Control Association: [www.ieca.org](http://www.ieca.org)

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### Education

- Clackamas Community College: 503-657-6958, [www.clackamas.cc.or.us](http://www.clackamas.cc.or.us)
- Clark College: 360-992-2000, [www.clark.edu](http://www.clark.edu)
- Metro Natural Gardening Program: 503-234-3000, [www.oregonmetro.gov/garden](http://www.oregonmetro.gov/garden)
- Mt. Hood Community College: 503-491-6422, [www.mhcc.edu](http://www.mhcc.edu)
- Oregon State University: 1-800-291-4192, [www.oregonstate.edu](http://www.oregonstate.edu)
- Portland Community College: 503-977-8888, [www.pcc.edu](http://www.pcc.edu)
- Portland State University: 503-725-3000, [www.pdx.edu](http://www.pdx.edu)
- Professional Landscape Network (PLANET): [www.landcarenetwork.org](http://www.landcarenetwork.org)
- University of Oregon: 541-346-1000, [www.uoregon.edu](http://www.uoregon.edu)

### Integrated Pest Management

- Database of IPM Resources: <http://attra.ncat.org/attra-pub/ipm.html>
- Oregon State University Extension Service offers information, and links on all topics. Go to [eesc.orst.edu.htm](http://eesc.orst.edu.htm), or call your local extension office or Master Gardener hotline for information or referrals:
  - Clackamas County: 503-655-8631
  - Multnomah and Washington County: 503-821-1150
- Bay-Friendly Landscape Principles and Practices, [www.bayfriendly.org](http://www.bayfriendly.org)

### Invasive Plants

- Oregon Department of Agriculture: [oda.state.or.us/plant/Inv\\_spp/100\\_Worst\\_Inv\\_2002.html#plant](http://oda.state.or.us/plant/Inv_spp/100_Worst_Inv_2002.html#plant)

### Local Business Licensing

- Beaverton: 503-526-2255, [www.ci.beaverton.or.us/departments/finance/finance\\_license.htm](http://www.ci.beaverton.or.us/departments/finance/finance_license.htm)
- Small Business Development Center, at Mt. Hood Community Collage (Fairview, Troutdale, Gresham): 503-491-7658, [www.bizcenter.org/gresham/index.html](http://www.bizcenter.org/gresham/index.html) or [www.ci.gresham.or.us/departments/cedd/bap/resources/bus\\_resources.htm](http://www.ci.gresham.or.us/departments/cedd/bap/resources/bus_resources.htm)
- Forest Grove: 503-992-3269, [www.ci.forest-grove.or.us/comdev1.html](http://www.ci.forest-grove.or.us/comdev1.html)
- Hillsboro: 503-681-6100, [www.ci.hillsboro.or.us/Finance/BusinessLicense.asp](http://www.ci.hillsboro.or.us/Finance/BusinessLicense.asp)
- Lake Oswego: 503-635-0260, [email permit@ci.oswego.or.us](mailto:permit@ci.oswego.or.us)
- Portland: 503-823-5157, [www.lpdxbi.org](http://www.lpdxbi.org) And [www.businessinportland.org](http://www.businessinportland.org) provides links and information for anyone starting or running a business in Portland.
- Sherwood: 503-625-5522, [www.ci.sherwood.or.us/businesses/licenses.html](http://www.ci.sherwood.or.us/businesses/licenses.html)
- Tigard: 503-639-4171, [www.ci.tigard.or.us/](http://www.ci.tigard.or.us/)
- Tualatin: 503-692-2000, [www.ci.tualatin.or.us/city/Departments/Finance/Business%20License.htm](http://www.ci.tualatin.or.us/city/Departments/Finance/Business%20License.htm)
- Vancouver, WA: 360-619-1079, [www.ci.vancouver.wa.us/finance/biz-occ/biz-occ.htm](http://www.ci.vancouver.wa.us/finance/biz-occ/biz-occ.htm)
- West Linn: 503-656-4261, [www.ci.west-linn.or.us/Forms/forms&apps.htm](http://www.ci.west-linn.or.us/Forms/forms&apps.htm)

### Naturescaping/Native Plants

- National Wildlife Federation provides information on landscaping to attract and support native wildlife: [nwf.org/backyardwildlifehabitat/](http://nwf.org/backyardwildlifehabitat/)
- Audubon Society has information on Naturescaping: [www.paws.org/work/wildlife/naturescaping.html](http://www.paws.org/work/wildlife/naturescaping.html)
- Three Rivers Land Conservancy: [www.trlc.org/BYHCP](http://www.trlc.org/BYHCP)
- Naturescaping: [www.emswcd.org/naturescaping](http://www.emswcd.org/naturescaping)
- Metro Natural Gardening Program: 503-234-3000
- Oregon Native Plant Society: [www.npsoregon.org](http://www.npsoregon.org) (Washington: [wnps@tardigrade.net](mailto:wnps@tardigrade.net))
- Oregon State University Extension Service: <http://extension.oregonstate.edu/>
  - Multnomah and Washington County: 503-821-1150
  - Clackamas County: 503-655-8631
- Hardy Plant Society of Oregon: 503-224-5718, [www.hardyplantsociety.org/](http://www.hardyplantsociety.org/)
- Tree Care industry Association: has great resources at their website, [www.treecareindustry.org/index.aspx](http://www.treecareindustry.org/index.aspx)

