VERSION 2.1

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Oregon Department of Transportation

ROADSIDE DEVELOPMENT MANUAL:

GUIDELINES FOR PLANNING, DESIGN, CONSTRUCTION AND MAINTENANCE FOR LANDSCAPE, HARDSCAPE AND VISUAL RESOURCES

Highway Division, Technical Services Branch,

Geo-Environmental Section

OREGON DEPARTMENT OF TRANSPORTATION

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SUMMARY OF CHANGES

Chapter	Summary of changes made	Date revised
All	Major rewrite of document	04/01/2018
All	Publish	04/30/2018

1. INTRODUCTION

PURPOSE

The purpose of this manual is to provide project team leaders, designers and other stakeholders an overview to and guidance in the design and function of landscapes and the various design elements within ODOT right-of-way. This manual describes Roadside Development requirements and guidance that balance safety, economy, ecology, aesthetics, sustainability, and compatibility with the needs of Maintenance and Operations for a variety of transportation project types that range from urban to rural.

ORGANIZATION OF MANUAL

This manual is organized in a sequence similar to how projects are organized. After the manual's introduction, which provides an overview, the regulatory context describes the legal requirements that shape our work. Background strategies for planning roadside development are provided in the next section followed by the ODOT project development process. Design context that addresses the fit of a project to its surroundings comes next.

The guidance on roadside development, including plants and planting, is provided in the next chapter with design principles providing the issues of concern for ODOT regarding roadside development. Issues associated with the design of hardscape (walls, flatwork, site furnishings and structures) is addressed in the next chapter, followed by irrigation design.

The development of contract documents for projects come next. Construction and inspection guidance follow and then the issues associated with the maintenance of roadside development projects are discussed in the last section of the manual's body. Each section and subsection have a summary.

Useful information is provided in the manual's appendices. That information includes: glossary of terms, references, an encyclopedic group of seed tables, forms for scoping, and a template for project specific maintenance guide.

ROLES AND RESPONSIBILITIES

This manual strives to support the ODOT Mission Statement, which is "To provide a safe, efficient transportation system that supports economic opportunity and livable communities for Oregonians." Roadside development designs are provided by licensed landscape architects to support that mission statement. It is the responsibility of project landscape architects to be familiar with the content of this manual and to provide designs that enhance "livable communities" and the principles outlined in this manual. Furthermore, it is the role of the

landscape architect to be an advocate for these principles to project delivery teams and team leaders.

POINTS OF CONTACT

For questions or comments regarding the Roadside Development Manual, contact the Roadside Development Program Leader:

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MANUAL REVISION PROCESS

This manual is updated periodically. To expedite updates, this manual is available on-line. The on-line version is considered an official document. As an on-line document, it will not be published and distributed as a traditional publication, and there is no user list for update notifications.

It is the user's responsibility to verify they are using the most current version of the manual as their reference. Updated information will be detailed on the ODOT Roadside Development web page.

This Second Edition and subsequent editions will include indications of new or changed sections. Changes are identified on the "Change Sheet" on ODOT's Roadside Development web page. The change sheet summaries additions and changes that occur between manual revisions. To initiate a change that provides corrections or improves content contact the Roadside Development Program Leader.

OVERVIEW

FIGURE 1-1 HWY 3 NORTH OF ENTERPRISE

Highways are more than a conveyance system for people and products; they enable our connections to cultural and natural features, scenic views, to one another and the society at large. Highway roadside aesthetics are not mere ornamental embellishments. They are the picture frame through which is viewed one of the most beautiful regions in the country.

Our roadsides are the first impression many visitors have of our state. The scenery viewed from Oregon's roadways draw tourists. Highway roadsides help define the sense of place and leave an impression regarding the well-being of our communities. Engaging roadsides can enliven the journey of long haul travelers helping to make their trips safer. The roadside treatments along highways that run through our natural areas display Oregon's priorities regarding environmental stewardship. Roadside aesthetics affect property values and quality of life.

Oregon's roadsides reflect our shared pride of this place. In reading this manual and considering they myriad opportunities available in roadside design, keep in mind the functions and values of Oregon's roadsides and in your work strive to express that vision.

Oregon is renowned for its natural and built environments. Our transportation designers have a history of developing projects that protect and highlight the unique beauty of the diverse landscape.

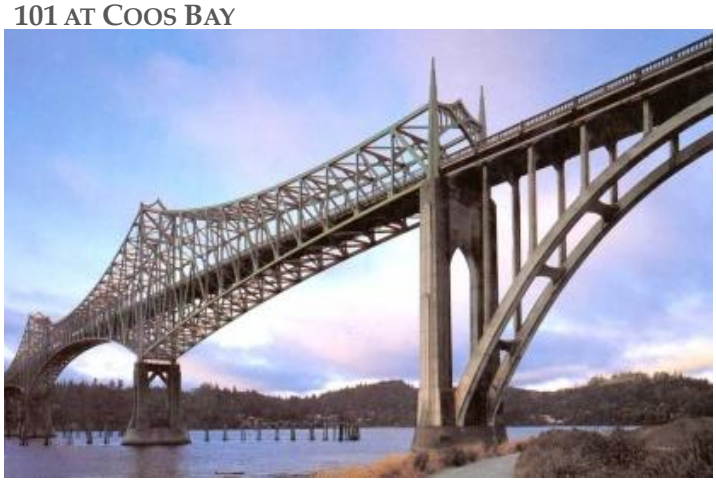
The Historic Columbia River Highway was the first Scenic Highway in the United States. This significant built feature was modeled after highways in similar mountainous European landscapes and was artfully designed by Samuel Lancaster, an Engineer, and Landscape Architect. Like the best of Landscape Architecture, the aesthetics were not applicate onto independently designed structures, but designed into the features.

FIGURE 1-2 HISTORIC COLUMBIA RIVER HIGHWAY FROM CROWN POINT

Similarly, the Pacific Coast Highway travels the length of the state along our coastline, crossing many rivers, streams, and bays. This highway is renowned for gracefully fitting into the landscape and its elegant historic bridges.

There are many examples of this interplay between the natural environment and transportation developments. The Oregon Department of Transportation (ODOT) and the Oregon Transportation Commission (OTC) has designated 26 Oregon Scenic Byways. Each Scenic Byway tells an Oregon story of the locations and their relationship between the natural and cultural environments.

FIGURE 1-3 CONDE MCCULLOUGH BRIDGE ON HWY 101 AT COOS BAY



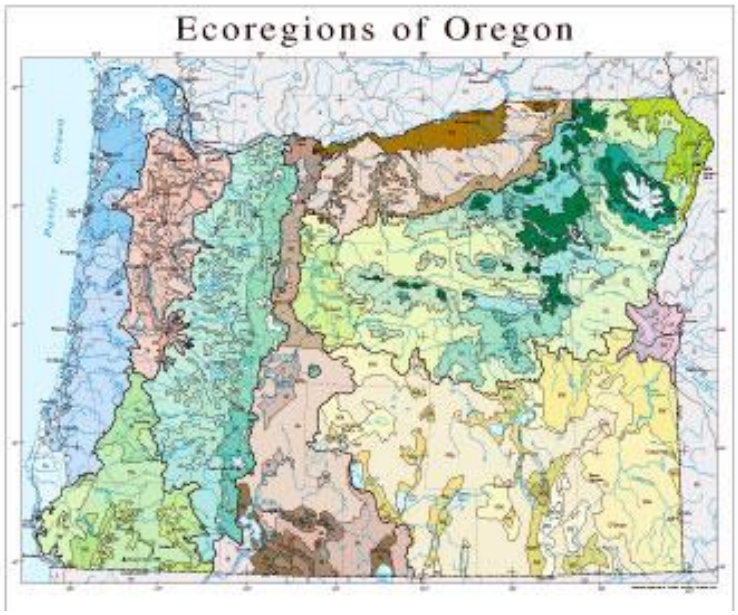
Not all highways and interstates in the state pass through such dramatic landscapes, however all projects have opportunities to reinforce the area's sense of place and to provide responsible stewardship of the public resource through design, construction and maintenance. The focus of ODOT's Roadside Development Program is to support safe transportation corridors while protecting resources and enhancing the road user's experience through conservation, design, and manipulation of the various elements of roadside landscapes.

The Goals of the Roadside Development Program Manual are to:

- Demonstrate responsible environmental stewardship by helping designers and other transportation professionals provide enduring roadside treatments that support safe road use, are attractive, functional, and embraced by all stakeholders.
- Provide a common language and basis for understanding Roadside Development for all Federal, State, and Local partners in the development of ODOT projects.
- Serve as guidance to help meet the goals of Context Sensitive and Sustainable Solutions, Practical Design, least-cost design and other State and Federal programs for roadside landscapes.
- Serve as a complementary guide to the following ODOT publications: Highway Design Manual, Bike/Pedestrian Plan, Routine Road Maintenance (Blue Book), Water Resources Specialist Manual, Aquatic Habitat Restoration and Enhancement Guide, Erosion and Sediment Control Manual and other ODOT policies, procedures and documents related to highway projects and their roadsides.

This manual is not intended to provide systematic design instruction for all Roadside Development project types. While providing design basics, it is intended to inform the reader of the reasoning behind the best practices and requirements regarding roadside development work, which must be considered throughout Project Development. For project specific help include a Landscape Architect (LA) in Project Development Teams and call upon Region and Statewide LAs.

FIGURE 1-4 ECOREGIONS OF OREGON



KEY DEFINITIONS

(See also Appendix A: Glossary of Landscape Terminology)

Ecoregion – is a definable geographical area possessing unique characteristics of climate, geology, soils, hydrology, vegetation and wildlife. The ten Ecoregions found in Oregon are the Basin and Range; the Blue Mountains; the Coast Range; the Columbia Basin; the East Cascades; the Klamath Mountains; High Lava Plains; Owyhee Uplands; the West Cascades; and the Willamette Valley.

Hardscape – is the human-made, non-living component of landscape, more prevalent in urban settings. Examples of include walls (retaining, sound/noise), rails (bridge, guard), surfacing (pavement, other) and structures (posts, signs, bridges, buildings).

Landscape – as used in this Manual, Landscape includes the area traveled through, from the details of the immediate roadside to panoramic vistas seen from the road.

Operational Right of Way – is the portion of the right of way either directly under traffic or the critical safety zones adjacent to the roadway. These include the road shoulders, an obstruction free run-out and recovery area, ditches, and clear sight lines free of visual obstructions.

Roadside – is the area outside paved road surface. This applies to all lands managed by ODOT and may extend to elements outside the right of way boundaries. Examples include unpaved median strips, rest areas, roadside parks, viewpoints, heritage markers, pedestrian and bicycle facilities, wetlands, stormwater treatment facilities, environmental mitigation areas and

quarries and disposal sites. ODOT's ownership is estimated to include about 70,000 acres of non-travelled land.

Roadside Development – is defined by the Federal Highway Administration as the development of right of way areas beyond the roadway and shoulders. As defined in the Code of Federal Regulations, Roadside Development also includes Safety Rest Areas, Scenic Overlooks, Information Centers, and visual access to adjacent Scenic Lands. Roadsides often include existing resources, such as habitat for plants and wildlife or wetlands, riparian areas, cultural resources and scenic resources. At ODOT, Roadside Development projects can include erosion control, water management facilities, site restoration, environmental mitigation, hardscape developments and scenic enhancements.

Visual Resource Management – consists of the inventory, assessment, evaluation and planning for the conservation of visual landscape components. At ODOT, this is often conducted when a highway project will result in measurable diminishment of these visual components. Visual resource management should be an on-going process during design development that informs the project decision-making process. Mitigating activities may be required to be incorporated into the project.

HISTORY OF ROADSIDE DEVELOPMENT AND LANDSCAPE AESTHETICS IN OREGON

FIGURE 1-5 OREGON TRAIL INTERPRETIVE CENTER

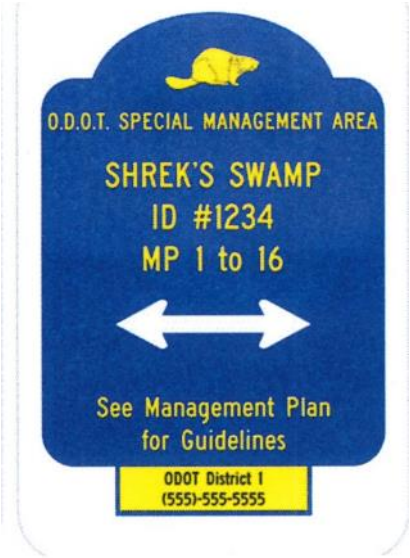
Much of Oregon's modern history is represented in transportation. From the Oregon Trail in the early 1800s, through the advent of tourism in the early 1900s with the completion of the Columbia River Highway, the McKenzie River Highway and the Crater Lake Highway and into the age of superhighways with the completion of Interstate 5 in 1966.

After the publishing, in 1962, of Silent Spring by Rachel Carson the environmental movement gained momentum. This was manifest in an explosion of environmental regulations and the creation of regulatory agencies

The Highway Beautification Act of 1965, championed by Lady Bird Johnson, resulted in Oregon's stewardship of the scenic resources including the control of eyesores like billboards and junkyards along the highways.

In 1997, The National Research Council's Transportation Research Board (of the National Academy of Sciences), conducted a study on the effects of transportation infrastructure on landscape and environment. Their findings concluded that the effects of transportation infrastructure are not only immediate but also cumulative and long-term, including negative effects on the climate, biodiversity, habitat and natural processes.

FIGURE 1-6 SPECIAL MANAGEMENT AREAS (SMAS)



For Roadside Development, the implications of this evolving environmental awareness include:

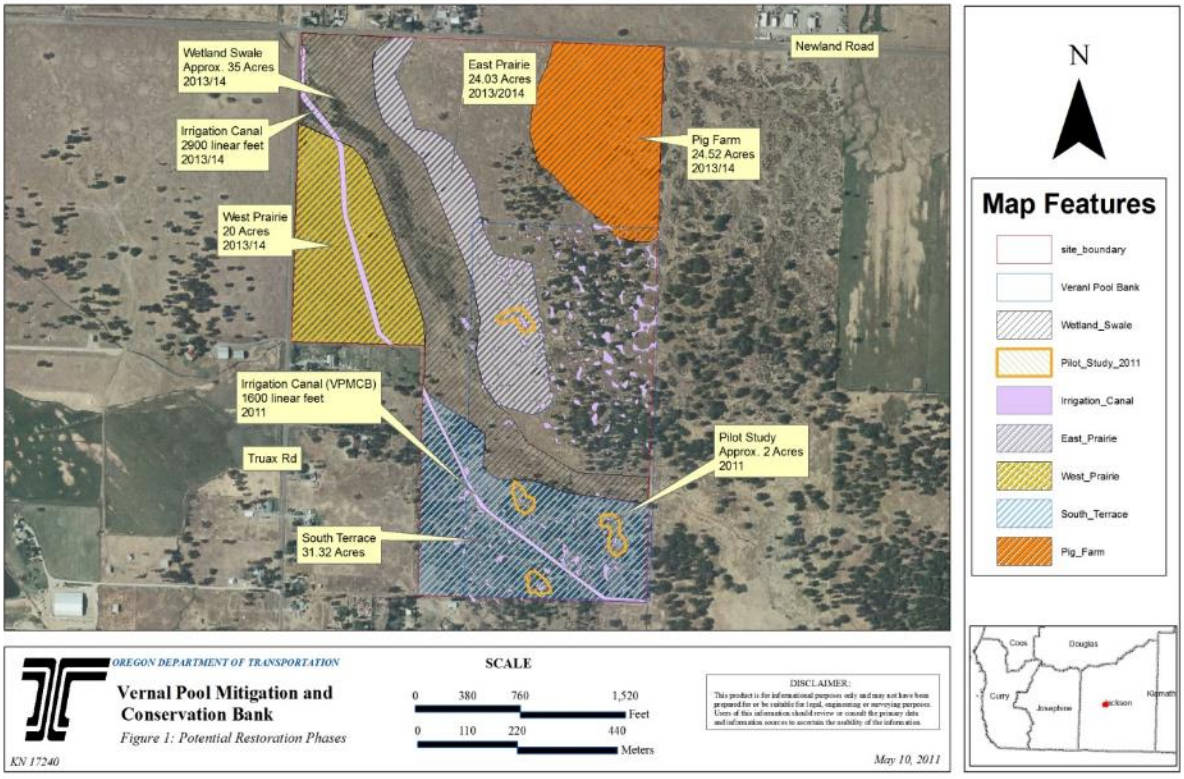
- A shift from individual species protection to broader habitat conservation measures, such as ODOT's Special Management Areas and Habitat Conservation Plans:

> Special Management Areas (SMAs) receive careful maintenance to preserve protected species along ODOT's roadsides. SMAs are identified with unique blue signs.

Efforts to mitigate for the fragmentation of habitat areas and wildlife corridors, through improved management of wildlife crossings and fish passage projects.

- Move from individual, project-specific wetland mitigation to larger scale, multi-project mitigation and conservation banking;
- Treatment of highway storm water runoff using roadside water quality features to diminish water pollution;
- Transition to a greater use of native plants, that reduce water use, lower maintenance costs, and provide pollinator habitat;

FIGURE 1-7 VERNAL POOL MITIGATION AND CONSERVATION BANK



Compensatory mitigation can result in significant environmental enhancement projects

Section Summary

Transportation has long been central in Oregon's history. Respect for the natural environment while addressing human needs is part of Oregon's culture. These values, embracing responsible environmental, stewardship are supported by policies and enacted by practices throughout the state.

2. ROADSIDE DEVELOPMENT PRINCIPLES AND CONSIDERATIONS

ODOT's Roadside Development Program endeavors to balance Safety, Economy, Ecology, Aesthetics and Sustainability. These are explored further below.

A. Safety – Safety is a key objective in roadside design. Safety for road users, for pedestrians and cyclists, for wildlife and for maintenance and construction staff who work beside traffic is the highest priority.

On roads designed with pedestrian amenities and plantings, motorists' speeds are often slowed due to the change in the road environment. When a lower speed appears appropriate to the motorist, it is more readily accepted. Traffic calming techniques are described in the Highway Design Manual.

A visually chaotic roadside can present distractions and result in driver fatigue. Natural appearing roadsides help alleviate fatigue. Monotonous stretches of roadway with little visual interest may even lull the driver to sleep. Roadside plantings have been shown to increase attentiveness; slow driving speeds and diminishes collision severity. Design of aesthetically pleasing roadsides can be important for improving roadway safety.

Roadside and median plantings can reduce glare from on-coming headlights and glare from sunlight when the sun is low on the horizon. Evergreen trees, however, can shade the highway allowing icy conditions to persist in winter and plantings can block sight lines.

B. Economy – Our highway system is critical to the transport of goods and services, thereby directly supporting our commerce and economy as critical infrastructure. The quality of Oregon's scenery, as seen from roadways, bolsters the tourism industry, which is a major economic force in Oregon and is a high priority for ODOT.

C. Environment – Thoughtful roadside design will avoid the creation of roadside habitat that is likely to result in collisions with wildlife. However, the use of native plants along the roadside can provide important pollinator and small animal habitat and support rare plant species. Dense native vegetation can prevent the encroachment of invasive weeds. Trees and other plants provide cooling shade to streams, which is vital to Oregon's native fish.

In urban settings, trees can reduce the "Urban Heat Island" effect by providing shade for buildings, and pavement. This can reduce energy use in summer and cool stormwater runoff, again helping streams flow with cool water, which benefits salmon.

Roadside Development and Maintenance are important partners in the management of noxious weeds. State agencies are required to manage against specific plant species, which threaten our agricultural industry or the environment. Maintenance employees work to eliminate noxious weeds wherever they are found along our rights of way.

Roadside Development staff coordinates closely with other environmental disciplines such as hydrologists, botanists, biologists and erosion control and water quality specialists, to provide desirable roadside features while minimizing the negative impacts of the roadway infrastructure.

D. Aesthetics – The designer responsible for roadside development, usually a landscape architect, can enhance a regional sense of place. Roadsides are more than a buffer between the travel way and surrounding landscapes; they are often a valued transition into a community.

Natural features, rural views and long-distance panoramas are preferred over urban and semi-urban views. These visual resources are often accessed by Oregon's roads. The public also values visual features that fit the locality and contribute to a sense of place.

E. Sustainability – Sustainability is a high priority for the Oregon Department of Transportation. ODOT is the first DOT in the country to have a Sustainability Plan, which continues to evolve as new technologies and projects provide opportunities for wise use of resources.

The ODOT Sustainability Plan identifies seven priority areas: Energy use and climate change; Material resource flows; Environmental Stewardship; Land use and infrastructure; Economic health; Health and Safety; and Social responsibility/workforce well-being and development. Roadside Development provides support to all of these priorities.

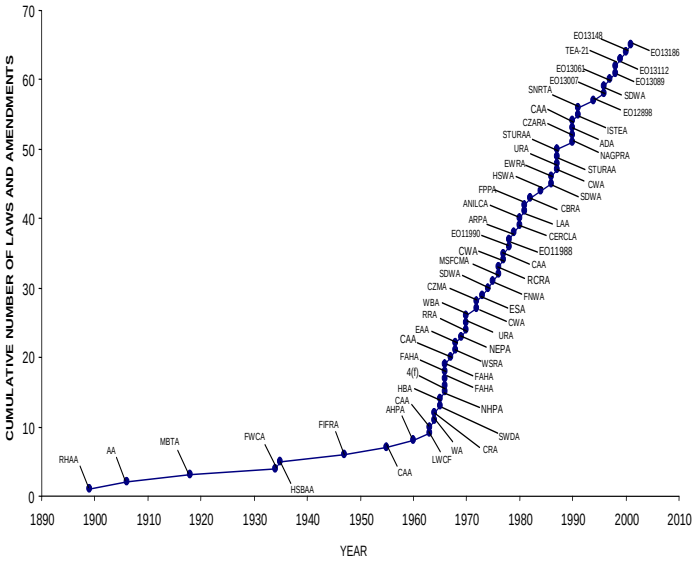
SECTION SUMMARY

This section describes ODOT's Roadside Development priorities and provides examples of how Roadside Development can impart those priorities into the landscape.

3. REGULATORY CONTEXT

Federal, State, and Local legislation require that visual resources and the environment must be considered during project development. Many of the regulations are not listed, however Key Regulations are provided below.

FIGURE 3-1 THE NUMBER OF FEDERAL ENVIRONMENTAL LAWS AFFECTING TRANSPORTATION INCREASED AROUND 1965



FEDERAL

23 CFR 713.304(d) - Unneeded portions of highway right of way can be conveyed to any public entity or private party, but only if the land is not needed to restore, preserve, or improve the scenic beauty and environmental quality adjacent to the highway.

23 CFR 750 - Highway Beautification Act of 1965 and all subsequent amendments. Establishes provisions to protect the public investment, promote safety and recreation, and preserve natural beauty along federal and primary highway system roadsides including control of outdoor advertising signs, authorization for information centers at safety rest areas, control of junkyards.

23 CFR 752.1 - "Landscape and Roadside Development" - furnishes guidelines and prescribes policies regarding landscaping and scenic enhancement programs, safety rest areas, and scenic overlooks. These include providing native wildflowers and the enhancement of pollinator habitat during roadside development.

River and Harbor Act of 1899. This act prohibits altering navigable waterways or discharging effluent into navigable waterways.

National Environmental Policy Act (NEPA) of 1969. This act establishes a national policy that requires all federally funded or federally participating projects to give proper consideration to the relationship between humans and the environment, and to assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings. (Sec. 101.b.2 [42 USC Sec. 4331]) The NEPA language implies that esthetic assessments must not only describe the visual attributes of projects, but must also evaluate their effect on the relative visual experience.

Clean Air Act of 1970 This act authorized the development of federal and state regulations to limit emissions from both stationary (industrial) and mobile sources.

33 U.S.C. 1251 et seq. (1972) Clean Water Act resulted in the National Pollution Discharge Elimination System (NPDES), which regulates all discharges into waters of the State, including stormwater runoff. The 1200-C permit, administered in Oregon by the Department of Environmental Quality (DEQ), directs ground -disturbing activities that can result in sediment laden water entering waterways.

Noise Control Act of 1972 This act establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare.

Endangered Species Act - 1973 This act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found.

Surface Transportation and Uniform Relocation Assistance Act of 1987, Section 130. Requires at least one quarter of one percent of funds expended for landscape projects be used to plant native wildflowers.

Architectural Barriers Act of 1968, and the Americans with Disabilities Act of 1990. These acts establish guidelines for accessibility of facilities. Under their provisions, ODOT is required to follow guidelines in the ADA Standards.

Executive Memorandum on Environmentally Beneficial Landscaping, April 26, 1994. This memorandum stresses the use of regionally native plants, minimal impact to habitat on federally funded projects.

Presidential Memorandum – Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators, June 20, 2014. Established the Pollinator Health Task Force, directed Task Force to develop a National Pollinator Health Strategy (Research Action Plan, Public Education Plan, and Public – Private Partnerships), directed Federal land management agencies (including USDOT) to enhance pollinator habitat. Memorandum specifically directed USDOT to coordinate with State transportation agencies to promote pollinator-friendly practices and corridors.

STATE

Oregon's Statewide Planning Goals and Guidelines; Goal 5 - Oregon Administrative Rules - To protect natural resources and conserve scenic and historic areas and open spaces.

Oregon Noxious Weed Laws: Oregon Department of Agriculture requires that aggressively spreading exotic plants listed as noxious weeds be controlled.

Oregon Highway Plan: Scenic Resources: Policy applies to all state highways, not only designated Scenic Byways. Action 5B.4 - Use best management practices to minimize impacts to scenic resources, and preserve and/or enhance visual quality within the state highway right of way when improving and maintaining the state highway system.

Administrate Rules 734-32-0000 through 734-32-0070 establishes the Scenic Byways Program as authorized by ORS 184.617 and 184.619.

State of Oregon, State Purchasing and General Services Act, Section 2166.404 of the Government Code. This act requires that ODOT use and require the use of xeriscape practices in the practice and maintenance of landscapes associated with state-owned property or facilities.

House Bill 4139 (2014 Legislative Session) - Establishes Task Force on Pollinator Health, directed Task Force to examine relevant issues, consult with Oregon State University and Oregon Department of Agriculture to develop educational materials on BMPs to avoid adverse effects from pesticides on pollinators.

OREGON DEPARTMENT OF TRANSPORTATION

The Oregon Transportation Plan calls for the development and implementation of the Scenic Byways Program. OTP Strategy 3.2.4, 3.2.5, and 4.3.4.
The 1999 Oregon Highway Plan under Policy 5B, 1D and Goal 5 identifies the Scenic Byways Program the Oregon Highway Plan March 2000 Implementation Action Plan.

ODOT Directive - DES 20-01 – Ornamental Landscaping: November 5, 2001; To establish process to review and approve installation and maintenance of ornamental landscapes along state highways.

ODOT Project Delivery Leadership Team (PDLT) –Operational Notice 04– Environmental Performance Standards. This Operational Notice (Notice) provides expectations and guidance to the ODOT Project Delivery business line for meeting environmental performance standards (EPS) as required by Section 18 of the Oregon Jobs and Transportation Act (JTA) and Oregon Administrative Rule (OAR) 734-024-0005 to 0040.

ODOT Directive TSB11-02(D) – Documents Requiring Professional of Record Seal (August 1, 2011). This act specifies the types of documents that are required to be sealed by a Professional of Record (POR) for highway design and construction. Roadside development plans, erosion control plans, and their respective specifications are required to be stamped by a POR.

USFS/ODOT Memorandum of Understanding (No. 28729) – This agreement addresses situations where State Highways run through U.S. Forest Service lands. The Agreement is a basis for collaboration on the use of the shared resource. Among the issues it addresses is a requirement that on ODOT projects adjacent to USFS lands, all plants and seeds used be of genetically appropriate (local) origin.

Sudden Oak Death Task Force Strategic Action Plan - ODOT is a signatory to an "All Lands" Memorandum of Understanding (MOU) to collaborate in implementing the recommendations of the Strategic Action Plan to contain the plant killing pathogen Phytophthora ramorum. Enforcement of ODOT's Standard Specification 01040.19(c) satisfies this agreement.

Special Management Areas – This advisory describes the background to and maintenance and construction requirements for the Special Management Area (SMA) program which addresses

protection of threatened or endangered species or special botanical areas when they are located in ODOT Right of Ways. GE09-02(A)

LOCAL

Many local jurisdictions have requirements pertaining to transportation planning, roadway and roadside design, and landscape. In particular, many municipalities have established street tree planting lists. Contact the local agency for information.

SECTION SUMMARY

The government, its laws and Agency guidelines provide for preservation of scenic roadsides, environmental protection, pollution prevention, wildflower and pollinator protection, preservation of sensitive habitats, enhancement of the environment and generally support responsible environmental stewardship.

Roadside Development projects take many forms and are supported by and often required by federal, state, and local agencies.

4. PLANNING

ODOT's Planning Division works to identify transportation issues, consider alternatives (including changes in land-use designations and transit/alternative modes), and then provides the information statewide for project development. The planning effort is required to integrate Land Use considerations with transportation developments in a manner that supports livability and sustainable communities.

ECO-LOGICAL PLANNING

FHWA is presently emphasizing Eco-Logical approach linking transportation planning with a systemic process of natural resource identification, avoidance, minimization and mitigation. ODOT is making similar strides in better connecting our planning and environmental business lines to improve outcomes.

CORRIDOR PLANNING

Corridor planning is a process of inventory/analysis/objective-setting that results in a thematically cohesive design. ODOT has several examples of this approach, including the I-84 Corridor Strategy and The Scenic Byways program, both of which establish design and maintenance criteria for future projects. This corridor-level planning process is beneficial for conservation of visual resources. This leads to more visual harmony and a more interesting and comfortable experience for road users.

The National Environmental Policy Act (NEPA) requires that agencies proposing a project with a federal connection assess potential environmental impacts, including visual resources. The Act requires identification of key visual resources, view corridors, consideration of impacts to those visual resources, and actions that could be taken to avoid, minimize and mitigate for adverse impacts.

The Oregon Department of Fish and Wildlife, under direction from the Governor, has developed the Oregon Conservation Strategy. This planning document examines the various ecoregions in the state, identifies goals and key resources for conservation, and establishes guidance for activities designed to meet the conservation goals. As a sister State Agency, ODOT is required to observe this Strategy and assist in meeting the goals through our planning, projects and maintenance activities.

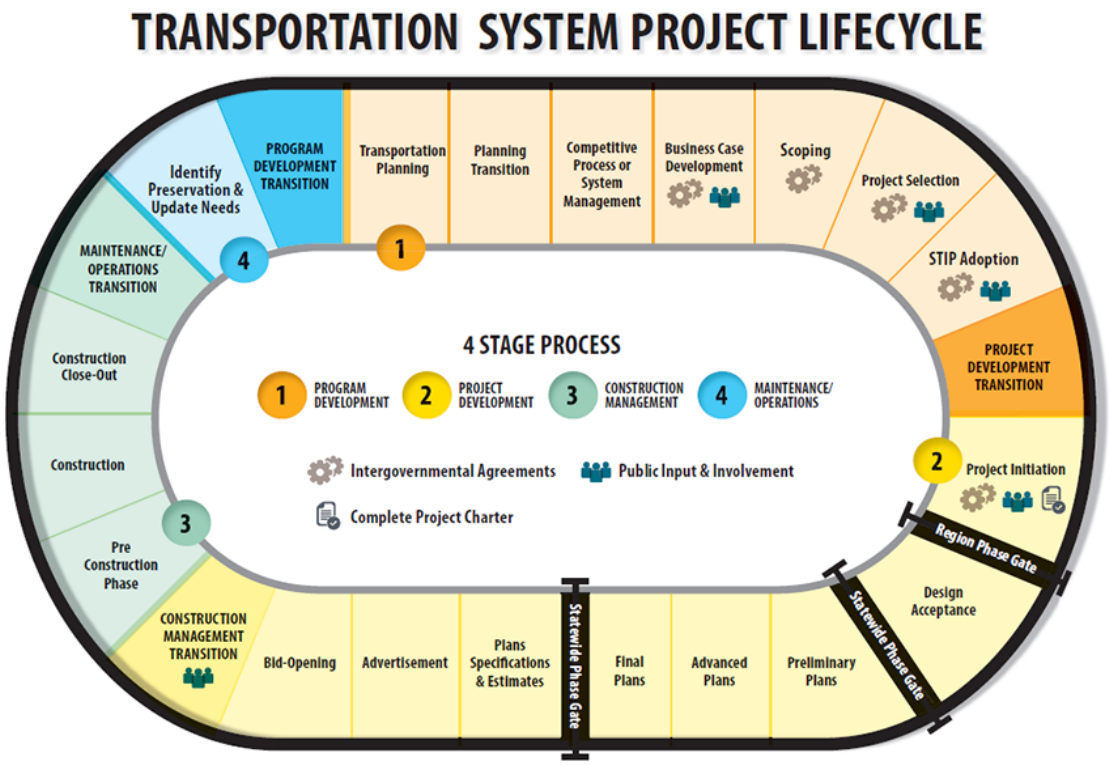
SECTION SUMMARY

ODOT and other governmental agencies have programs in place to anticipate transportation needs and to plan for transportation projects in ways that satisfy community and transportation needs, maximize the environmental good, and enhance the road user's experience.

5. PROJECT DEVELOPMENT PROCESS

ODOT has a well-established Project Delivery Process, as displayed on the following graphic:

FIGURE 5-1 PROJECT DELIVERY SYSTEM



As seen in the above, there are significant efforts made prior to initiating Project Design.

PROJECT DEVELOPMENT TEAMS

Each Project Development Team has a Project Leader. This individual is well versed in the broad range of disciplines required to bring a project to completion. Every Project Development Team consists of members from different disciplines. Beside planners, designers, landscape architects and engineers, the teams include Specification, Construction Regional Environmental Coordinator (REC) and Maintenance staff so all project aspects are being thoughtfully considered.

PROJECT PLANNING

Scoping is the first step for determining the Roadside Development role in a project. Scoping is conducted as part of the Project Prospectus, where context sensitive and sustainable solutions

(CS3), visual resources and roadside development are identified and project input is provided. It is important for the person conducting the Scoping exercise to be aware of full breadth of Roadside Development's capabilities, in order to fully appreciate the opportunities presented by each project. The scoping form will help walk them through Roadside Development and Visual Resource considerations on a project.

During this stage, discuss with the Project Leader the letting of planting/restoration projects as a separate contract. There are several reasons that the general construction project and the landscape planting could be more successful if contracted separately. The roadway construction project will be completed faster without the planting and establishment period. Having the landscape planting a separate contract allows a landscape professional to be the prime contractor in the field of their expertise and the landscape contractor is likely to be expert in the required maintenance, maximizing the plant survival during plant establishment. Having the roadside planting as a stand-alone contract also opens the opportunity to have plant establishment periods that are longer than the standard 1-year period currently specified.

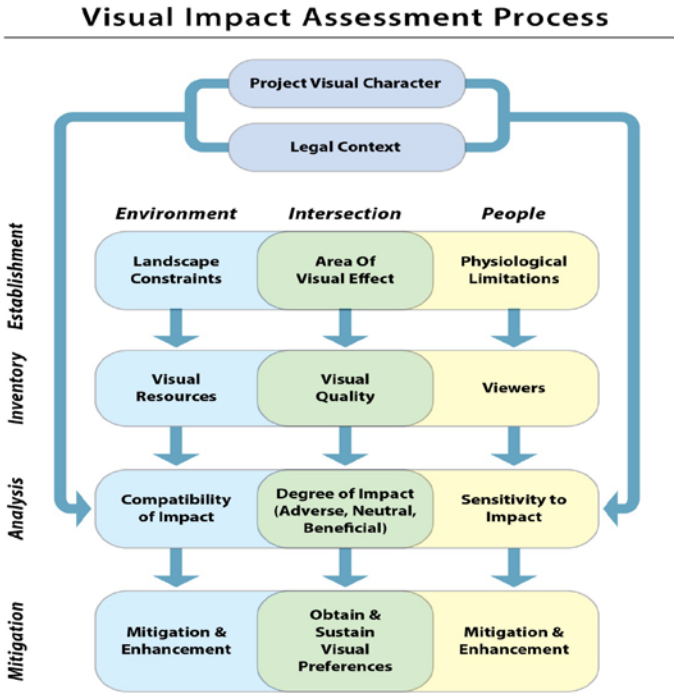
In the event that roadside development work is contracted separate from general construction, the division of work needs to be identified in the project plans. Work on the general construction needs to be finished prior to beginning work on the landscape installation. Work with Project Leader at this early stage to determine what work would best be split off to a landscape contractor and how that division of work will be conveyed to the contractors.

During project scoping it is also important to note that almost every project will require some level of Roadside Development, particularly temporary and permanent erosion control and seeding. Complex projects that anticipate unique site maintenance procedures should have the development of an Operations & Maintenance Document included in the scope.

Please see the revised Scoping Form included in the Appendices.

FIGURE 5-2 VISUAL IMPACT ASSESSMENT PROCESS

VISUAL RESOURCE INVENTORY AND ANALYSIS



Because of the public nature and visual importance of roadways, the visual impact assessment on roadway projects is required on certain NEPA classifications. ODOT has kept current regarding Visual Resource Inventory and Analysis as this field has evolved. Protocols established in 1988 and later in 2012 have been supplanted by the current guidelines.

The National Cooperative Highway Research Program (NCHRP) study of 2012 formed the basis for the Guidelines for Visual Impact Assessment of Highway Projects (FHWA, January 2015). ODOT utilizes the 2015 FHWA methodology for Visual Resource Inventory and Analysis.

The analysis will determine if a Visual Impact Assessment (VIA) is necessary and if it is required, determine through inventory and analysis of the landscape, the project and the users who will view the landscape and the project, what level VIA is required.

There are four levels of effort and depth of information provided in a VIA:

Memorandum – This would be the result of a small project with minor impacts, no controversy, with no or few key viewpoints and the project is compatible with the local environment

Abbreviated – The abbreviated VIA would have limited controversy, few key viewpoints, be basically compatible with the local landscape and the project would have no or limited impacts to the scenic resources.

Standard– The standard VIA would have local controversy, moderate visual impact, multiple viewer groups and few to multiple key viewpoints. It may be compatible with the local landscape and the project would possibly have impacts to the scenic resources.

Expanded– The expanded VIA would have statewide controversy, substantial visual impact, many viewer groups, multiple key viewpoints, it may conflict with the local landscape and the project would have substantial impacts to the scenic resources.

Reports are provided to the Region Environmental Coordinator who is handling the NEPA work on the project. The information is then compiled into the NEPA documentation.

SECTION SUMMARY

ODOT has processes in place to plan projects. Federal regulations exist to ensure care is given during the planning process to the appearance of completed projects. Visual Resource Inventory and Analysis guidelines are important tools in ensuring ODOT is a wise steward of its landscapes and the visual quality of the environment. Roadside development can best take advantage of opportunities when included in planning at the earliest stages.

DESIGN CONTEXT

ODOT builds roads. These roads run through towns, cities, and rural or natural landscapes. These are the contexts that the project design must respect and accommodate. ODOT also has and builds facilities that may be offices, technical centers, maintenance facilities, housing, material stockpiles or material borrow sites with each facility impacting the surrounding site context either by contrasting or complementing. Each place is unique; every site has its own characteristics; and every project presents unique challenges and opportunities in addressing that context. There are different design theories, legislative directives and inter-agency agreements that exist, which influence the approach taken for Agency projects. Four approaches are listed below that involve roadside development and the skill set practitioners can bring to a project.

CONTEXT SENSITIVE AND SUSTAINABLE SOLUTIONS (CS3)

CS3 is a set of design concepts founded in an FHWA initiative, which includes consideration of the built and natural environments surrounding proposed projects. This often includes a high level of public involvement as a means for obtaining a sense of the community's values.

COMPLETE STREETS

Complete Streets is a set of design principles, which recognize the community values, placed upon multi-modal transportation systems. Safety for bicyclists and pedestrians is emphasized while motorists and freight vehicles continue to be facilitated. The Complete Streets principles are inclusive, diverse, and accountable to local interests. A good supplement to Complete Streets is: Main Street…when a highway runs through it: A Handbook for Oregon Communities

FIGURE 5-3 COMPLETE STREETS

PRACTICAL DESIGN

Practical design is a strategic approach to planning intended to deliver focused benefits for the State's transportation system while working with the realities of a constrained funding environment. At a minimum, this approach considers safety, economic development, adjacent communities, the environment, the overall transportation system (not just highways), and cost.

Use the link to see the report. Practical Design Strategy Report (2010)

Additionally, ODOT has recently developed two initiatives, which contain design criteria for roadside design projects. These are the Jobs and Transportation Act (JTA), a State Legislative action, which contains a number of performance criteria, and the Federal Aid Highway Programmatic (FAHP), which contains Best Management Practices for navigating projects through the Endangered Species Act.

CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN

CPTED is a national, voluntary program based on the theory that the design and effective use of the built environment can lead to a reduction in the incidence and fear of crime. CPTED consists of four key concepts, all of which are interrelated:

- Natural Surveillance - involves the placement of physical features in such a way to deny hiding places at project sites.
- Natural Access Control - is the physical guidance of people by the well-designed placement of entrances, circulation, fences, landscaping, and lighting.
- Territorial Reinforcement - is the use of physical attributes that express ownership such as fencing, pavement treatments, signage, and landscaping.
- Maintenance - Allows for the continued use of a space for its intended purpose. It also serves as an additional expression of ownership.

SECTION SUMMARY

This section lists several approaches to addressing the contexts through which project design concepts are evaluated.

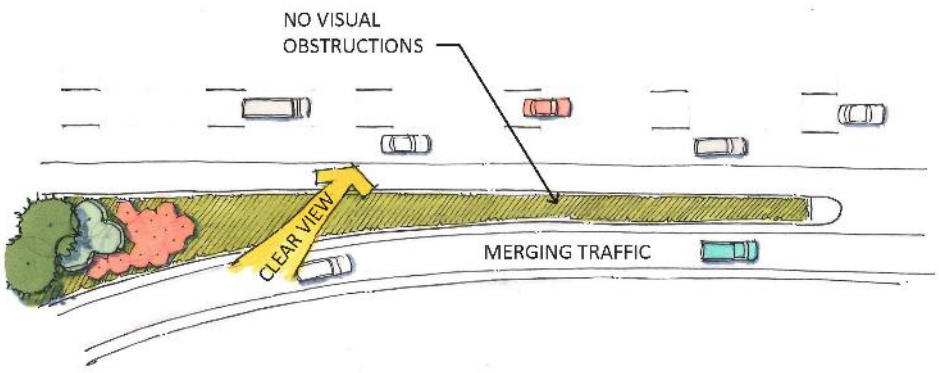
6. DESIGN PRINCIPLES AND PRODUCTS – GUIDANCE ON DESIGN

This chapter begins the actual guidance where designers are provided with ODOT's best practices. Keep in mind a few over-arching general concepts.

SAFETY

First and paramount consider how Roadside Development affects safety. Designs shall not introduce obstructions in the run-off and recovery zone adjacent to the pavement. Plantings shall not block or obscure, important views. Unobstructed views in intersections and highway interchanges, especially freeway onramps are critically important.