### Notification

- Utility Notification Center: 811 or 1-800-332-2344, [www.digsafelyoregon.com](http://www.digsafelyoregon.com)
- City of Portland, Pollution Reporting hotline: (24/7) 503-823-7180
- Oregon Emergency Response System (OERS): 1-800-452-0311

### Pesticides

- EXTOWNET(The EXtension TOXicology NETwork): <http://extownet.orst.edu/>
- NW coalition for Alternatives to Pesticides: [www.pesticide.org](http://www.pesticide.org)
- Oregon Department of Agriculture: 503-986-4635, or [www.oregon.gov/ODA/](http://www.oregon.gov/ODA/)
- National Pesticide Information Center (NPIC) – out of Oregon State University: 800-858-7378, fax 541-737-0761 or [npic.orst.edu](http://npic.orst.edu)
- Oregon State University Extension Service: (information and links) <http://extension.oregonstate.edu/> or call your local extension office or Master Gardener hotline for information or referrals.
  - Multnomah and Washington County: 503-821-1150
  - Clackamas County: 503-655-8631
- EPA, *Healthy Lawn, Healthy Environment*, [www.epa.gov/oppfead1/Publications/lawncafe.pdf](http://www.epa.gov/oppfead1/Publications/lawncafe.pdf)
- IPMopedia: <http://toxipedia.org/display/ipmopedia/IPM+Education+Project>



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### Recycling/Disposal

- Metro Resource Information Center: 503-234-3000, [www.oregonmetro.gov/recycling](http://www.oregonmetro.gov/recycling)
- City of Portland: 503-823-7202, [www.portlandonline.com/bps/index.cfm?c=41461](http://www.portlandonline.com/bps/index.cfm?c=41461)
- Clackamas County: 503-557-6363, [www.co.clackamas.or.us/dtd/garb/](http://www.co.clackamas.or.us/dtd/garb/)
- Clark County, WA: 360-397-6118 ext. 4352, [www.clackamas.us/transportation/recycling/](http://www.clackamas.us/transportation/recycling/)
- Washington County: 503-846-8609, [www.co.washington.or.us/HHS/SWR/](http://www.co.washington.or.us/HHS/SWR/)

### Site Assessment for Hazardous Materials

- Contact Oregon DEQ, Northwest Region at 503-222-1741, [www.deq.state.or.us/lq/cu/siteassessment/index.htm](http://www.deq.state.or.us/lq/cu/siteassessment/index.htm)

### Soils/Soil Testing

- Soil and Water Conservation Services (Soil Survey)
  - Clackamas County: 503-655-3144, [www.conservationdistrict.org/](http://www.conservationdistrict.org/)
  - East Multnomah: 503-222-SOIL (7645), [www.emswcd.org](http://www.emswcd.org)
  - West Multnomah County: 503-238-4755, [www.wmswcd.org](http://www.wmswcd.org)
  - Tualatin: 503-648-3174 ext. 5
- Oregon State University Extension Service: (information and links) <http://extension.oregonstate.edu/>
- Washington Organics Recycling Council: [www.compostwashington.org/](http://www.compostwashington.org/)
- Compost Tea Industry Association: [www.composttea.org](http://www.composttea.org)
- National Resources Conservation Service – Soil Survey: 503-326-3941  
<http://websoilsurvey.nrcs.usda.gov/app/>

### State Codes

- Oregon Revised Statutes, Chapter 671. Legal standards pertaining to Landscape Architects, Landscape Contractors, and Landscape Businesses: [www.leg.state.or.us/ors/671.html](http://www.leg.state.or.us/ors/671.html)
- Oregon Department of Environmental Quality (DEQ) – Solid Waste Requirements. Solid Waste duty office: 503-229-5263.

### Regional codes

- Metro Solid Waste Department: 503-797-1836

### State Licensing

- Landscape Contractors Board: 503-986-6561, [www.lcb.state.or.us/](http://www.lcb.state.or.us/)
- Business Information Center: 503-986-2222,  
[http://egov.sos.state.or.us/br/!PKG\\_BC1\\_WEB\\_REFERRAL.DISPLAY\\_REFERRAL#Top](http://egov.sos.state.or.us/br/!PKG_BC1_WEB_REFERRAL.DISPLAY_REFERRAL#Top)

**Pollution Prevention  
Outreach Team  
6543 North Burlington Avenue  
Portland, Oregon 97203-5452**

**503- 823-7807**

**[www.EcoBiz.org](http://www.EcoBiz.org)**

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