FIGURE 6-1 CLEAR VIEW AREA FOR ONRAMPS



More safety issues regarding drivers, maintenance staff, wildlife and pedestrians are also described in this manual.

DELINEATION

Design vegetation and grading to help guide traffic through highway corridor. For example plantings in median strips and directional berms can reinforce the alignment of the highway.

HYDRAULICS

Integrate the roadside ditches and water quality features such as filter strips and treatment swales into the roadside development plan. These are generally engineered features that benefit from thoughtful design to gracefully fit them into the landscape.

SNOW

Where snow accumulation is anticipated, living snow fences can be designed into a project to address drifting snow. Provide areas for plowed or blown snow adjacent to roadsides and in safety rest areas. Snowmelt runoff areas can have different soil moisture characteristics and support different plants than surrounding areas. Plan for runoff from snow melt.

CONTEXT (CS3)

Roadways and their roadsides become part of the landscape and community. Design roadsides to complement the character and appearance of the surrounding area.

CONSERVE THE BEST, ENHANCE THE REST

Desirable vegetation which will be undisturbed by the project is already established and paid for. It helps with site stabilization, and provides a source for the natural spread of desirable plants. Salvaging topsoil or wetland soils for re-use can save money on site preparation and improve plant survival. Salvaging large wood and rock provide materials for habitat developments on land or in water. Protect, conserve and salvage historic, cultural and protected natural resources.

RURAL AND URBAN DIFFERENCES

Rural

For rural projects good design will match the surrounding environment and preserve important views. This can be achieved using native plants in plantings that mimic the natural landscape. Maintenance along rural roadsides is typically weed control and infrequent mowing. Consider the rural context; in some agricultural areas adjacent property owners may have issues with the selection of native seeds or plants. Other lands owners, may require the use of regionally native plants.

FIGURE 6-2 RURAL WILDFLOWER SEEDING ADDS BEAUTY AND RETAINS SAFE CLEAR ZONE

Urban

Urban projects are subject to greater variables of climate, conditions and context. There is reflected heat and light, more compacted soils, constrained water management and reduced air quality. Roadside projects will be subject to more use by people including potential vandalism. Urban projects frequently allow for greater creative expression and often emphasize the ornamental aspect of the landscape designs, even if native plants are used. Providing streetscapes with street trees offer environmental and aesthetic benefits to the urban environment. Street trees help define and characterize the public right-of-way, provide traffic calming and reinforce definition between various modes of travel. Maintenance practices on urban projects will be more intensive.

FIGURE 6-3 HWY 99E IN OREGON CITY

It is important to note here that it is ODOT's DES 20-01 policy that intensive urban landscape treatments requested by local governments will be maintained by the local government. This arrangement must be documented in an Inter-Governmental Agreement (IGA).

WATER USE

In 2015 Oregon endured a record drought. This prompted legislation (ORS 184.423), an executive order (No. 15-09) and revisions to the Oregon Transportation Plan (4.1.1.) where sustainable practices and conservation of water becomes integral to Oregon's standard operating procedures. Roadside designs must be planned with awareness of the value of water.

An approach to roadside design that conserves water is Xeriscaping. Xeriscaping is the practice of landscaping for areas that receive little or no supplemental water. The point is to fit the landscape treatment to the naturally available water.

- Regionally native plants are well suited for this strategy but xeriscaping does not require strict adherence to the use of native plants.
- Many horticultural introductions or California natives are capable of thriving with no supplemental water.
- Xeriscaping practices include grouping of plants in "hydrozones" where plants that have the same water requirements are grouped together.
- Xeriscaping may be a varied landscape, with wetland plants in swales, drought tolerant plants on slopes and other areas with mulch, rock or pervious pavement.

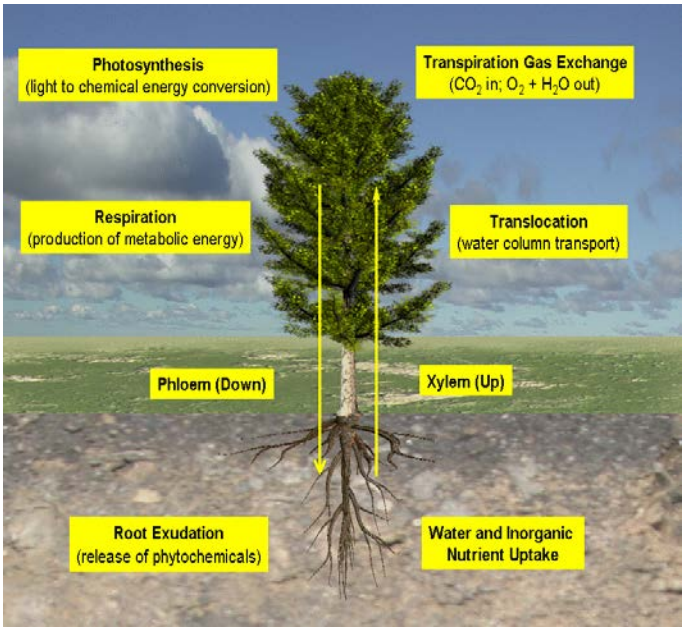
- Xeriscape design might direct roof drains or runoff from impervious surfaces through landscape features or capture water for future use.

NATIVE VERSUS HORTICULTURAL PLANTS

The use of native plants has many benefits, including:

- Native plants are adapted to the local climate, hydrology and soils, making them easier to establish and more likely to thrive with less maintenance. Less maintenance results in cost savings;
- Native plants reinforce the site's sense of place;
- Native plants often hold value to First Nation peoples as food, medicine, or other traditional purposes;
- Native plants support wildlife, particularly for co-evolved pollinator species, which share interdependency with the plants.
- In many cases, rare plant species are found along the roadside, and represent some of the few remaining populations of those species, requiring regulated protection.
- U.S. Department of Transportation and the Federal Highway Administration have developed a comprehensive manual titled Roadside Revegetation An Integrated Approach to Establishing Native Plants and Pollinator Habitat. This manual is especially relevant for projects that run through public lands.
- Plants and seeds used on ODOT projects that are adjacent USFS lands must be native plants the parent stock of which is of local origin.
- A good plant list is provided in this document's appendix

FIGURE 6-4 FEATURES & FUNCTIONS OF A PLANT



Oregon has many attractive native plants that can be used in an ornamental fashion. Massing native wildflowers or bright fall color in front of dark evergreens can produce a dramatic effect that provides ecological benefits and reinforces Oregon's unique character. In developing planting plans consider the potential for wildlife conflicts with vehicles. Do not to provide cover or browse for large animals along the roadside or the median. Consider the optimal growing conditions of the native plants. Plants that grow to great size, or thrive in cool shade with rich soil are inappropriate for the constrained spaces and reflected heat of paved urban settings. Also, roadside soils are often compacted and infertile and not optimal conditions for growing plants.

Many horticultural introductions have attributes such as, unique appearance, disease resistance, drought or pollution tolerance or provide for stormwater treatment. Many cultivars are tolerant of heat, reflected light and are hybridized to fit in urban situations. Know the plants, sometimes horticultural introductions are the right choice. Know also, that many exotic garden plants have escaped cultivation and are considered weeds.

PHYTOREMEDIATION AND WATER QUALITY (WQ)

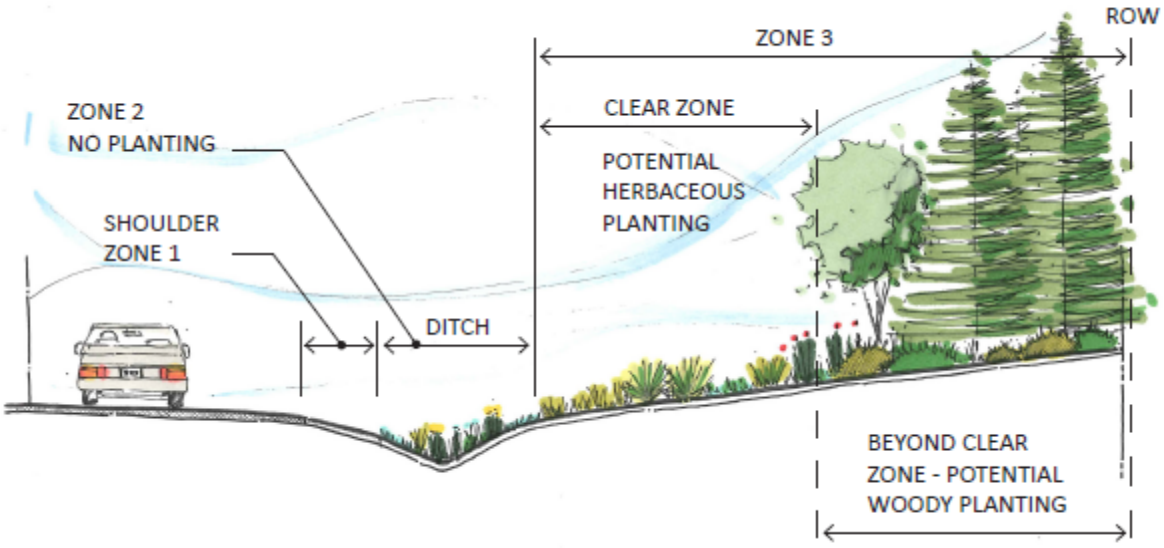
The management of stormwater runoff from paved highways is necessary to address increased runoff volume from impervious surfaces and the pollution that accumulates on road surfaces. ODOT has programs in place for developing WQ facilities for new impervious surfaces to treat highway runoff. Stormwater treatment requirements are based on state and federal regulations.

SPECIFIC DESIGN ISSUES REGARDING ROADSIDE PLANTINGS

There are safety issues related to plantings in the operational right of way. Plant no vegetation where it can block views, particularly at intersections and on-ramps. Drivers need clear views of the traffic into which they will be merging. Off-ramps present less of an issue for sight lines, however trees that shade an off-ramp can allow ice to persist creating poor traction where vehicles need to slow to the intersection. Refer to Oregon Highway Design Manual Chapter 4.2.6. Freeway Interchange quadrants may be appropriate for tree plantings if they are located to allow clear sight lines. Anticipate the needs of maintenance and do not facilitate unauthorized campers. Herbaceous flowering plants can be used throughout such areas if they are compatible with maintenance practices.

Along roadsides and medians a band that is free of obstructions is called a clear zone. This includes a safe run-out and recovery area for errant vehicles. Depending on road type, driving speeds and roadside topography the clear zone width varies. Verify the clear zone width prior to designing the roadside. No plants with stems that get greater than 4" diameter should be planted in highway clear zones. Also, Maintenance has standard practices for roadsides in the operational right of way.

FIGURE 6-5 ROADSIDE ZONES SECTION



To facilitate these practices, design no seeding or planting from the edge of pavement across the shoulder (this is maintenance zone 1). From the edge of the shoulder to the back slope of roadside ditches must be kept free of any obstructions or plants that impede visibility or the hydraulic function of the ditch. This is part of the run-off and recovery area (maintenance zone 2). From the back slope of the roadside ditch to the limits of right of way plantings can be planned so long as they respect the clear zone limitations and the plantings can be accommodated by Maintenance. The intent of these caveats is not to discourage roadside plantings, but to maximize safety and encourage collaboration with Maintenance in dealing with roadsides.

Roadside plantings are valuable in many ways. One recent study (Safe Streets) has developed evidence that planting medians with small trees can reduce crashes by as much as 50% on lower speed highways. Planting trees and shrubs in raised medians and along the roadside can be planned if clear zone requirements can be met or design exemptions approved. Such plantings can reduce speeds and have a traffic calming effect. Please refer to the Oregon Highway Design Manual, Chapter 4.3.

As design develops, consider how Maintenance will deal with the project once it is constructed. Talk with maintenance personnel to find out the maximum angle of slope on which mowing equipment can be safely operated (1V:3H recommended, 1V:2H is possible) and the size and reach of the equipment. Design safety into the project by providing access and parking for service vehicles. Consider what Maintenance likes and dislikes. Maintenance does not dictate design, but they are project stakeholders and the caretakers of roadside landscapes.

SUBSECTION SUMMARY

This subsection provided an overview of guiding design principles that are used in good Roadside Development. Project Leaders can use this information to understand the issues considered by designers, and designers can use this information to bring a comprehensive suite of solutions to the project's many facets.

ROADSIDE DESIGN DOCUMENTS

Plans and documents for a project will include an entire suite of construction documents which will include plans, details, special provisions, bid item list and cost estimate. Designing for roadsides can simultaneously serve multiple objectives such as enhancing safety, preventing erosion, improving aesthetics, treating stormwater mitigating noise and enhancing pollinator habitat. The challenge is to accommodate the requirements of the other design and engineering disciplines and gracefully address all the opportunities a site offers. A definitive resource for the road engineering is the Highway Design Manual. Important design considerations such as sight lines, slopes, obstructions, clear zones and other factors that will influence roadside development are described in the Highway Design Manual. Although design exceptions do occur, roadside development designs must satisfy the criteria outlined in the Highway Design Manual.

Types of roadside development designs may include the following:

TEMPORARY AND PERMANENT EROSION AND SEDIMENT CONTROL (ESC) DESIGNS

Most projects will expose soil and will require a plan to control erosion and sedimentation and to manage stormwater runoff. Sediment, once it enters waterways is considered pollution and that can have lethal effects on aquatic species. Functioning ESC is environmental protection that is required by laws that are described in project permits and required by the project contract as defined in the construction plans and specifications. Failures of erosion and sediment control devices can result in the need for site repair that takes time away from scheduled work. Sediment entering waterways is considered pollution and discharges can result in significant fines.

Contract Plans include erosion and sediment control plans. Construction practices and schedule cannot be accurately anticipated by a designer. Knowing this, ODOT specifies that the construction contractor is responsible for the Project's Erosion and Sediment Control Plan (ESCP). The ESCP is the paper plan (usually using the contract erosion control plan as its basis) and the implementation of that plan on the construction site. The ESCP includes project schedule and is required to be updated as site conditions evolve. Contractors can opt to use the

Contract Erosion Control Plans as the ESCP, so designers producing erosion and sediment control plans must anticipate risks at every stage of the construction process.

Erosion prevention relies on covering exposed soils. Permanent measures to prevent erosion include the preservation of existing vegetation and providing seeded vegetation. An important Best Management Practice (BMP) is to stabilize soils by means that do not rely on seed germination such as matting or mulch. It is easier to prevent erosion than control sediment pollution once it is loosed. Compost socks, sediment fences, sediment traps and multiple types of sediment barriers stop the transport of sediment. Stormwater runoff, especially once flows concentrate into rills and channels can be a destructive force that can remove and convey large volumes of sediment. A hydraulic engineer is qualified to evaluate criteria for stormwater runoff management. Channel liner matting, check dams, slope drains, energy dissipaters, detention ponds and Baker tanks are tools one can use to address stormwater runoff.

A landscape architect, hydraulic engineer or erosion control specialist are qualified to develop ESC plans. Refer to the ODOT Erosion Control Manual for best management practices, and Oregon Standard Specifications for Construction, Section 00280 (Erosion Control), as well as the ODOT Standard Details for the specifics on installation of the various erosion control measures.

SITE RESTORATION DESIGNS

Permanent site stabilization is established on finished grades by reintroducing vegetation to the project roadsides. A landscape architect is qualified to develop site restoration plans. Site Restoration begins with erosion control because germination won't occur unless soil and seeds are held in place. Best practice is to use native plant seeds and plants in site restoration. Some native plant species are slower to provide cover than some commonly used exotic species. This may require that sterile erosion control grasses be included in the seed mix as a nurse crop and/or by means that do not require germination to stabilize the soil during seed germination. Site restoration with permanent seeding may include tree, shrub and wildflower seeds and often with plantings. The optimal conditions for project site restorations are the same as those for landscape planting. A good sequence for site restoration is as follows:

- Have the soil tested to determine what is needed to amend and condition the soil to best support vegetation. See item 3 in Landscape Planting for discussion of soil.
- Site preparation will be influenced by project objectives and site conditions, particularly soil types and slope. Generally, the process of site preparation is to loosen subsoils and amend per the testing lab recommendations. Several different site preparation scenarios are listed in Oregon Standard Specifications for Construction, Section 01040 .
- Seeding: Seeding is a major component of site restoration. For more detailed information on seeding, see in this document, the Landscape Planting Design section and Appendix C. A comprehensive set of seeding directives are provided in the Oregon Standard Specifications for Construction, Section 01030.
- Plantings: The installation of shrubs and trees can be an important component of site restoration. Unlike seeding, direct planting of trees and shrubs allows control over the

landscape design. This topic is discussed in this document in the Landscape Planting Design section and a comprehensive set of planting directives are provided in the Oregon Standard Specifications for Construction, Section 01040

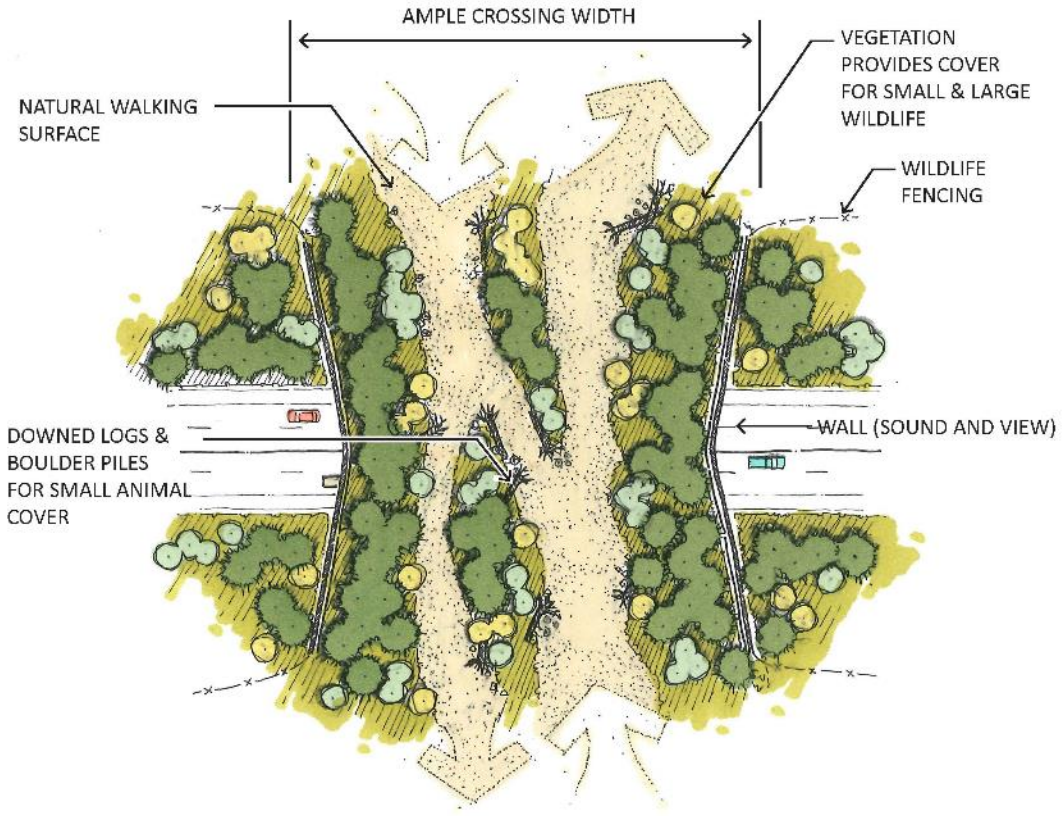
- Maintainability – Keep maintenance in mind during design of roadsides and coordinate with Maintenance staff during Project Development. Design for the ease-of-maintenance and safety of maintenance staff into roadside projects. Generally, the Landscape Contractor will be required to provide plant establishment watering, weeding, mulching, pruning, and replacement of failed plants at no cost to the Agency, for a period of one year or rarely, more. Following acceptance of work at the end of the plant establishment period, roadsides becomes the responsibility of Maintenance staff unless an intergovernmental agreement is in place.

ENVIRONMENTAL MITIGATION DESIGNS

These types of projects are typically required by state or federal regulation to mitigate for project impacts to protected resources. The designs blend biology, botany, soil science, hydraulics and wetlands to replace landscape features impacted by project work. Mitigation for project impacts to visual resources can also be required during the NEPA documentation process and will result in specific designs. Environmental design projects can include:

Passage designs – Whether for wildlife or fish, passage projects involve erosion control, grading, revegetation, fencing, culvert or bridge or other related features. Coordinate wildlife passage with ODFW not only to use their expertise to site the crossing in the best location, but also so that hunting/fishing regulations can explicitly define the area as off limits.

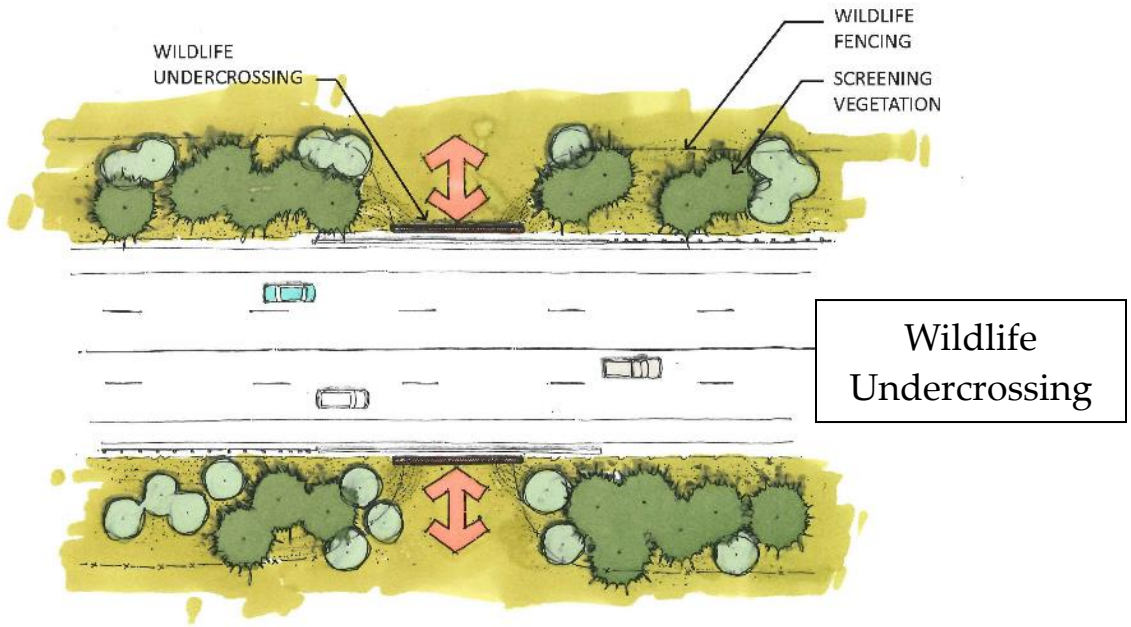
FIGURE 0-1 WILDLIFE OVERCROSSING



Use native plants for revegetation although non-native forage seeding may be used to attract herbivores to passage location. Don't provide perches where predators could discourage the intended use of the passage. Provide jump-outs and/or crawl-outs in the wildlife fence that allow animals to escape if they are inside the road corridor fencing. Consider screening wildlife crossings with vegetation so that concentrations of animals do not distract drivers on the adjacent road and to isolate wildlife from the roadway.

Within a terrestrial passage corridor install woody debris and boulders to provide small animals cover. Animals use culverts to cross roads. If culvert is large enough, consider a terrace above the high water elevation for animal passage. Provide motion activated "critter cameras" to monitor wildlife use. Design maintenance access into the passage facility. These projects require close coordination with the project bridge/culvert /hydraulics designer and terrestrial or aquatic biologist, as well as the Maintenance staff.

FIGURE 0-2 WILDLIFE UNDERCROSSING



Design may be needed for fish passage projects. Work with a hydraulic engineer in the placement of woody debris, fish rocks, pools, riffles and glides. Know the water's characteristics to guide the planting design and plan for erosion prevention. Planting plans should develop a diverse riparian habitat and shade the water. Design that no trees are planted within 20' of the footprint of a bridge.

Habitat Restoration designs – If a project cannot avoid impacts to a protected plant or habitat, it may be necessary to develop a replacement habitat area. The restoration can be upland, wetland or simply replacing vegetation removed during construction. This can involve grading, hydrology and soil amendments, plus revegetation with an appropriate native plant community. These designs require sufficient care during establishment to assure regulatory staff that the sites are on a trajectory to be self-sustaining in the long term. Habitat restoration designs require close coordination with the project botanist/biologist. Contracting restoration projects separate from associated road construction projects allows horticultural experts to be the prime contractors and the best-qualified maintenance staff for the longer plant establishment periods that can be allowed when planting is contracted separately from roadway work. Because these projects are usually required by permit, ODOT is committed to their success.

Pollinator Habitat designs – Pollinator populations are about 50% of what they were 60 years ago, and still diminishing rapidly. Habitat loss, pesticide use, diseases and parasites contribute to this decline. Pollinators fertilize and thereby enable the continuance of plants that support both natural and agricultural landscapes. At this time, the creation of pollinator habitat is not required by regulations. However, the issue is important and supported at the highest levels of ODOT leadership. Where appropriate, pollinator habitat features can and should be incorporated into most ODOT projects. Pollinator habitat BMPs include the following:

FIGURE 0-3 POLLINATOR

- Wildflower diversity with overlapping bloom time – multiple species for each season - spring-summer-fall. Include plants in the Composite such as asters, sunflowers, balsamroot etc. These are often late season bloomers that provide both nectar and pollen. Include pea flowers like lupine, vetch, lotus etc. to fix nitrogen in the soil and include plants in the Ericacea like madrone, manzanita, rhododendron, huckleberry and salal as they provide structure in a landscape as well as nectar and pollen. Milkweed is another important pollinator plant. In plant selection, choose "work horse" species that are commercially available and have demonstrated strong growth on other projects. Native species are preferred however most pollinators are opportunistic and forage off of many different plants. The beauty of wildflowers are also appreciated by road users.
- Bunch grasses are better than stolon spreading grasses because they provide ground nesting bees with access to the bare soil between the plants.
- Hedge rows of flowering shrubs along fence lines or living snow fences of closely spaced shrubs and strategically located trees.
- Water is used by pollinators.
- Nesting and egg laying sites can include bare soil, plants with pithy stems (such as elderberry or sunflower), undisturbed areas, dead wood, rock piles and brush piles and species specific host plants.
- Where appropriate consider species specific host plants such as milkweed for the Monarch butterfly, Kincaid's lupine for the Fender's Blue butterfly and the early blue violet for the Oregon Silverspot butterfly. These species are either at risk or listed as threatened or endangered, so introduction of host plants would only be appropriate where they would be isolated from standard maintenance practices. The presence of listed species on Rights of Way complicates the management of that land and adds time and cost to maintnenance. Areas such as long or steep slopes where mowing does not occur, wetland or riparian restoration areas or Agency lands not in ROW are examples of lands where these types of enhancements could be considered.

In designing pollinator habitat the site may have adjacent property uses that affect the habitat's success. Existing areas of wildflowers, natural areas or agricultural crops that use pollinators

will improve success. Adjacent agriculture that uses pesticides will diminish the likelihood of success.

Some of the pollinator habitat designs can conflict with other Agency obligations or priorities, such as safety. Flowering plant bloom periods might conflict with required maintenance work. Also the public may consider pollinator habitat designs to be unkempt or weedy after the peak bloom and complain to ODOT. Responsible use of resouces is part of design and designers must understand how the ROW is operated. As with other roadside design elements, coordinate with Maintenance any pollinator habitat design to avoid potential conflicts.

A best practice for the development of pollinator habitat with minimal conflicts with Maintenance would be to include a diverse suite of wildflowers in the seeding for embankment or cut slopes where mowing or maintenance would be infrequent or not occur at all.

FIGURE 0-4 POLLINATOR HABITAT

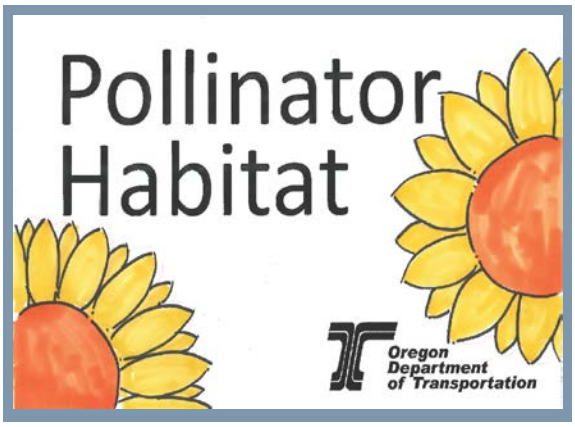
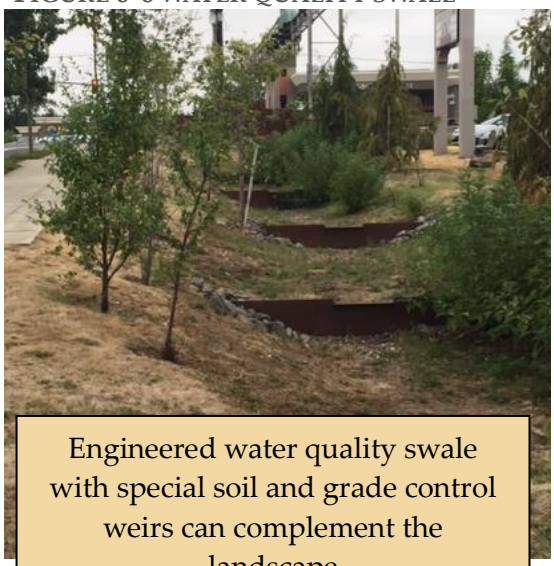


FIGURE 0-5 RUN-OUT AND RECOVERY ZONE

Mowing of the run-out and recovery zone with a well-defined edge (line drawn for emphasis) maintains safety, diminishes fire risk and provides a kept, neat appearance. During the growing season, the unmown central portion of the interchange enables pollinator habitat. Cutting vegetation in this central portion in the autumn, after flowers have bloomed out and seeds set, removes unwanted woody vegetation and prepares the site for renewed blooms in the spring.

Wetland (and floodplain) Mitigation designs – These projects are required as permit conditions. Mimic naturally occurring wetlands with precise grading, hydrology, soil conditions and vegetation of appropriate native plant species for these projects. Coordinate with the project wetland specialist to achieve successful mitigation projects.

FIGURE 0-6 WATER QUALITY SWALE



Engineered water quality swale with special soil and grade control weirs can complement the landscape

Stormwater Quality Facilities – Pollutants deposited on roadways affect water quality. Water quality facilities include flow-through planters, filter strips, swales, detention basins, and constructed wetlands. Plants in these facilities physically intercept and uptake pollutants and facilitate infiltration so that microbes in the soil can break down the pollution. Designs for these facilities can have multiple functions such as aesthetic plantings, buffers to sensitive areas, pollinator habitat or other functions. Vegetation in these facilities does not need to be mown but maintenance will be needed. See References in the Appendices for lists of plants suitable for vegetative phytoremediation. Know that water quality soils are free draining and that some facilities have underdrains to further hasten the removal of water. Treatment facilities often do not provide wetland conditions and wetland plants may not thrive in these facilities.

A Hydraulic Engineer is needed to determine the volumes and velocity of stormwater anticipated and the size of conveyance and treatment facilities. The designer should collaborate with engineers on these designs. The nature of these projects is the management of flowing water, often over special soils, so erosion control for these facilities is critical. Stormwater treatment facilities require routine inspection and maintenance and designs need to provide for safe maintenance access. The special provisions for roadside water quality facilities are found in sections 01010 through 01014

VISUAL RESOURCE DESIGNS

These projects can be a NEPA required result of the Visual Impact Analysis (VIA), or they might simply be good design. Typically the designs screen unsightly views, reveal desirable views, or place visual elements throughout a transportation corridor to reinforce corridor continuity. Designs might specify that freshly exposed rock faces be stained to mimic naturally occurring patina. Refer to Sections 01030, 01040, 01120 and 03020.

FIGURE 0-7 PLANTED ISLANDS

Other roadside functions: Designs may include plantings intended to diminish the work of or danger to Maintenance. Plantings of trees and large shrubs can be designed in dense groupings for the interior of large grass areas to diminish the mown area while providing visual interest and small animal habitat. Design these planted islands with graceful curves that are easy to follow with mowing equipment and in sizes and shapes that do not create hidden camper warrens or habitat for larger animals. Planting low shrubs or other vegetation on steep slopes, like bridge approaches, reduces mowing and improves safety. Plantings can displace weeds, sequester carbon, block wind, prevent erosion or stabilize shallow slip planes, block headlight glare, reduce the urban heat island effect or serve as living snow fences. Trees intercept air borne particulates and exhale oxygen. There are many reasons that roadside landscaping provides value beyond being ornamental.

AESTHETIC PLANTING DESIGNS

Aesthetically pleasing roadsides are valued by the public. Ornamental plantings can occur along the highway corridor or at specific locations, such as Interchanges or safety rest areas, at sound walls and where an additional landscaping is accepted as appropriate by the Project Development team. Aesthetic planting designs can serve to tie the project to the greater context of the project site, or reinforce corridor continuity. Other functions can be combined with aesthetic plantings such as stormwater treatment, stormwater detention and pollinator habitat creation to take full advantage of opportunities available in the landscape design. Aesthetic plantings are often urban in character and can result from requests by local agencies for more than the normal Roadside Development treatment. Ornamental landscaping is the focus of Highway Division Directive DES 20-01.

There is value in roadside landscaping and the landscape architect is the advocate for these priorities to the Project Development Team. Once the scope and scale of landscape design have been accepted by the Project Development Team, it is time to get specific with the designs and begin to move into Contract Document Preparation, where the Designer provides detailed information how to build the Roadside Development project.

SUBSECTION SUMMARY

Roadside Development concepts are developed from knowing the project site and the synthesis of design components from several different design disciplines. Combining them in a graceful, functional, and ecologically sound design that is safe and maintainable is the role of Roadside Development. This subsection outlines the range of work undertaken by roadside development designers. Project Leaders can use this information to better appreciate the opportunities that Roadside Development can bring to a project.

7. LANDSCAPE PLANTING DESIGN

The following landscape planting design guidelines are some of Landscape Architecture's best practices adapted to Agency specific situations.

GENERAL DESIGN CONSIDERATIONS

Verify plan assumptions by reviewing engineering section drawings. Sections show the slopes and warping transitions of finish grades that are not readily apparent from plan views. Consider vehicle, pedestrian and bicycle use of the completed project and anticipate their movements, views and potential hazards as they move through the designed project. Review the Standard Specifications in Oregon Standard Specifications for Construction, Section 01030 and 01040 for seeding and planting.

CONTOUR GRADING

The first step in a landscape planting design is determining the land shapes through contour grading. If topsoil will be placed at a later date, then specify grading to the desired sub-grade. Wetland mitigation projects, water quality facilities, water inlet and outlets require precise contour grading.

Slopes of 1V:3H are easily mown. On steeper slopes up to 1V:2H mowing is more difficult and includes seasonal limitations. Steeper slopes should be either seeded or planted with species that require little or no maintenance.

For areas to remain undisturbed, plan the grading to smoothly transition to area to be retained. Where vegetation is to remain undisturbed, the contour grading should match existing grade no closer than the tree's drip line. Avoid the use of sharp grade breaks in grading. For both the top and bottom of slopes, smoothly round the transitions to existing grades.

Coordinate the contour grading with the project's design engineer. Earthwork is shown in General Construction in the Contract Plans.

SOILS

The ideal naturally occurring soil is characterized as topsoil. Good topsoil is composed of 5-10% organic matter, 40-45% mineral material, and 50% pore space for air and water.

Soils differ greatly throughout the state. Soil in the windblown sagebrush steppe will be different than soil in a damp Coast Range forest. Project site conditions are important considerations when amending soils. During road construction roadsides are typically stripped of topsoil and compacted to create a structural sub-base. This creates a difficult environment for vegetation. Healthy soil is critical for establishing healthy roadside vegetation. Best practices for roadside soils are as follows:

- For planting strips between sidewalk and curb or in medians over excavate to depth of 18-24". Scarify planting strip bottom then install topsoil or planting soil in quantity that anticipates settlement. Coordinate with designing engineers to show topsoil in Typical Sections.
- Structural Soil is a growing media comprised of open graded aggregate blended with minor components of clay loam and stabilizer that can be compacted to support sidewalks. Use of structural soil allows tree roots to extend beyond what is typical for urban plantings.
- Plan to stockpile and redistribute existing (select) topsoil.
- Determine where to stockpile soil on site (clear with archeology, botany staff and erosion control).
- Minimize requirements for fertilizer and pesticide use. Incorporate compost as a soil conditioner, mycorrhizal fungi as a bio-amendment.
- When acceptable with engineer, take measures to mitigate overly compacted soils, such as ripping the soil surface or not compacting the surface layer of plantable material.
- Soils that are good for planting are erodible. Stabilize soils by means that do not rely on germination.

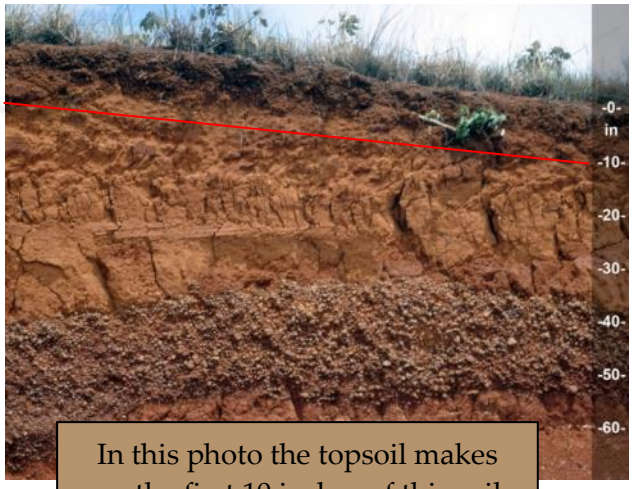
Provide a soil sample for testing, of the post construction soil. A Special Provision entry and a Bid Item for Soil Testing and/or Soil Biota testing will make the testing a contract requirement. The testing laboratory will provide a report, which identifies soil properties, and provide recommendations for soil conditioners, amendments and soil biotic supplements needed to create good soil for planting. To avoid schedule implications provide the soils test in a timely manner. If working the soil is not feasible, such as on a steep cut slope, the application of a compost blanket can provide a good media for seed germination. For poor soils, choose vegetation that does not need high-nutrient soils to flourish such as pioneer species or plants, which fix nitrogen in the soil.

Soil Conditioners and Amendments – Soil conditioners modify the soil structure (e.g. tilth). Soil amendments improve the soil nutrition.

- Restore the soil as closely as practicable to the qualities existing in adjacent undisturbed soils (pH, % organics, soil biota).

- Soil conditioners enhance the soil's moisture holding capacity thereby reducing or eliminating the need for irrigation.
- During planting, apply soil conditioners to the upper few inches of the backfilled pit to improve oxygen availability to the surface roots of the tree.
- Recognize that the addition of soil conditioners can create conditions very different from the surrounding soils. A benevolent planting pit may discourage the plant from sending roots into adjacent native soil, it may not drain well or result in soil moisture being wicked away from the planting pit. Backfill with unamended native soil is frequently the best material for self-sustaining plants.
- Understand your soil treatments. Peat is acquired by mining living wetlands. Compost and coir mulch provide the similar functions but are derived from waste materials.
- Uncomposted material such as fresh sawdust can deplete plant-available nitrogen in the short term, even if it eventually decomposes. Uncomposted material is not a suitable soil amendment for new plantings.

FIGURE 7-1 TOPSOIL



In this photo the topsoil makes up the first 10 inches of this soil

Topsoil – Topsoil is a naturally occurring, biologically active combination of minerals, organic matter, air, water, and microorganisms providing the optimal conditions for plant growth. It takes a very long time in nature to create topsoil. Amendments and tilling can duplicate many of the characteristics of topsoil.

Topsoil can be an amendment when only subsoil remains on a site. Commercial topsoil generally consists of mineral soils mechanically combined with organic matter.

- Plan to remove, stockpile, and replace existing topsoil when appropriate. Existing topsoil can have necessary nutrients, organic matter, and microorganisms already present. Topsoil is considered waste because it is "unsuitable material" for constructing embankment.
- Use existing topsoil onsite to reduce the costs of disposing of excess excavated material. Stripping, stockpiling and reinstalling topsoil does incur costs.
- Verify a stockpile area is available to store topsoil during construction.
- Do not stockpile topsoil if noxious weeds and their seeds are present.
- Use imported topsoil to provide a medium for plant growth when native soil has been removed or is highly disturbed.

Compost –Best practices use compost to enhance soils, prevent erosion or with seeding. Refer to Section 03020 of the Standard Specs for the various criteria sought for fine, medium and coarse compost. Each texture (fine, medium, coarse) has specific uses in Erosion Control and Roadside Development.

Erosion – Prior to establishment of vegetation, topsoil, amended soil and water quality soil mixes can be easily eroded if not protected. When a layer of uncompacted material is placed on a compacted roadside slope, a slip plane can form between the two materials resulting in a slide. Seeding applied without sufficient means to protect the soil can be washed off the slope with the topsoil requiring reapplication of the seed and repair of the slopes. Erosion control is required during all phases of project construction. Use Best Management Practices (BMPs) during roadside development design/construction to keep topsoil in place. Refer to Section 00280 of the Standard Specifications for requirements regarding erosion and sediment control.

Compaction – Plants require friable soil with the right balance of organic matter, microorganisms, minerals and pore space. In contrast, roadway construction requires highly compacted soils with low organic matter content for structural stability. Soil compaction poses a challenge for roadside revegetation.

- Where feasible, specify in contracts that the contractor has the responsibility to restore the soil to less than 80% density in all staging areas. Higher compaction rates are allowed in areas that are critical for the structural road prism.
- Planting pits on compacted embankment slopes may not drain well. Waterlogged planting pits can kill trees. Provide drainage trench to daylight in the event that planting pits do not drain.

Harsh Conditions – The desire for aesthetic plantings in urban settings such as planting strips between sidewalk and curb, or in landscaped islands surrounded by pavement must be evaluated for how the plants will fare over time. The environment in these situations is subject to reflective light and much greater heat, for longer duration, than would be naturally occurring. It is possible to compensate for these harsh conditions by specifying heat and drought tolerant plant species. Consider irrigation to support planting strips and medians. "Smart" irrigation controllers can work with water conservation and sustainability goals. Plantings that might thrive on the north coast would likely perish in the Rogue Valley or eastern Oregon. Be honest in the determination of the viability of non-irrigated planting strips and islands. Consider safety and how maintenance staff will access planting areas surrounded by pavement. Is an area designated for a maintenance vehicle, or will traffic control be required for simple maintenance. Is the location safe for Maintenance personnel? See the following section for Hardscape Design for possible aesthetic treatments that do not use plant material.

FIGURE 7-2 SHREDDED WOOD

Mulch – Mulch prevents erosion and helps retain soil moisture which is vital for seed germination. Mulch may be compost, bark, wood chip fiber, rock, gravel, hydraulically applied fiber or weed free straw. Use mulch to cover bare soil. Straw mulch works well as temporary erosion prevention. Mulches applied to soils at finished grade shades soil, discourage weeds, and can provide soil nutrients and biology.

FIGURE 7-3 MYCORRHIZAE

The gray cloud surrounding the plant roots are filaments of mycorrhizae

Mycorrhizae – are a group of fungi existing naturally in topsoil. Mycorrhizae uptake water and nutrients and provide this solution to the roots of plants in exchange for carbohydrates. In this exchange they supplement the plants' root system. Mycorrhizae exist in undisturbed soils and adding mycorrhizae where there is no disturbance may not provide additional benefits. In disturbed soils adding mycorrhizae will likely enable soils to support greater plant species diversity, increase drought and disease resistance and improved soil structure.

Fertilizer – Fertilizers are used to provide nutrients for plants but fertilizers do not replace the characteristics of good soils. Fertilizer use should be minimized. Commercial fertilizers are labeled to document the content's ratio of Nitrogen (N), Phosphorus (P), and Potassium (K) (listed in order: N-P-K). Fertilizer is applied in various combinations as determined by the results of a soil analysis. Native plants do not uptake fertilizers well; therefore, fertilizers can accelerate weed growth at the expense of native plant species. Fertilizer use has a negative impact to aquatic wildlife water quality and it is prohibited near salmon bearing waters. Where used, time-release fertilizers are preferred because it would still be functioning after seeds have sprouted and it is less likely to be released in solution and washed off site.

SEEDING

FIGURE 7-4 RYE GRASS

Rye grass germinates fast but is non-native and shallow rooted

Seeding is the most common means of providing vegetative cover on ODOT roadsides and there are many, sometimes conflicting goals in seeding. Seeds that germinate fast and provide a quick green cover provide erosion and sediment control after disturbance. Low growing plants can block out weeds and reduce maintenance requirements. Landscape architects want those things (where appropriate) and to use a variety of native plants for aesthetics and species diversity.. Traditionally grasses were the dominant plants installed on roadsides by seeding. Now seeding can consist of grass, forb, shrub and even tree seeds. When used for temporary erosion control on areas that will be re-disturbed by construction fast growing non-native seed, like rye grass can be used. Rye grass persists in the landscape, it is difficult to eradicate once introduced and may be an unwanted species in the permanent vegetative community. Similarly, straw which is spread as temporary mulch for erosion control contains viable seeds from its parent crop which could likewise be unwanted species even if the straw is weed free. Native plants for roadside seeding supports most roadside revegetation objectives but one needs to know the growth habits of the native plants. Designers also need to know their site and design the seed mix to the specific needs of the site. There can be reasons where natives are not the best choice:

- Locations where adjacent land uses are not compatible with the use of native plants, for example a grass seed grower would not want strains of grass next to his field that could corrupt the field's genetics.
- Developed areas may have designs that require horticultural introductions to provide a certain look, such as matching existing vegetation.
- Developed areas where (for example) non-native plants are a permanent and pervasive component in the region's plant community and seeds from off-site would infest and potentially dominate a native plant community.

For permanent seeding, native seeds are recommended for the following reasons:

- Native plants are adapted to the site conditions.
- Native plant are not aggressive spreaders into adjacent properties (agricultural land)
- Native plants thrive with very little maintenance. Less water, mowing, herbicide.
- Native plants contribute to the Oregon sense of place.
- Native plant mixes with a variety of native wildflowers support pollinators.
- ODOT has a sustainability committee which recommends the use of native plants. A 1994 Presidential memorandum and a 2014 Presidential memorandum stress the use of native plants and the use of pollinator habitat plants respectively.

- Native plants comply with water conservation landscape practices dictated by the 2015 executive order regarding Oregon's drought.

Some native grasses and flowering plants are slower to geminate and provide vegetative cover than rye grass or other non-native grasses. This matters because erosion prevention relies on soil cover to function. Because the seeding windows occur during the brief overlap when ample soil moisture coincides with the growing season, getting quick vegetative cover with native seeds can be difficult. To establish permanent seeding the soil's surface needs to be sufficiently stabilized to prevent erosion and hold the seeds in place.

Provide sufficient quantity of seed so that the plants close ranks as quickly as possible. Using a spreadsheet seed calculator, providing a permanent roadside seed mix with about 200 seeds per square foot is a reasonable quantity. (This number varies; rangeland seeding with forbs and shrubs may be less than 50 seeds per SF and lawn grass seeding could be more than 500 seeds per SF). To develop a permanent seed mix using native plants to stabilize the soil during germination and include fast germinating plant species as the nurse crop for slower germinating species. Slender wheatgrass (Elymus trachycaulus V. Trachycaulus) is a native annual grass that germinates quickly. Regreen © and Quickguard © are patented wheat grasses with sterile seeds that will not persist in the landscape. Poco barley (Hordeum vulgare "Poco") is a low growing grain that does not persist. When permanent seeding is also the erosion control seeding a nurse crop species should be included in the native mix at a rate of about 20 seeds per SF.

There are several means of stabilizing the seeding area using means that do not require germination. Seeding and then installing erosion control matting is the most foolproof method. A durable hydromulch like Bonded Fiber Matrix (BFM) or High Performance Growth Media (HPGM) is applied just like any other hydroseed, but the mulch application rate is higher and the material forms a sprayed on erosion control matting. The BFM or HPGM are not durable against flowing water. A compost blanket is a good erosion prevention and seeding media (again not resistant against flowing water). It is important that medium textured compost is used, because that allows water to pass through the media. Compost is applied to a thickness of 2" with a pneumatic blower and blended with a tackifier during installation. By this method the compost will remain on slopes up to 1V:2H. However on long slopes the installation of straw wattles at given intervals will key the compost in place and shorten slope length. The compost erosion blanket can then have seed applied by hydroseeding. The thickness and dark color of the compost retains heat which helps seeds

FIGURE 7-5 COMPOST BLANKET

Compost erosion blanket

germinate. The compost provides organic material and jump-starts soil biology. Also compost removes material from the waste stream, helping ODOT comply with its sustainability objectives.

When developing a native seed mix, the seeds should be of plants that are regionally endemic. Seed mixes should be comprised of seeds that are readily available at reasonable cost. The mix should have 3 or 4 grasses so that multiple growth characteristics and rooting depths are provided. Both perennial and annual grasses should be in the mix. A nurse crop consisting of a fast growing species that will not persist in the landscape is important to provide quick greenery and erosion control while slower species are establishing. Wildflowers are recommended with at least one that is a legume or nitrogen fixing plant so that the mix will self-fertilize and build the site soils. Other seed mixes for wetlands, water quality, pollinator forage or other special purposes may also be required. Many native species and wildflower seeds cost more than commercially grown grasses, but cost and value are not the same thing and the natives provide good value. Good design requires that seed cost and availability be verified during the design stage so that availability problems do not arise during construction.

Seeding may include shrubs and trees as well as grasses and wildflowers. Do not introduce tree seeding into clear zones or any plant seeding that would grow to block critical sight lines. Verify that non-grass plants in seed mix have life cycles compatible with maintenance practices. ODOT has developed a set of native Eco-Regionally based blends. The lists provide some cultural requirements such as wet or dry conditions (see Appendix C). Modify these basic blends to support project-specific objectives. In the appendices a link is provided to access a spreadsheet seed calculator which the designer can use to develop a site specific seed mix. Another link is provided in Appendix C to a spreadsheet named Seed Master that provides useful information on 350 species of grasses, forbs and woody plants.

General – Refer to Section 1030 of the Standard Specifications regarding seeding requirements. Learn to read labels and watch for the presence of weeds in the mix. For critical sites, provide a special provision that requires seed testing to verify seeds are accurately represented by seed sack label. Be available as a resource to project inspectors. Those are the people who ensure that contractors comply with the project requirements.

Wildflowers – Projects with federal participation require that an amount equal to 1/4 of 1% of the roadside development estimated cost must be used to plant native wildflowers. Native wildflowers can provide food and habitat to pollinators and beautify roadsides. Some wildflowers fix nitrogen (nutrients) into the soil.

Wildflowers tend to have deeper, coarser root systems than grasses, which bind soil deeper and promote deeper infiltration of rainwater. Colorful roadsides can encourage the economic activity of tourism. Wildflowers blooming along the roadside can enliven a drive making the driver more alert and thus, safer. Wildflowers have a different life cycle than grasses and most will not persist if they are mown like grass. When seeding to establish a dominance of wildflowers, 50% of the seed mix or more should be wildflower seeds. It may be necessary to include a nurse crop grass in the mix to stabilize the soil as the wildflowers establish. Mowing wildflowers late in the summer after seeds have set allows the plant to complete its life cycle, putting the wildflowers on a trajectory to be self-sustaining in the long term. Coordinate with Maintenance when wildflowers are used with roadside seeding to discuss their routine maintenance practices. Low growing flowering plants can be compatable with mowing and where mowing is necessary, even a short bloom period can improve aesthetics and pollinator habitat.

PLANTING

The proper use of plantings can help make roadsides more attractive and add environmental value. The prime directive is that Rights of Way must be safe, maintainable transportation corridors. Plantings present multiple opportunities, but must support that directive. Select plant material for use in right of way based on site conditions, traffic speed, maintenance issues, safety issues, aesthetics, plant characteristics, plant availability, plant cost, plant success rates in the field, and other horticultural requirements. Selected plants should be adapted to the climate of the area and to the unique environment of the roadside.

Carefully consider planting woody species on the highway prism. Long, difficult-to-maintain roadside slopes or within interchanges are among possible planting locations. Don't locate plants that block access to structures or visibility of signs or impede maintenance activities when designing planting plans.

Some general design considerations for the use of plants are:

- Conserve existing native vegetation in place, where possible; this reduces clearing and grading, revegetation and erosion control costs. It reduces installation and long-term maintenance costs.
- Use plantings to provide visual cues that reinforce changes in speed and driving conditions by changing the type, density and height of plantings.
- From a roadway, plantings are viewed at speed from a distance. Complex roadside plantings are not appropriate. Masses and groupings of plants or a random mosaic of plants work better than fussy detailed plantings.
- Select plants that are adapted to the project's ecological region (EPA Level 3 Eco-Regions), the specific conditions of the site. Consider their ability to provide ecological values, their water requirements, their maintenance requirements and their aesthetic attributes.

- When project is near water, design plantings that provide cooling shade to the water. Plan no trees within 20' of a bridge's footprint.
- Do not create spaces near roadways where large mammals can hide or congregate. Don't use known browse plants along the roadside. A good general rule is to design no large vegetation within 30' of road shoulder.

Figure 7-6 Trail route avoided existing tree

- Design for the mature size of woody plants. Plantings with excessive density can require thinning as the stand matures. Don't design unnecessary maintenance into a project.
- The U.S. Department of Agriculture (USDA) has mapped the entire country into a series of cold hardiness zones based on the estimated minimum temperatures in a given area. Sunset Western Garden Book has a different hardiness zone map of western states. Cold hardiness is often the determining factor of plant's suitability to an area. Refer to a Hardiness Zone Map to determine the appropriate zone of the project site. Each plant species is rated to a minimum cold hardiness zone. Select plants, which will do well in a project area's zone. Climate change has shifted the cold hardiness zones north, but unusual cold snaps still occur which kill even native plants.

Landscape architects are aware of the many criteria that contribute to the selection of plants and they are familiar with the plants that satisfy those criteria. These include:

- Production of extensive root systems
- Native to the area
- Rapidity of establishment
- Tolerance of site conditions
- Resistance to insects and diseases
- Availability from commercial suppliers
- Ability to self-perpetuate (or inability to self-perpetuate)
- Compatibility with maintenance objectives and practices
- Compatibility with adjacent land uses
- Rate of growth, mature size; height; shape; density/visibility
- Leaf type/size; leaf and fruit drop; thorns
- Wood strength; disease and drought resistance

And cultural criteria:

- Appropriate characteristics for desirable functions
- Suitability for space and site conditions
- Compatibility with natural plant succession
- Ability to regenerate after damage
- Longevity – carbon sequestration
- Ability to maintain or enhance habitat values for wildlife (where appropriate)
- Ability to withstand traffic-generated stresses, such as air pollution and air turbulence, reflected heat and light
- Avoid creating areas that will be difficult to access for maintenance or will tend to collect trash and debris
- Consider compatibility with roadside maintenance objectives for the area

General –Refer to Section 01040 of the Standard Specs. Additional best practices are listed below:

- When appropriate use commercial water holding polymers and other similar products to increase the moisture holding capacity of soils.
- Clearly indicate in the Project Specifications if the length of the establishment period is different than the standard length of one year. Variances of the establishment period length are not granted often.
- Require Contractor to provide a demonstration installation for each plant type for approval prior to continuing with the general planting.
- Best practices for planting are shown in project plans and Standard Details, numbers 6100-6107 Group plants with other plants that have the same cultural requirements. Where irrigation is provided anticipate planting "hydrozones" so that irrigation can accurately match the plants' water needs.
- Good drainage is as important as adequate moisture for plants.
- Use tree wraps only in circumstances where conditions and tree species warrant its use. If used, wrap in autumn and remove in spring.

During the plant establishment period, required work includes watering, fertilizing, pruning, insect, disease, and weed control. The importance of watering new plantings cannot be

overstated. Periodic inspections that include Agency inspector, landscape architect and Contractor, and prompt replacement of unsatisfactory plants are requirements of Specifications.

PLANT TYPES

FIGURE 7-7 MITIGATION PLANTING

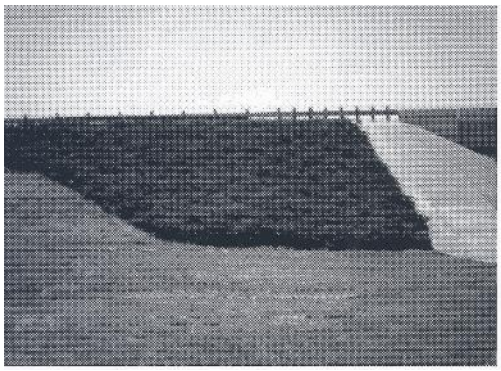
Grasses and Herbs: These plant types are usually installed by seeding. When direct control of plant locations is required, grasses and herbs can be installed as live plants.

- Oregon has many native grasses and showy forbs that provide aesthetic and ecological functions. Include native grasses and forbs for permanent site stabilization and revegetation, as well as aesthetic planting designs.
- Ornamental grasses often require a high level of maintenance. Some are considered invasive species.

Shrubs and Groundcovers: Shrubs along the Roadside can provide aesthetic and ecological enhancement. Oregon has a wealth of native shrubs and a climate that can support many horticultural introductions. Shrub plantings may enhance habitat or mitigate impacts where bridges or culverts are replaced.

Continuous shrub cover – Massed shrub or groundcover plantings are recommended for aesthetic reasons, erosion control and for areas that are too steep for mowers to safely access.

FIGURE 7-8 SHRUBS AS CONTIGUOUS



- Use shrub varieties sized appropriately for the site.
- Calculate plant quantities using the slope factor to account for surface area being larger than area shown in plan view.
- Avoid shrubs with leggy growth habits. Use species that carry their foliage close to the ground surface to help reduce weed growth near their trunk. This reduces the need for hand weeding, herbicide use and the possibility of damage due to string trimmers or mowers.

- Plantings designed to close ranks to provide a contiguous mass of vegetation require less maintenance than beds with freestanding plants that may be subject to individual shearing. Maintenance intensive ornamental landscaping such as "poodle cutting" is discouraged and should be avoided.

FIGURE 7-9 AVOID "POODLE CUT" TRIMMING

Bed plantings are those areas of well-prepared soil, planted with varying plant types. A significant portion of a bed is generally open to weed invasion during the establishment period, necessitating frequent weeding activities either by hand weeding or with the selective use of herbicides. Consequently, the maintenance costs for shrub beds can be a significant part of the overall maintenance budget.

- Enter into an interagency agreement with the local jurisdiction regarding maintenance of planting beds.
- When appropriate, use a concrete mowing strip, to make maintenance easier.
- Provide maintenance guidelines.
- Use of weed barrier geotextile is discouraged. Most often the covering mulch gets displaced and the unsightly geotextile becomes exposed. The geotextile interferes with the soil's ability to access water and air, and weeds eventually grow either through it or on top of it.
- Use a root barrier when trees are planted near pavement.

Trees: Trees provide many benefits. Design tree placement beyond clear zone/recovery zones, where they do not impede sight lines and in locations which allows for unimpeded maintenance activities around them.

In the selection of trees, species selection is very important. Revisit the passage regarding native vs. horticultural plants.

Location Considerations: Suitability for space and site conditions.

- Do not plant tall trees under overhead powerlines.
- Do not use plants with large leaves (e.g. big-leaf maple) in areas where the leaves could block catch basin inlet grates or smaller culvert inlets.

- Avoid planting trees with large spreading crowns near traffic intersections.
- Avoid planting trees that bear fruit or nuts near sidewalks or parking lots.
- Shade from evergreen trees can allow ice to persist on roads. In curves, intersections, and at on and off ramps this is critical. This issue is most concerning in mornings, so trees east of pavement should be carefully considered.
- Trees need an 8′ clear height over sidewalks, 16′ clear height over streets (refer to Highway Design manual).

FIGURE 7-10 LONG POTS

There are many nursery container sizes. Long pots hasten deep root growth.

Photo: Stuewe and Sons, Inc.

The size of trees at time of planting should be based on the type of project. Larger sizes are appropriate for urban installations. Large trees are frequently balled and burlapped. For revegetation and mitigation, small trees, 1″ caliper or bare root are appropriate. Improved plant survival is gotten by using plants that developed deep root systems by being grown in long pots.

- For street trees, sizes, 1 1/2″ – 2 1/2 inch diameter at breast height (DBH) is an appropriate size for ease of installation, establishment, visual impact, and costs. Tree sizes are often dictated by local jurisdiction. Trees these sizes perform best with irrigation or a regularly filled slow-release water bag.
- Use trees larger than 3 inches DBH only if there is a requirement for a specimen tree. Large trees are not recommended.
- Environmental Mitigation projects generally use very young trees. Installing a marking stake and/or browse protector with each tree in mitigation plantings helps maintenance personnel locate the plants and avoid damage to the trees from string trimmers or wildlife. (Use only browse protectors that are photodegrade, or made with bio-polymers that biodegrade)
- Trees will require watering, weeding and tending. The design should consider the establishment work and provide estimates on the anticipated costs of plant establishment in determining the plant's bid item cost (establishment is included in the planting bid item).

GENERAL PLANT TYPE RECOMMENDATIONS/LISTS

Many municipalities maintain a list of preferred plants, including trees, for use within their urban areas. Please refer to the individual City or County for this information.

Restoration and revegetation projects are typically planted with a well-reasoned variety of native plant species. Factors that determine species percentages within a plant selection are:

- Desired composition of the plant community. Use a nearby reference site to provide examples of a desired community composition.
- Function within the plant community, such as over story, understory, shrub, groundcover, and herbaceous.
- Hierarchy of appearance; foreground, middle ground & background.
- Dominance in the plant community. Growth characteristics.
- Permit stipulations may require specific species and community composition.

PLANTS TO AVOID

- Annual ornamental plants - The use of single-year, ornamental plants (i.e.: annual color) is discouraged within the right of way due to the high costs of maintenance and replacement. Native annual wildflowers that self-sow may be an exception to that rule. Local garden clubs may be interested in rotating displays of annual wildflowers. These will need access and maintenance permits from the District Maintenance Manager.
- Plants requiring pruning - Plants requiring frequent pruning to keep sight lines clear or to look good should not be used in the roadway. Ornamental hawthorn is an example.
- Plants with weak wood - Due to the open character of the roadway, plants are exposed to high winds. Trees which are weak-wooded or that routinely generate excessive limb-fall, such as liquidambar or cottonwood, can provide potential hazards to traffic or become projectiles during mowing operations.
- Trees with aggressive root systems - with roots that vigorously seek water or sewage and can obstruct or damage storm or sewer piping or heave pavement. Willows and Cottonwood are examples. In natural areas those trees are appropriate and desirable.
- Noxious or invasive plants - Do not use plants that are listed as noxious or invasive even if they are available through local nurseries. Refer to ODA's Noxious Weed Policy and Classification System for further information about invasive plants.
- Vining groundcover plants are not suited for use due to their high maintenance needs, and aggressive growth habits. Low-growing shrubs are a better alternative. (English ivy is a "B" listed weed and thus prohibited. Vinca is listed in Portland as a nuisance and discouraged elsewhere)

- High Maintenance Tree Types - The maintenance of the following trees is difficult. They are appropriate for planting in mitigation, restoration or habitat plantings but should be avoided on roadsides:
    - Western Hemlock - shallow rooted and needles increase maintenance needs
    - Black Cottonwood - limbs break easily and become a safety concern. Aggressive roots can damage storm or sewer piping and they can heave pavement.
    - Red Alder - short-lived and brittle
    - Big-leaf Maple - large leaves can block drainage system inlets
    - Willow species - aggressive roots can damage storm or sewer piping.
    - Linden – Non-native, aphids drip honeydew and nectar is harmful to bees.

SECTION SUMMARY

This section provided a short course of landscape planting design. Project Leaders can better understand the breadth and complexity of roadside development and have a landscape architect on the project team to take advantage of the opportunities available to them to improve a project. Designers can use this information, with a good understanding of the project and site, to design a thriving roadside landscape that will contribute to a safer, more attractive and ecologically sustainable right of way and a better road user's experience.

8. HARDSCAPE DESIGN, STRUCTURES AND SAFETY REST AREAS

Roadside Development provides aesthetic input to structural elements in both rural and urban areas. In Rural areas, this input is usually limited to project components such as bridges, bridge rails, retaining walls, rest areas, viewpoint / wayfinding sites, and hardened treatments of cut or fill slopes, which will remain non-vegetated and exposed to travelers. In Urban areas, in addition to the above items, design input may be required for sound walls, pavement/pavers, signage, pedestrian and bicycling facilities, streetscape site furnishings, lighting systems and other transportation-related facilities.

Structures "fit" in a landscape when design themes are established in a corridor plan. The visual impact from structures in the landscape can be enhanced by:

- Repeated form, line, color, and texture.
- Use of earthtone paints and stains.
- Use of self-weathering metals.
- Use of natural stone exposed surfaces.
- Select paint finishes with low levels of reflectivity.
- Use rustic designs and native building materials.
- Use natural-appearing forms to complement landscape character.
- Screen the structure from view through the use of natural landforms and vegetation.

FIGURE 8-1 COMBINED ART INSTALLATION AND WATER

Weathering steel art installation and water quality facility along Hwy 99E in Oregon City

In developing the shape, and "fit" of hardscape items, the palette of tools available to the Roadside Development designer includes line, color, pattern, texture and finish. The general principles for these tools are described here:

LINE

Straight lines tend to be forceful and direct the observer's eye more directly than curved lines. Curved lines are sometimes described as smooth, graceful and create a

relaxing and natural feeling. The lines shaped in an "S" curve have historically been integral to shapes considered beautiful.

FIGURE 8-2 BATTLE ROCK WAYFINDING POINT

Natural materials, earth tones and graceful curves are used at the Battle Rock Wayfinding Point

Horizontal lines can be used to reduce the perception of height of objects, such as walls. Vertical lines can be used to reduce the perception of length of objects and to provide a sense of scale to a setting.

COLOR

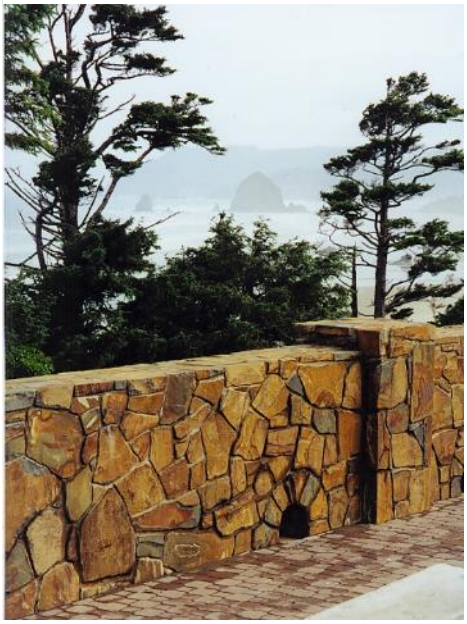
Color plays a principal role in our ability to make sense of the landscape. distinguish elements from one another nt. In this regard, color is an important element in the roadway.

Use the following practices to diminish visual conflicts and downplay particular features.

- Darken galvanized steel to diminish glare.
- Use low luster paints wherever possible to help reduce glare.
- Color is most effective within 1,000 feet. Beyond that point, color becomes more difficult to distinguish.
- Select colors in the context of the entire landscape.
- Use earth tone colors to harmonize with the natural landscape.
- Do not choose colors to match the color of the sky.
- On smooth surfaced structures use colors that are two or three shades darker than the background colors to compensate for the shadow patterns created by naturally textured surfaces.

- Select colors to achieve the best blending with the surrounding landscape in both summer and winter.

FIGURE 8-3 SILVER POINT



Use color to enhance aesthetics and to improve driver perception and, therefore, the safety of the roadway.

- Link elements widely separated by space by repeating similar colors.
- Emphasize elements by using colors brighter than those around them.
- Deemphasize elements by using muted colors, which reflect less light.
- Draw attention to a spot and for quick identification by using high-contrast colors close to one another.

Atmospheric conditions can reduce or enhance the intensity of colors. Haze, fog, and rain reduce the intensity and brightness of the color. Clear dawn or sunset light enhances colors.

- Colors that appear bright or very intense when viewed close will appear much grayer in actual field conditions.
- Use brighter colors than would normally be selected for objects intended to be viewed from close range to compensate for the atmospheric conditions.
- Narrow lines of color will quickly be lost unless they are very bright.
- Color lines only a few inches in width, meant to accent an element, will not be visible from long distances.

FIGURE 8-4 BRIGHT COLORS CREATE INTEREST

Bright colors create interest
with contrast and attract attention to the area

TEXTURE

- Texture adds an interesting element to otherwise broad, smooth surfaces. Textures are most noticeable where traffic speeds are slower as at controlled intersections or where structures are close to the travel lane.
- Use rougher textures if they are to be seen from longer distances.
- Provide anti-graffiti surface.

FIGURE 8-5 TEXTURED WALL

Course textures appear relatively smooth past a few hundred feet.

- Textures on horizontal paved surfaces will not be very prominent from the driver's perspective unless they are very coarse or very near the driving lanes.
- Use textures on pavement to highlight different use areas such as pedestrian ways, bike lanes, and important decision points for handicapped persons.

Less expensive or more expedient solutions can be unsightly. The visual impact of poorly considered decisions lasts for

FIGURE 8-6 SHOTCRETE AND SOIL NAIL WALL ON I-5

PATTERN

Repeating shapes provide interest to retaining walls where the shape of the panel provides the pattern. These decorative patterns are very successful at adding interest to otherwise plain surfaces.

- Ideally, coordinate the patterns through a corridor. This does not mean that all surface treatments should be the same.

- Use patterns to distinguish a particular site from others, to avoid monotony and create interest.
- Too many patterns in a small area can create visual confusion.
- If varied patterns are desired, a good rule of thumb is to limit any one view to only two different patterns.
- Verify that repeated pattern provides the desired effect. One installation of random rubble shapes resulted in a wall of soccer ball shapes when the pattern repeated.

Figure 8-7 Contrast on walls

The smooth, strong line of the cap is a good contrast to the angular lines of the panels in this wall.

FIGURE 8-8 WALLS WITH PLANT MATERIALS

Plant material incorporated onto walls provides interest and softens the visual impact of a wall

FINISHES

The surface finishes of elements such as bridges, walls, barriers, and pavement influence the visual character of a site. Special finishes may be used on virtually any structure or roadside element as long as its function is not impaired. Special finish options vary according to the type of structure and surface to be treated. Use special finishes (bright finish for example) can draw attention to obstructions. Verify the special finish is durable and its characteristics are stable.

Concrete, aluminum, galvanized, stainless, and weathering steel are stable materials with integral character that do not need the protection of surface coatings (with the exception of graffiti deterrent surfaces). Reflective surfaces of stainless or galvanized steel can cause unwanted glare. Paint has a service life and it eventually needs maintenance. Paint and powder coat finishes do not adhere well to galvanized surfaces unless the object gets special pretreatments. Staining agents have been developed that can color galvanized metal with a weathered rust patina.

Many concrete texturing and finishing methods are available including sandblasting, or washing to expose the integral aggregate. Patterned or artistic molds can be installed inside concrete forms to create surface effects. Texturing methods include removable templates that are impressed into green concrete to leave representations of brick, tile, and stone finishes.

The natural light gray color of concrete is often too light or reflective to fit natural surroundings. Many concrete finishes are available. Color may be integral through admixtures or through acid-etch stains or penetrating stains. Powdered pigments can be dry-applied on green concrete flatwork. Color pigmented masonry-quality cements can be applied in thin coatings. These coloration methods can be combined with texturing in very creative ways. Concrete does darken and develop patina over time.

Concrete surface treatments are being used on Oregon highway walls, where, they are increasingly used to maximize the limited right of way. In corridor-planned rights of way these special treatments are used to reinforce the roadside's thematic cohesion in exceptional landscapes like the Columbia River Gorge Scenic Area.

A special category of finishes exist to combat graffiti. These vary by ease of application, durability to weathering, resistance to graffiti, and ease of cleanup.

FIGURE 8-9 BARRIER

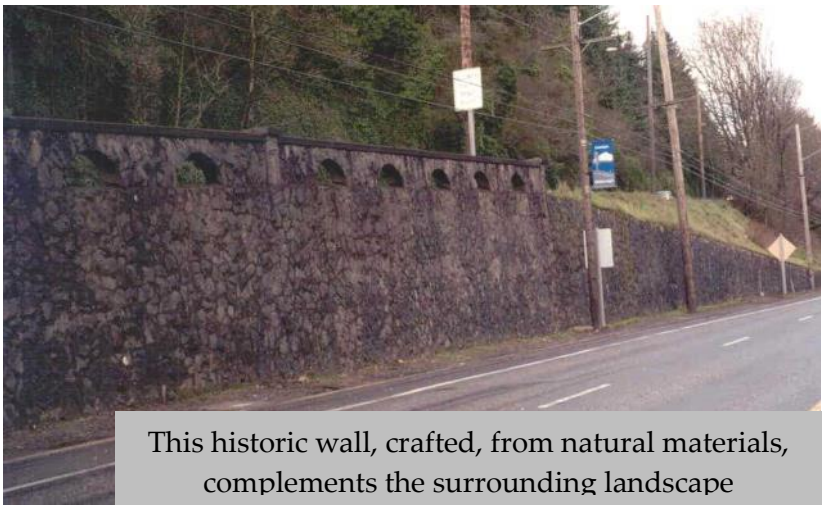
BARRIERS

There are difficulties in maintaining vegetation near or between barrier devices, and close to structures, signs, or luminaires. Vegetation under guardrails is an ongoing

maintenance problem that requires mechanical trimming or herbicide control. Vegetation against pavement can slow drainage and permit puddles to form. To reduce these problems, employ measures to prevent vegetation growth under or between barrier devices, such as gravel blankets, gravel beds rock mulch or a concrete skirt. Anticipate that barriers are frequently damaged and replaced.

WALLS

FIGURE 8-10 HISTORIC WALL



This historic wall, crafted, from natural materials, complements the surrounding landscape

Because walls are strong vertical elements, they can dominate the field of view. The color, texture, and pattern of walls have a strong influence on driver perception of the highway landscape. Often old structures built from natural materials set the theme for transportation corridors. These should be preserved where ever possible. Depending on the color and texture they will tend to blend or contrast with the surroundings. Highways enclosed by soundwalls can block views of the surrounding landscape and create their own, limited viewshed.

- In rural areas pick colors that blend with the natural surroundings. In urban areas where congestion often results in slow driver speeds, roadway sidewall treatments may exhibit a more architectural flair.
- Where feasible, address both sides of the wall.
- Utilize methods for reducing the perceived scale of sound walls, particularly in residential neighborhoods, such as plantings. Wall heights can be so tall that they overwhelm surrounding homes.

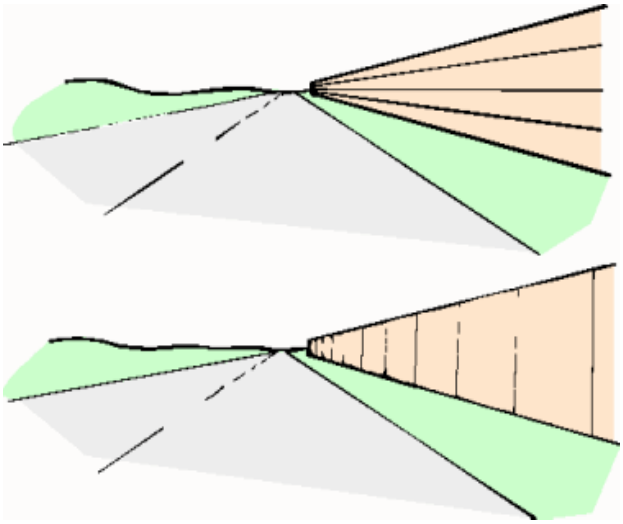
- Design horizontal patterns on the "house-side" of walls to de-emphasize the height.
- Use light colors and fine textures when tall walls are placed next to single story residences.
- Use muted colors so that they do not conflict with the color of the residence or its accessories.
- Surface finishes can greatly reduce the visual impact of a wall. Select finishes appropriate to the wall's context.

FIGURE 8-11 SOUND WALL

- Use vertical texture and rustication patterns when long sections of wall are visible from the driving lanes to minimize the apparent visual length of the wall.
- Where practical, vary the grade along the face of the wall and integrate with planting to minimize the apparent height of the wall.

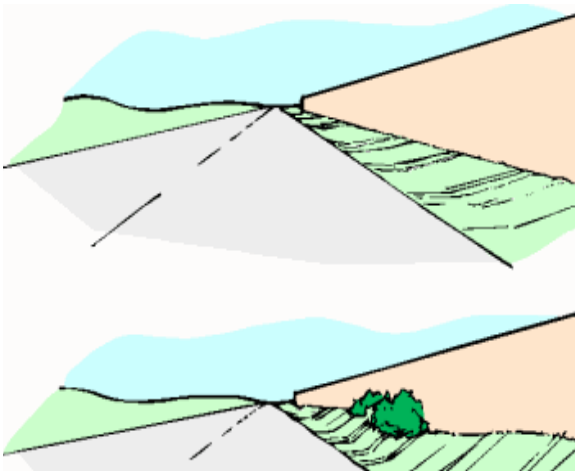
The dominant textural lines of walls affect their apparent height.

FIGURE 8-13 WALL TEXTURAL LINES



Plants and grade changes can add interest and reduce the apparent size of the wall.

FIGURE 8-12 PLANTS AND GRADE CHANGES

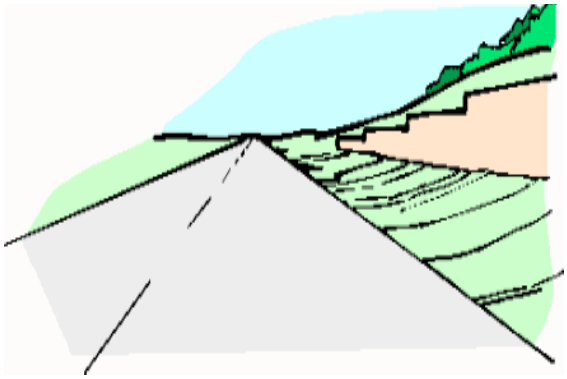


Design walls with the understanding that the horizontal line of the top of the wall has the surrounding landscape as its background.

- Design wall so that its lines and form do not conflict with the immediate surroundings.
- Wall caps that incorporate grade-changing step-downs contrast well with the rounded lines of adjacent landscapes. This highlights the wall, making it an even
- more dominant visual element.

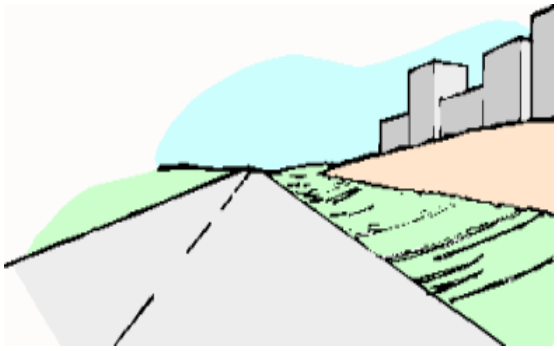
Profiles that increase the contrast between the wall and background make the wall more visually prominent.

FIGURE 8-14 HIGH CONTRAST WALL



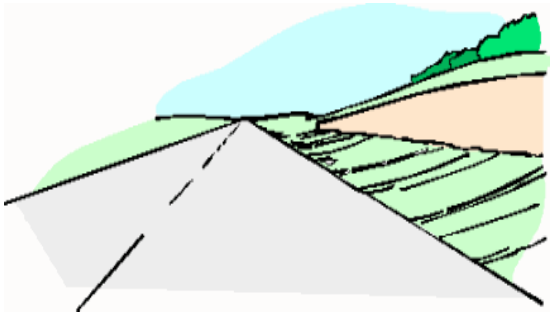
A smooth wall profile is often a pleasant contrast to more complex urban backdrops.

FIGURE 8-15 SMOOTH WALL PROFILE



- Wall profiles that follow the shape of the background will tend to be less obtrusive.
- Continue wall caps the entire length. Elevation changes should be spaced uniformly within the varying height section to provide a sensible, uniform rhythm.
- During design, produce a rendering of the wall elevation along its entire length. Working with this drawing will help identify and avoid building oddly spaced elevation changes and inconsistent angles or awkward radii.
- When possible design walls in 3D and generate a "fly through" animation to provide simulation of a driver's experience.

FIGURE 8-16 LOW CONTRAST WALLS



Wall profiles that mimic their backgrounds are less visually prominent.

- Construct test samples of surface finishes to evaluate the color selection and to establish proper application procedures.
-
- Construct test samples at the project site so the sample can be evaluated in the same light and with the same background as the final product.
- Integrate wall into landscape when possible
- Construct samples of adequate in size to accurately determine the effects of the finish both near and far from the surface. Sample sizes ten feet square or greater may be required.Retrofitting existing structures using special material applications can produce a desired effect. A variety of materials or processes are available to apply to horizontal or vertical surfaces. Check field history of the products to verify it has sufficient durability to serve the intended purpose.

FIGURE 8-17 IOWA ST. RETAINING WALL ON I-5 THROUGH SW PORTLAND

- Architectural veneers, or non-structural veneers of various materials, may be installed over other structures such as walls, abutments, columns, or riprap.
- The veneers may be stone, modular concrete pavers, or brick, and in some cases, tile.
- Veneers are useful in creating a thematic cohesion between unconnected elements such as bridges by retrofitting some portions of the surfaces with the same material.
- Veneers of local materials from the natural environment of the area can also relate the structure to the environment and highlight special areas.

Mechanically Stabilized Earth walls (MSE or Retained Earth Walls) can be faced with gabions, modular, pre-cast concrete panels, green wall systems or on a smaller unit scale is found in Modular Block retaining wall system. These systems impart patterns to wall surfaces that are more interesting than a smooth concrete wall. MSE wall pre-cast panels can be ordered with unique texturing and modular block walls are available in different shapes, textures and colors that range from simple and industrial to rustic and natural.

Wall face panels are available in a range of finishes options.

FIGURE 8-19 WALL FACE PANELS

Concrete masonry units come in a variety of patterns and colors. Combinations of units can create patterns.

FIGURE 8-18 WALL PATTERS & COLORS

Shapes, colors and textures of the modular unit can combine to provide designs in the wall. The scale of the structure and the type of unit affect the decision to add pattern in this way. Generally, larger structures require larger units and smaller structures work best with smaller units.

GREEN WALLS

New products and technologies provide for the construction of planted vertical surfaces. Planted gabions, stacked soil filled geotextile fabric bags and soil filled cellular confinement systems and other systems create opportunities to build structurally stable walls that blend into natural environments. The growth of plants with deepening root systems can strengthen the wall. For green walls, consider solar aspect, reflective light, available moisture or irrigation when selecting plant species. Green walls require engineering just like any structure.

This planted gabion wall is comprised of soil enclosed in geotextile fabric

Green wall of soil filled geotextile fabric bags is tied back into the slope

HORIZONTAL SURFACES

Horizontal paved surfaces (flatwork) suitable for special finishes include sidewalks, pedestrian crossings, paved medians and traffic control islands. The finishes described below are often pedestrian-oriented but may also be suitable in medians or driving surfaces wherever slower traffic speeds allow their treatments to be appreciated.

The most common finishing techniques for plain concrete surfaces are broom texture over trowel finish. Broom finish can be coarse, medium or fine and should be aligned perpendicular to the direction of the pedestrian circulation. Exposed aggregate is widely used as a flatwork finish but the slick surface of the round aggregate when wet can leads present a fall hazard, especially on sloped walkways.

Excellent texture may be added to plain concrete by simply adding a well-conceived scoring pattern. Scoring the surface in a linear pattern is probably the least expensive means of adding texture while scored patterns act as a network of control joints, which help control thermal cracks.

FIGURE 8-20 PATTERNED CONCRETE

Patterning concrete uses stamps or silicon molds to impress textures into partially cured concrete. Color may be added with integral pigments, stains or with a dry-shake method of applying surface dyes. The range of patterns available is large and several manufacturers provide options.

Stenciled colored or patterned textures that are heat impressed into asphalt are shown to not be durable in locations where vehicles drive over the patterning.

Select a suitable pattern weighing the following criteria:

- Consider local preferences and borrow themes from the surrounding architecture and environment.
- Give special attention to the roughness of texture of the pattern since some patterns impart deep impressions. Avoid textures that capture litter.
- Admixture pigment color can turn out different than color chip would indicate, especially in "brick" reds. It is regrettable when anticipated brick tones turn out to be bubble gum pink. Have large test sections constructed.

- Evaluate texture for its ADA compliance and impact on bicycles, walking assistance devices, wheelchairs, strollers, and its potential as a trip hazard.

Modular paving units such as bricks and concrete unit pavers are attractive, durable, and cost efficient paving materials. These can be suitable for both vehicular and pedestrian applications. Some paver types facilitate stormwater infiltration to diminish runoff volumes.

FIGURE 8-21UNIT PAVERS IN MEDIAN

An advantage of paving units, beyond being attractive, is that access to subsurface utilities is easier than with poured-in-place concrete and the pavers can removed and replaced to an as-constructed condition or salvaged for use in other areas. When properly installed with appropriate base preparation and edge restraints, concrete unit pavers can withstand heavy traffic loads. In wetter climates vegetation can sprout between units and maintenance may spray to eliminate the weeds.

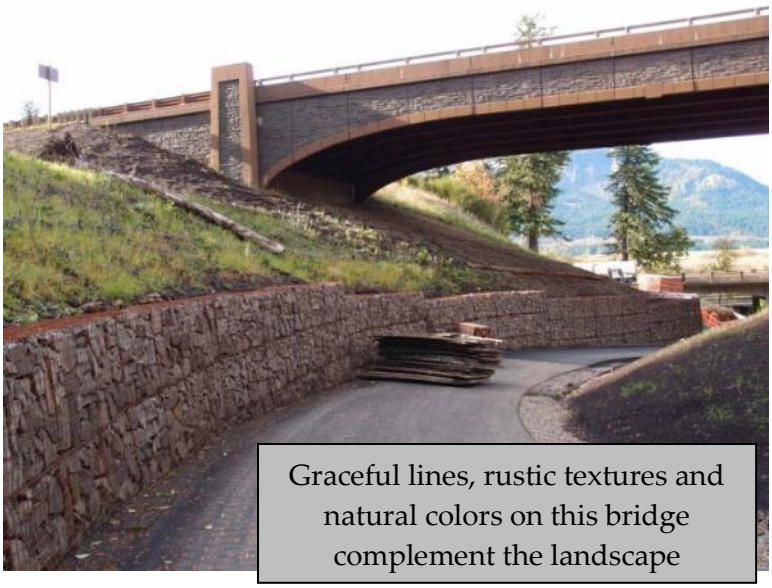
- Select the surface texture of the units to meet the requirements of safety for pedestrians and vehicles if the units will be part of the traveled way.
- Select sizes and colors that make a clear distinction between pedestrian and vehicular surfaces.
- Use high-fire clay brick pavers when bricks are used for a pedestrian surface. Standard masonry bricks are porous and in western Oregon, become a host for slippery moss.

PLANTINGS SURROUNDED BY PAVEMENT

Urban streetscapes frequently include trees planted in paved areas. These plantings often suffer because the roots do not have room to spread or access to air or water because the surrounding soil is capped by pavement and compacted to structural density. The installation of structural soil prior to construction of pavement allows tree roots access to those necessities. Another alternative is to install a hollow modular pavement suspension system that can support the pavement and allow large volumes of un-compacted growing media underneath the pavement. The pavement suspension systems can be combined with stormwater systems to provide detention.

BRIDGES

FIGURE 8-22 TEXTURED BRIDGE



Graceful lines, rustic textures and natural colors on this bridge complement the landscape

Bridges are gateways through the landscape and landmarks for a community. Due to their prominence in the landscape they provide special opportunities to reflect the context of the surrounding landscape and they can represent the design theme of the corridor where they are built. The view of a bridge is often more significant than the view from a bridge. Bridge aesthetics are best when they are designed into the structure rather than applied as decoration onto the structure's surface.

TRAFFIC BARRIERS AND GUARD RAILS

A traffic barrier is any type of longitudinal barrier, including bridge rails, guardrails, earthen berms (where permitted), used to redirect vehicles from hazards located within the Design Clear Zone; to prevent median crossovers; to prevent errant vehicles from going over the side of a bridge structure; or to protect workers, pedestrians, or bicyclists from vehicular traffic. These features are the purview of roadway designers, but landscape architects can influence their appearance.

Cable barriers are frequently used as a cost effective measure to prevent vehicles from crossing a median into oncoming traffic. These need frequent repair so designs should allow for access.

Concrete barriers can be colored by means discussed in the subsection "Finishes". Barriers can be constructed impressed with texture to mimic random rubble. Color and texture can be combined to make the barrier blend into the surrounding landscape. The safety function of barriers should never be compromised for the sake of appearance.

Bridge rails and guardrails are important for safety. Artistic shapes can be designed into railings without compromising safety. Railing type can block or enable views of Oregon's scenery. On bridges an open, visually permeable rail is preferred for aesthetic reasons. In addition, material type, color and finish can enhance the rail or bridge appearance.

Bridge rail designs, see section 200 of the Standard Drawings. Of greater consequence than bridge rails is the design of the bridge. Bridges are landmarks. The aesthetics of bridges contribute to the character of the surrounding area.

SECTION SUMMARY

This subsection provided a short course of landscape architecture regarding hardscape. With this information, Project Leaders and other stakeholders can better understand the opportunities available to them to improve a project through the use of thoughtful design. It is worth noting that although elaborate designs can greatly increase construction costs, thoughtfully designed hardscape can be constructed with not much more expense over minimal designs, but leave an enduring legacy of grace and beauty in the landscape. Designers can use this information, with a good understanding of the project and site, to contribute to a safer, more attractive roadway and a better road user's experience.

9. IRRIGATION DESIGN

When constructed, an irrigation system is integral to plant establishment for both ornamental and permit-required plantings. Many projects are now designed to require additional water only during the plant establishment period. Slow-release water bags can be fitted around trees or shrubs and when used, can eliminate the need for in-ground irrigation. Mitigation plantings may receive flood irrigation by temporarily blocking water flow. Watering as part of plant establishment is typically the responsibility of the Landscape Contractor.

Irrigation is a high maintenance and high cost item that may be necessary to establish high value and/or permit-required landscape plantings. On large or complex planting plans the use of an irrigation system may make plant establishment less expensive. In urban landscapes, especially in areas surrounded by pavement, like median islands and sidewalk planting strips, an irrigation system may be necessary to maintain living plants. The operation and maintenance requirements described in directive DES 20-01 extends to irrigation systems. Discuss irrigation with the Project Team leader and the District Maintenance Manager prior to providing irrigation system designs.

ODOT, through the Oregon Sustainability Act, is mandated to adopt wise water-use techniques associated with landscape developments. Irrigation systems should use water distribution devices that put water where it is intended with no runoff or overspray. Incorporate "smart" controllers and sensors so water application is matched to the plant's need and so line breaks are automatically identified and valves closed automatically to prevent water waste

A qualified irrigation system designer shall provide irrigation plans. Hydraulic calculations, familiarity with evolving technology and experience are required to design irrigation systems. Please refer to Section 01120 Irrigation Systems of the Standard Specifications.

- Design the irrigation system with controller flexibility to allow for scaling back the system to train plantings toward drought tolerance. This training has a purposeful pattern of frequency and duration. On initial planting, roots are near the surface, so water should be frequent and shallow. Transitioning the water regimen to deep and infrequent will allow soil surface to dry and train roots to seek deeper water where it will naturally be present.
- Install quick coupling valves to provide system flexibility.
- Do not incorporate turf irrigation for the right of way except in those situations where responsibility for the maintenance and operation is assumed by other entities.

- Drip, bubbler, gear driven rotors, impact heads and stream spray sprinklers are more resistant to wind drift that spray sprinklers.
- Install irrigation system prior to planting.

SOURCE OF WATER

Sources of water for irrigation includes municipal water systems and water pumped from a well, pond, stream, or irrigation district. Account for service development charges, permits and agreements that might be needed to bring water to the site. In some jurisdictions it might be necessary to calculate water use. Calculate that cost and include it in the estimate.

a) Municipal Water

Document in the project file:

- Location for the service meter. Define by contacting the serving utility.
- Location, size and depth of the municipal water main.
- Available gallons per minute and the static water pressure in pounds per square inch [psi] at the proposed meter location.
- Water pressure at the sprinkler head (or other distribution device) farthest from the Point of Connection (POC).
- Preliminary cost estimate for water meter and connection fee, monthly fees, and cost of water.
- Check for existing meters, their age, condition, and connections to the main.
- Water service agreement from the water supplier and an electrical service agreement with the electrical supplier (for the controller). Work with the Utilities Section to obtain utility agreements.
- Where sewer fees are based on water use, install a second water meter (deduct meter) at irrigation (POC) to keep track of water that is not impacting sewer system.
- Cost for connections in the (lump sum) cost estimate.

b) Well, Pond, Stream, or Irrigation District: Document in the project file

- Water is free of pathogens, pesticides, pollution or anything harmful to plants.
- Contact Dept. of Water Resources to identify water rights. ODOT holds many water rights.
- Desired location of pump (for pond, stream or irrigation canal only).
- Location and type of power source.
- Length of suction line required.
- Height of suction lift.
- Type of suction intake.

- Screening to prevent the intake of fish from surface waters is required.
- Screening to prevent the intake of contaminants is a best practice.
- Provide pump data in accordance with the Hydraulics Manual.
- Obtain the needed permit(s) from the jurisdictional authority for water withdrawal. Water rights permit may be required for pumping.
- Valves and water delivery system appropriate for "dirty" water.

LAYOUT

An experienced and competent irrigation designer is qualified to design the system using current technologies and best practices. Contractor designed/built irrigation systems are valid options.

SYSTEM CONTROLS/COMPONENTS

Current technology for automatic controllers is very sophisticated but simple to use and available at reasonable cost. "Smart" controllers can incorporate historic weather data, real-time weather station data, and other sensor data to provide landscapes with only the volume of water that is evaporating and being transpired by plants in each hydrozone. Controllers are available that operate using solar power or batteries. Two-wire controller systems eliminate complicated wire bundles and they are superior for phased projects. Wireless systems can be operated remotely or with handheld devices or even cell phones.

Considerations:

- Use smart controllers to comply with wise water-use Agency directives.
- Manual operation of the irrigation system is undesirable.
- Consider long-term maintenance costs. All irrigation systems will require routine inspection and maintenance.
- Fully inspect existing irrigation systems before adding on.
- Consult with maintenance personnel (of the party who will actually be performing the maintenance) to find out their preferred manufacturers/products so to match hydraulic characteristics and match parts inventories.
- Design the use of equipment to match that of the systems already present on the roadside to create an economy of maintenance.
- Select products with proven performance records.
- Specifications allow products to be specified by trade name or manufacturer without letter of public interest finding.

The Standard Specifications for Construction, Section 01120 provide direction regarding materials such as piping, valves, backflow preventers and water distribution devices. This

section also covers inspection, system hand-off and the broad range of aspects associated with irrigation systems. It is worth noting that, because irrigation system hydraulic calculations are based on a suite of interdependent products, irrigation plans can call for specific manufacturers and products by model number. Irrigation system designers should reference Section 01120 as well as other best practices in designing an irrigation system.

SECTION SUMMARY

This subsection provides an overview of irrigation systems and defers to the Standard Specifications Section 01120. Project leaders can use this information to appreciate the complexity of an irrigation system. Designers can use this information in their determination of a need for and type of irrigation system. This section does not provide instructions on design, installation or the operation and maintenance of an irrigation system, but does provide basic information regarding irrigation systems. Thanks to Washington Department of Transportation for providing valuable content for this section.

10. CONTRACT DOCUMENTS

Plans, Specifications and Estimate (PS&E) comprise the contract documents. As with other design disciplines of transportation projects, the production of Contract Documents for Roadside Development is a critical step in the life of the project. ODOT provides the PS&E Delivery Manual which outlines the process and details of creating contract documents and the Contract Plan Development Guide which outlines the ODOT standards for contract plans. The main purposes of the Contract Documents are to:

- Clearly convey the design and all details of the design to Construction Management/Inspection staff and to the selected Contractor.
- Provide the Contractor with the current best practices regarding the work, and to allow the flexibility to apply their knowledge on how to accomplish said work better, faster or cheaper, while still meeting the design intent and quality sought for the work.
- In general, Contract Documents do not instruct Contractor on means and methods of construction.

Products which become Contract Documents for Roadside Development typically include the set of Roadside Development Design Plans (including Detail sheets), **Project Specific Special Provisions**, Bid Items and Cost Estimates, and the most recent Standard Drawings, Standard Details and the applicable sections of the most recent Oregon Standard Specifications for Construction (00280 Erosion and Sediment Control, 01030 Seeding, 01040 Planting, 03020 Compost). The plan set and the specifications are organized in the same order as typical construction practices occur. For example, Mobilization occurs early in the specifications and during construction and Roadside Development plans are sequenced late in the plan set and the work specified in those plans occurs late in the sequence of construction.

ODOT follows a process of continual refinement of contract documents, as follows:

Design Acceptance Package (DAP) – sufficient information has been developed to identify the appropriate solution to the design issue and develop very early design documents. No special provisions or cost estimate are provided.

Preliminary Plans – this set of documents develops DAP plans, providing additional technical and construction review prior to Advanced Plans. Special provision sections and preliminary cost estimate are provided. This is not a required milestone.

Advance Plans – this set of documents will have the majority of issues and conflicts resolved. Special provisions and advanced cost estimate and bid list are provided.

Final Plans – this set of documents is intended to be ready for contracting, with minor tweaks during compilation with other discipline's documents. This is the set of documents, which will be sealed by the Professional of Record.

PS&E Submittal – Completed contract documents are let and advertised for bid.

There is a hierarchy of contractual legality, known as the "Order of Precedence" in contract documents. As found in Section 00150.10 of the Oregon Standard Specifications for Construction:

- Contract Change Orders
- Special Provisions;
- Agency-prepared drawings specifically applicable to the project and bearing the project title;
- Reviewed and accepted, stamped Working Drawings;
- Approved Unstamped Working Drawings;
- Supplemental Specifications;
- Standard Specifications; and
- All other contract documents not listed above.

Notes on a drawing shall take precedence over drawing details.

Dimensions shown on the drawings, or that can be computed, shall take precedence over scaled dimensions.

PLANS

It is ODOT policy that all products intended for final use (not draft) on a project will be sealed by a Professional of Record (POR); that only a POR with specialized knowledge of that particular subject can legally and ethically sign a Plan sheet; and that every Plan sheet will be stamped (please see ODOT Bulletins TSB11-01 (D) and TSB11-02(D)).

It is ODOT policy that plans provide Contractor the information needed to build the project, but not direction on the means and methods of how to build the project. Another policy is that except for infrequent instances specific products or manufacturer of products are not specified.

Product characteristics such as material, weight, dimension and testing criteria are used to identify suitable products. When specific products of particular manufacturer are needed, a Letter of Public Interest Finding is required to justify how the use of a particular product is in the public's interest.

Agency plans are developed in the Microstation design and graphic program. Some municipalities develop plans using ODOT graphic conventions in the AutoCAD program. Preparation of sheets in a plan set, including numbering, order, title and import of survey and other design information is included in the Contract Plans Development Guide (CPDG). Particularly relevant chapters are Chapter 10 Erosion Control, and Chapter 12 Roadside Development, although useful technical information is included throughout the CPDG.

Roadside development plan sets will generally include:

- Standard or Unique detail drawings
- Plant Schedule, identifying species (botanical and common name), size/container or form, American Standard for Nursery Stock reference, spacing, special qualities, quantity and other materials, as needed.
- Plan Drawings

Important items to include on the Plans include:

- Scale and North Arrow
- Plans that have roadway alignments shown use stationing tics as the sheet scale reference.
- ODOT Title Block
- "No work areas" (environmental resources, existing vegetation to remain)
- Limits of project, Right of Way lines and easements.
- Existing (typically dashed) and Proposed (solid) contours
- Existing and Proposed vegetation
- Specific construction features (erosion control facilities, irrigation, etc.)
- Specific notes to Contractors, not a duplication of special provisions.

PROJECT SPECIFIC SPECIAL PROVISIONS (PSSP)

Modifications to the Standard Specifications are made by modifying the Boiler Plate Special Provisions (BPSP). To verify the need for the change and to ensure compliance with Department of Justice requirements, the form 734-2798 (Special Provisions Summary Form) must be filled out to track all the changes made to the special provisions. The form provides its own

instructions and associated requirements. Make modifications to the BPSP in language that directs the contractor using the first person imperative mode. ODOT has the Specification and Writing Style Manual that provides the appropriate language, structure and style for editing the Special Provisions.

The BPSP provide instructions on how to edit the document. Also additions, deletions and revisions to the Oregon Standard Specifications for Construction are provided in then project specific special provisions. Nearly every Roadside Development project will, for example, require a modification to Section 01030 to insert the appropriate seed mix for the project. The boiler plate special provisions are revised frequently. Always begin with a new special provision boiler plate.

The Sections of the Standard Specifications most often used for Roadside Development projects include:

00280 – Erosion Control

00290 – Environmental Protection

00320 – Clearing and Grubbing

01030 – Seeding

01040 – Planting

01120 – Irrigation Systems

03020 – Erosion Control Materials (Compost)

Water quality facilities (01010 – 01014) are designed by hydraulic engineers with input from landscape architects for facility shape, contour grading and planting.

It is important, in preparation of the Project Specific Special Provisions that the wording of bid item names referenced in the PSSP and in the project plans match the wording of items listed in the bid item List. The Designer will be expected to seal the PSSP with a professional stamp of licensure.

OREGON STANDARD SPECIFICATIONS FOR CONSTRUCTION

The Standard Specifications direct the Contractor as to the materials, labor, construction practice, plant establishment activities, and describe how the work will be measured and paid. The

Standard specifications are updated on a regular basis (approximately every two – five years), with many of the regularly revised BPSP incorporated into the updated Standard specifications.

STANDARD DRAWINGS AND STANDARD DETAILS

ODOT Roadside Development does not, at this time, have any Standard Drawings.

There are, however, a number of Standard Details. These detail drawings display the adopted best methods toward various Roadside Development tasks, such as planting, erosion control strategies, irrigation and so on.

BID ITEM LIST

ODOT maintains a Bid Item List in spreadsheet form of those materials most commonly ordered on projects. This assists in developing internal cost estimates and helps contractors develop their cost estimates and approach to the project. Modifications are made to the list as materials technology and best management practices evolve. Names of items in the Bid Item List are the names that must be used in plans and special provisions.

SECTION SUMMARY

This section provides an overview of how designs are packaged into the plans, specifications, and estimates that comprise the legally binding contract documents. Designers can use this information as a guide to identify requirements and standards necessary in the production of contract documents.

11. OPERATIONS AND MAINTENANCE DOCUMENTS

Once a project is properly constructed, and following the successful completion of the Plant Establishment period, it is turned over to Maintenance. Maintenance staff should provide input on the design during the PDT process, and should be clear and accepting of the expectations of the Roadside Development project. Designers should be clear on the routine practices undertaken by maintenance and not design roadside landscapes so complex that an Operations and Maintenance Document (O&MD) is needed. Mitigation projects, revegetation projects restoration projects and the occasional roadside development project may have characteristics that require special maintenance treatments which would be outlined in an O&MD. The development of the O&MD can be considered the final document prepared by the Design staff.

The O&MD should clearly identify the goals for the design, any permitting or regulatory commitments surrounding the project, and recommendations/schedule for maintenance activities. It may include maps, information about performance criteria, target plant communities, and expectations for Maintenance activities.

The O&MD should be signed by the POR, Region Environmental Manager, and the District Maintenance Manager.

Please see Appendices for an example of an O&MD. This document is not a standard form. It is provided as an example to show the type of information an O&MD can provide to be a useful tool for Maintenance.

SECTION SUMMARY

This instructs designers to identify for Maintenance special characteristics in a required mitigation or landscape project that will require special attention and to describe what that special attention would involve.

12. CONSTRUCTION

PRE-CONSTRUCTION CONFERENCE

This meeting is an important milestone in the life of a project. It is also the best opportunity for conveying the intent and critical components of a design to the parties responsible for construction. This meeting is typically held with ODOT Construction Project Management and Inspection staff, selected Contractor and their Inspection staff, and a few of the design/environmental professionals. The project will be discussed, questions will be asked and answered, and it is very helpful for the Roadside Development designer to be present.

Please refer to Sections 01030 and 01040 of the Standard Specifications for more detail on Construction. Some additional guidelines are listed below:

During the planning and design process, areas of potential conflict between the environmental requirements and construction practices should have been identified and unavoidable impacts would have been addressed in mitigation plans. Plainly identified "No Work Areas", project permit restrictions and diligent Agency inspectors combine to minimize conflicts during construction. When environmental protection is a best practice, and when environmental protection is a permit requirement, unanticipated conflicts do arise during construction roadsides such as the following:

- During pre-construction meetings, draw attention to the kinds of activities that are prohibited in the sensitive areas and designated lands.
- During the pre-construction meeting, emphasize the importance that the installation of construction fencing or flagging is to identify and protect no-work areas.
- Environmental impacts might be unavoidable when safety or practical construction operations would be compromised.
- Strive to minimize each impact. On a case-by-case basis work to integrate environmental and safety objectives with the project design
- Vegetation removal in sensitive areas should not occur. In the event this does occur, new plantings that provide the same function and value should be required to replace the removed vegetation.
- Where required, include compensatory mitigation plans.
- The Regional Environmental Coordinator and/or the Environmental Resources Unit can provide clarification on environmental regulation requirements.
- Erosion control can be a significant issue in sensitive areas, particularly near water bodies. Contractor's Erosion and Sediment Control Manager (ESCM) is tasked with anticipating and preventing erosion problems.

- Note timing restrictions due to the sensitive portions of the life cycle of protected species. Sensitive times include winter feeding periods, migratory periods, nesting seasons or others. Species affected can be birds, fish, mammals, amphibians, reptiles or even insects.
- Follow the Standard Specifications for Construction and ADA requirements. Minor deviations from the design can create physical barriers for disabled people. When designs are altered to enhance accessibility, the designer must always be consulted to ensure compatibility with the required design parameters.

CONSTRUCTION INSPECTION

Erosion Control Inspection. Effective functioning erosion and sediment control (ESC) are required by in our construction contracts and by permit requirements that are effectively the law. Inspectors receive training in erosion control and the inspection of ESC BMPs. Because a failure in ESC facilities can result in a "take" of endangered species and compromise ODOT's relationship with regulatory agencies, Construction addresses the inspection and enforcement of erosion and sediment control with the same diligence as with other aspects of the construction contract.

Nursery Stock Inspection. A Certificate of Compliance is required for all Contractor furnished materials. Materials on landscaping projects include many items besides plant material, such as planting media, pesticides, fertilizer, mulch, staking and guying material, irrigation/electrical material, drainage, surfacing, and more. Construction inspectors may not be expert at evaluating plant material. Call landscape architect, Professional of Record or someone with horticultural expertise if support in nursery stock inspection is needed.

- Reject plants that are not delivered with a State Inspection Certificate from ODA. Plants from California must have a USDA inspection Certificate. These strict certification requirements are in place to contain the spread of plant killing pathogen Phytophthora ramorum.
- Inspect planting stock at the nursery or other approved source to ensure the quality of planting stock. The size and quality of planting stock cannot be rigidly standardized because of varying growing conditions and vegetation types however the American Standards for Nursery Stock Z60.1 is the accepted guide to nursery stock plant characteristics. Specification Section 01040.19 outlines requirements regarding plants.

1. General Condition - Check the general condition of the plants in the nursery block from which the stock is to be taken for:

- Uniformity of Leaf Coloration. Leaves that exhibit yellowing, brown edges or tips, or discoloration could indicate poor drainage, fertilizer deficiency, herbicide damage, insect damage, or disease, and may not meet specifications.
- Bud Development. During dormant periods, plants should have buds that are firm, plump and uniformly spaced. A slight cut may be made into the bark to determine that the phloem (growing layer just beneath the bark) is moist and green.
- Uniformity of Growth. The plants in any given block should exhibit uniform vigor and health.
- Presence of Weeds. An overgrown, weed-infested nursery block indicates lack of care and the plants growing in it may be in a poor state of vigor because of the weed competition. Weeds should not be present in containers.

2. Damage - Check individual plants for freedom of defects such as:

- Decay. On trees, look for spots of decayed tissue on the trunk and branches.
- Sun Scald or Sunburn. The destruction of tissue caused by the heat of sunrays striking a plant on the south or southwest side. Reject trees with sunscald.
- Abrasions of the Bark. Abrasions severe enough to damage the cambium tissue may warrant rejection.
- Girdling Roots. Roots that circle around the trunk or a stem will strangle the plant. Reject plants with girdling roots.

FIGURE 12-1 GIRDLING ROOTS

This tree has girdling roots. As tree trunk thickens over time the ring of roots does not move resulting in the plant's death

Reject trees with circling/girdling roots.

- Improper Pruning. Cuts should be where the branch meets the swollen feature called the branch collar. Cuts flush with the trunk are incorrect.
- Frost Cracks. Long vertical splits in the bark and/or wood may occur on the south and southwest sides of young and thin-barked trees. Reject trees with frost cracks.
- Signs of Injury. Reject plants with dead leaves; dry buds; dieback of twigs and branches; blackened sapwood and sunken, discolored patches of bark (sunscald) on the trunk or limbs.
- Root Ball. Roots should be throughout the soil so the root ball stays together during planting. Reject plants with cracked or broken root balls.

3. Pests/Diseases - Check individual plants to make sure they are free from:

- Diseases. These will appear in a variety of forms such as abnormal leaves, twigs, fruits, discoloration or malformation of leaves and bark or unusual discharges of sap through the bark. Any plant showing evidence of disease should be rejected.
- Insects. Look for insect eggs or evidence of damage from insect feeding on leaves, twigs, buds, or other plant parts. Examine the trunks of trees for borer holes that appear as tunnels drilled into the bark and inward into the wood of the trunk.

For more information regarding invasive pest and disease species look on-line at Penn State University. In addition, the University of Davis and The Nature Conservancy maintain national control information on specific invasive species, as well as an inventory of photographs, and lists of species resources.

4. Growth Habit - Check individual plants for proper habit of growth as follows:

- If a particular habit, (single stem, multiple stem, etc.) has been specified, verify that conform to this requirement.
- Shade, and flowering trees are symmetrically balanced. Shade trees should have a single leader. The balancing should be well developed and characteristic of the species.
- Evergreen trees should be full foliage plants with uniform density. Do not accept sheared plants, such as pines sheared for Christmas trees, unless specified.
- Shrubs should be well branched in a manner characteristic of the species.

5. Root System - Healthy roots should be able to hold the soil mass together yet not be crowded around the outside perimeter of the root ball.

- Inspect a random sampling of plants of each species by removing them from their containers to determine that the root system is healthy and of appropriate density.
- Check that the roots are dense enough to hold the soil together, but not so dense as to be considered root bound.

- Root ball size is proportional to plant size as determined by the American Standards for Nursery Stock.
- Vital growing roots are generally white. Dead roots are brown.
- Reject plants that are found to be root bound and plants that have insufficiently developed root systems to hold the soil together when removed from the container.

FIGURE 12-2 ROOT DENSITY

The photo on the shows appropriate root density for a four inch container. If this root mass was found in a one gallon container, it indicates the plant was recently transplanted and it should be rejected

6. Tagging

- Tag plants that meet the above criteria with seals placed on all plants or representative samples at the nursery. This will assist in future inspection of these plants when delivered on the job site.
- Indicate that seals, tags or flagging placed on planting stock in nursery do not imply acceptance on the construction site.

FIGURE 12-3 ROOT BOUND

Plant in this photo is root bound. Note that few roots are white (healthy)

SHIPPING AND HANDLING

Inspect stock at the construction site to ensure that the plants are from an approved source, are in a healthy and undamaged condition, and conform to sizes, quantities, and standards called for in the specifications.

- Plants should not be damaged during shipment from the nursery to the job site.
- Each shipment of plants should be free of weeds, disease and insect pests, and meet all applicable State and Federal certification requirements. All necessary quarantine or State nursery inspection certificates should accompany each shipment.
- A representative sample of all plants should be legibly tagged with the correct botanical name, common name, and size to agree with the specifications and plant list. Bare root plants should be shipped in bundles with each bundle properly tagged.

- Planting stock, which has not been inspected, at the source should be inspected as the material is being unloaded, or immediately thereafter, so that plants which are unacceptable can be set aside for removal from the project site.
- Where root formation is irregular, measurement of the spread of bare root plants should be the average, considering all sides of the plant, rather than the maximum root spread. The Inspector may allow moderate deviations from exact measurements in the case of plants that normally have irregular root systems.
- Large root stubs on nursery grown balled or bare rootstock is evidence of lack of proper care and root pruning, and sufficient grounds for rejection. Root stubs frequently characterize collected stock that need to be evaluated that root systems are adequate.
- Damage to plant material caused by improper operation of mechanical diggers may be sufficient cause for rejection at the construction site. Verify that plants dug with equipment leaving a cone shaped ball comply with American Standard for Nursery Stock regarding size of root ball for plant size.
- Bare-rooted plants should have adequate live, damp, fibrous roots, free of rot and mold.
- All shipments of plants must arrive in good condition. During transport, plants must have been protected by a covering such as canvas or plastic sheeting. Root balls and bare root plants should have been protected by moist burlap, sawdust, plastic, etc. Under no conditions should the root system have been allowed to dry out. All plants must exhibit normal turgidity and vigor.
- Reject plants damaged in transit, or not conforming to the specifications. All rejected plants should be removed from the site immediately. However, these plants may be suitable for other jobs so take care and do not damage any rejected plants. Be careful that any system of identifying these plants does not ruin them for resale to other buyers.

Carefully store and maintain plants until planted as follows:

- Shade and protect outside storage from the wind.
- Heel-in bare root or balled plants stored on the project to protect them from drying out at all times by covering the bare root or balls with moist sawdust, wood chips, shredded bark, or other approved mulching material.
- Keep plants, including those in containers, in a moist condition until planted.

PROTECTING EXISTING VEGETATION

The preservation of existing trees within the right of way may require identification and treatment for preservation. Contact the Regional Environmental Coordinator regarding necessity fora tree preservation plan may be required to detail the specifics on identification of tree species, construction activities that will be limited around the trees, and mitigation measures required if tree replacement becomes necessary. Use a certified arborist or landscape

architect to develop the tree preservation plan and use this person during construction to oversee activity within or near the tree protection area.

- Protect existing trees from construction impacts. The Critical Root Zone of trees is 1.5 feet per every inch DBH. Activity within this zone harms the tree. At a minimum, protect the root zone to the outermost reach of its branches (the drip line). If cuts or fills are required in the vicinity of trees to be saved, consider retaining walls, tree wells, gravel, or drainage systems to protect the root systems.
- Do not store, park or drive vehicles or equipment around the base of a tree. This compacts the soil and harms the tree. Do not allow stockpiling of fill or building materials within the tree's dripline.
- Avoid scraping soil from roots or cutting them too deeply or too close to the tree, which can cause the tree to die or have a weakened hold and be blown down. This damage may not be visible for years.

SITE PREPARATION

1. Compaction - Appropriate soil treatment is crucial for the success of roadside restoration (including erosion prevention seeding).

- Analyze the soil for compaction. Soil compaction can be tested using the bulk density test. Test the soil to a depth of two (2) feet. If the density is greater than 80%, take steps to break up the compacted soil unless the location is in the structural roadbed prism. If the location is in the roadbed prism, consult with the designing engineer to discuss options.
- Staging areas become compacted. These areas will have to be ripped to restore pore spaces between the soil particles.
- Rip compacted soils, ideally in two directions, to a minimum depth of 18 inches before planting. The roots of most plants are above this depth.

2. Soil Treatment according to plans and specs.

- Utilize compost to improve soil structure, organic composition, and as a mulch and as erosion control blanket where specified.

3. Protect existing soil conditions - One challenge for the Project Manager and the Construction Office is to avoid or minimize damage to the soils resulting from construction activities. Mitigate unavoidable damage to the soil before planting. Standard Specification Sections 01040.43 – 01040.48 address care of soils. Best horticultural practices go into greater detail. Consult landscape architect for more detail

PLANTING PITS

The Inspector should check and approve the stakeout of all planting areas and plant locations prior to digging. Minor relocation of planting areas and holes can be done at this time to avoid utility lines, signs, rock outcrops, drainage ditches, or impervious or wet soil conditions.

- If minor relocation of plantings is not possible, contact the POR to adjust the design requirements.
- Observe excavation of planting pits to determine if they will drain properly. Planting pits in compacted road prism may need drainage trench cut to daylight.
- Test planting pit drainage in accordance with the specifications if the Contractor has a difficult time excavating, if soils have high clay content or are compacted or the ground looks impervious.
- Excavate planting holes to the sizes on the contract plans and per Standard details (Best thinking is to dig hole shallow but wide, up to 3 times the root ball diameter).

PLANT INSTALLATION

Design documents consider construction requirements such as site accessibility and constraints such as contract timing. During construction:

- Do not deviate from plans without approval of the POR.
- Do not place aggressive rooted trees on top of pipe alignments.
- Determine that planting operations are properly completed in conformance with Contract Plans and Specifications and good horticultural practices.
- Review and become familiar with all plan sheets, quantities, details, specifications, and other provisions of the contract. At this time, questions or interpretations can be answered or problems resolved through discussion with the landscape architect, horticulturist, or other authorized persons.

The Standard Specifications provide a list of requirements in Section 01040.49, General Planting.

Water all plants as needed to complete the planting operation. Weather and soil conditions dictate the need for watering. Over-watering is as harmful as under-watering. Adequate watering is more critical during the first few weeks following transplanting. Do not allow plants to stress from lack of water.

Transplant Guidelines - The chance of success is much greater if plants from the same altitude and ecosystem are used because they are adapted to that area's climate and elevation.

- Collect plant materials during the dormant season.

- Keep them protected from wind, direct sunlight and heat.
- Protect stems from wind and keep them cool and moist. Dig holes shallow and wide as shown on plans. Larger holes will be required in more compacted soils.
- Make planting holes deep enough so that the downslope side of the root ball is entirely buried.
- Plant so the root collar is at the depth at which it was previously growing.
- Collect plant cuttings from multiple parent plants in good condition (if available). In general, take no more than one third of the parent plant's material and take no more than 50 percent of cuttings or seed from a given area.
- Use watershed boundaries as cutting, plant collection, and transplant zones where practicable. In addition, collect necessary plant material within a 500-foot elevation band of the planting site.
- For plant cuttings, use young branches (1 to 2 years old). "Pole" cuttings (2-6 inches dia.) are acceptable where reliable soil moisture is deep or "structure" is needed in riparian settings.
- Prior to planting, protect plant cuttings from wind by covering them with plastic sheeting or moist cloth.
- When possible, install cuttings on the same day they are collected. If cuttings must be stored, keep them in cool damp storage.

SEED SELECTION

When using seeds of native plants, it can be important that seeds are from the same region and elevation. Designer should have verified seed availability (and cost) prior to specifying.

- With sufficient advanced notice, growers will collect seeds from the project's area and elevation. Availability of native seed produced in the local area cannot always be counted upon. Contract seed collection is an effective means to assure the locally derived material is being used for a project.

PLANT ESTABLISHMENT AND PERIODIC INSPECTIONS

The following activities are common and are often components of the Plant Establishment period. See also Sections 01040.70 – 01040.79.

- Plants may require repositioning as a result of, wind action, vandalism, etc. Keep disturbance to the root mass at a minimum.
- Firmly embed stakes; re-driving may be necessary. Do not allow stakes to rub the tree.
- Adjust guys to allow some movement. Adjustments may be necessary to keep the tree straight (not too tight), to prevent a large amount of swaying and prevent damage by rubbing.
- Secure protective wrapping, when used, on trunks or stems.
- Take corrective action if damaged by vehicle, fire, or vandalism.

- Replace plants damaged by animals (i.e., deer, rodents). Seek advice from Natural Resources Section on control measures.
- Report infestations of insects and disease to the horticulturist or other appropriate professional for recommendations on corrective action.
- Look for and remove broken branches or sucker growth.
- Where discoloration of foliage occurs, especially in evergreen material, seek advice on corrective measures.
- Remove dead and severely damaged plants immediately and replace within 15 calendar days.
- Inspect for settlement of soil or soil mix and replace to required grade, repositioning plants if necessary.
- Inspect berms and water basins (constructed for the purpose of retaining water) to ensure that they are functioning properly. Repair and rebuild as necessary.
- See that project areas are weeded, mowed, or sprayed as specified.
- If planting projects require the use of fertilizers, follow specifications.
- Qualified personnel, utilizing the best horticultural practices and tools, should perform pruning at the appropriate time. Topping and "hat-racking" are not acceptable pruning techniques.
- Three periodic inspections, jointly performed by Contractor and Agency Inspector, are required during the Plant Establishment period: Spring, summer, and fall. After each inspection, inspector submits a written notice of required corrective work. Contractor has 15 days from receipt of written notice to complete corrective actions.
- Conduct a final walk-through to confirm all corrective actions have been completed. Provide Final Payment only after resolution of this "punch-list" of items. The Project Manager or a representative, a Landscape Architect, a maintenance person, the Inspector and Contractor should attend the final walk through.

SECTION SUMMARY

This section provides construction inspectors with a list of characteristics and conditions to look for when checking compliance with plans and specifications by landscape contractors. Items to look for during inspections of hardscape item construction are not listed as the lack of variability and specific nature of hardscape makes that inspection straightforward. It is worth repeating that having a landscape architect participate in plant establishment inspections is a good idea if construction inspector is not expert in evaluating planting best practices and plant health.

13. MAINTENANCE AND MANAGEMENT

This chapter is not a maintenance practices guide. The Routine Road Maintenance, Water Quality and Habitat Guide (Blue Book) , the maintenance guide for water quality facilities and other guidelines provide Maintenance with well-considered suite of practices that balance responsible environmental stewardship with the care of our transportation system. Landscape architects are often the professionals of record to address salmon habitat, nesting birds, wildlife crossings, bike lanes, wetlands, T & E plants, Special Management Areas, stormwater, revegetation, aesthetic landscapes, urban streetscapes and pollinator habitat. Each of these tasks can result in new maintenance responsibilities that are added to the jobs of cleaning up after accidents and repairing its damage, removing road kill, repairing culverts, removing and repairing landslides, removing obstructions, maintaining free flowing drainage, plowing snow, repairing pavement and the other jobs that maintenance shoulders. It is important for landscape architects to appreciate the breadth of maintenance's responsibility, their limited resources and the relentless cascade of tasks that they address.

ODOT Maintenance is an important stakeholder in (and in some regards the client of) roadside development. Maintenance has experience, insight and familiarity with roadside issues. This positions Maintenance to be pivotal in the success of roadside projects. It is important to coordinate with Maintenance during the project design in order to provide them with a project that will be good design that satisfies commitments made to stakeholders yet is cost-efficient to maintain. Roadside landscape architecture may result from permit requirements, community consensus, or for purely aesthetic reasons.

Roadside vegetation is maintained primarily for safety within the constraints of limited resources. Safety includes elimination or obstructions in the run-off zone, keeping sight lines clear, eliminating cover for large wildlife, reduction of fire fuel and removal of hazard vegetation. Since run-off-road accidents comprise almost one third of all motor vehicle accidents, clear roadsides are an important component of road safety. Maintenance also repairs damage caused by normal use, by collisions and in winter they remove landslide debris and snow.

SECTION SUMMARY

Refer to manuals and documents owned by the Maintenance and Operations Branch for roadside maintenance practices.

APPENDIX

APPENDIX A: GLOSSARY OF LANDSCAPE TERMINOLOGY

Acid/Alkaline - Soil pH, percent Hydrogen, is a measure of hydrogen ions in the soil. The pH scale ranges from 0-14. pH of 7 means a neutral soil. pH below 7 is acidic soil. pH above 7 is alkaline soil or basic soil. Various plants respond differently to pH variations. Plants adapted to a region are adapted to the soil pH of that region. When a pH change is desired, a soil test is taken, and the soil amended to the desired pH.

Aesthetics - Evaluations of the sensory perceptions (sight, sound, smell, taste, and touch) with respect to judgment about their pleasurable qualities.

Aesthetic Quality - Those desirable characteristics of the highway and roadsides such as harmony between the natural and built environment, continuity of visual form, and graceful simplicity of designs. (OAR 734-055-0010(3))

Balance - In design, balance refers to the equilibrium or equality of visual attraction. Symmetrical balance is achieved when one side of the design is a mirror image of the other side with a distinct dividing line between the two sides.

Asymmetrical balance use dissimilar forms, colors, and textures to obtain balance. Compositions on either side of the central axis are different, but carry equivalent strength of visual impact.

Balled in Burlap (B&B) - Plants are prepared for transplanting by digging them so that the soils immediately around the roots remain undisturbed. The ball of earth and root is then tightly bound in burlap or similar mesh fabrics.

Bare Root (BR) - Bare root plants are dormant plants that have had the soil removed from the roots.

Best Management Practices (BMPs) - Regarding water quality, these are physical, structural, and/or managerial practice that, when used individually or in combination, prevents or reduces pollution of water.

Biofiltration - The use of soils and vegetation to filter and treat stormwater runoff as it is conveyed through an open channel or swale.

Bio slopes - A flow-through BMP incorporated into roadside embankments and placed between pavement and a downstream conveyance system that use a variety of physical, biological and chemical treatment processes to provide stormwater treatment. Also called vegetated filter strips.

Botanical Name - The true plant name, written in Latin and traditionally underlined or italicized, used universally. Common names can vary by region and are not reliable identifiers. The botanical name usually consists of two names, genus and species, but plants that are horticultural introductions may include additional names.

GENUS 1st word, capitalized

SPECIES 2nd word, lower case

VARIETY 3rd word (if appropriate), in single quote, capitalized

FORM 4th word (if appropriate), close single quote, capitalized

Example - *Juniperus chinensis* 'Pfitzerana Glauca'

Branch - An offshoot from a trunk or main stem. It could be also called a bough or a portion of a main stem.

Buffer - The zone contiguous with a sensitive area that is required for the continued maintenance, protection, function, and structural stability of the sensitive area. The critical functions of a riparian buffer include shading, input of organic debris, uptake of nutrients, stabilization of banks, erosion control, filtering of pollutants, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects.

Caliper - The diameter of the trunk of a deciduous tree as measured 6 inches above ground level, up to 4 inches caliper size. If greater caliper than 4 inches it is measured at 12 inches above ground level.

Cambium Layer - The layer of actively dividing cells between the outer bark and the inner wood of woody plants.

Canopy - The topmost layer formed by the leaves and branches of a forest's tallest plants.

Clay - Mineral soil particles with a diameter of less than 0.002 millimeter. It is a fine-grained soil that has a high plasticity index in relation to liquid limits. Clay soils have slow water infiltration, high water retention capacity, high shrink/swell when dried/wetted, and are somewhat resistant to erosion.

Climax vegetation - Is a community of plants, which, through the process of ecological succession have developed to a self-regenerating steady state. See pioneer species.

Complexity - The multiple qualities in a landscape or habitat that provide ecological functions or visual interest such as the combination of form, color, and texture.

Compost - Stable, mature, decomposed organic solid waste that is the result of the thermophilic, aerobic biodegradation under controlled conditions. The result has a uniform, dark, soil-like appearance.

Compost Erosion Blanket – This is a soil cover of medium or coarse compost used to protect disturbed soils, introduce soil biology and enhance soil nutrients. Compost erosion blankets are installed (usually at a depth of 2") with tackifier as a component and are often used as a media for seeding.

Conifer - Conifers are plants that develop seeds in a cone, usually evergreen, with needles or scales in lieu of broad leaves. Examples of conifers include pine, spruce, fir, and cedar.

Container Grown - Plants grown and delivered to the job site in tubes, pots, bags or other containers. The containers are manufactured in nominal sizes with a capacity of about 3/4 stated size (i.e., gallon containers have about 3 -quart capacity). ODOT references containers numerically with No. 1 container being 1 gallon, No. 2 container being 2 gallon, etc. The bid item list lists notes the most commonly used container sizes.

Context Sensitive Design - Refers to roadway standards and development practices that are flexible and sensitive to community values to better balance economic, social, and environmental objectives.

Corridor Continuity - The thematic cohesion of a corridor as developed by the coordination and sequence of visual features as experienced by the roadway user.

Critical habitat - Critical habitat consists of "the specific areas within the geographical area occupied by the species, at the time it is listed … on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection."

Cuttings - Live plant material without a previously developed root system. Source materials for cuttings should be dormant when the cutting is taken. Specific language used by ODOT is *plant cuttings, less than 1 inch* and *plant cuttings, greater than 1 inch.*

Deciduous - Plants that shed all their leaves at the end of the growing season and remain leafless during the winter or dormant period.

Designated lands - Lands that have been officially recognized or identified for their special functions. Many of these are managed for environmental functions as well as other uses, such as recreation. These can include:

- National Wildlife Refuges.
- National Forests.
- National Parks.
- State, county and local jurisdiction parks.
- Wild and Scenic Rivers.
- Scenic and Recreational Highways.
- Designated critical habitat for threatened or endangered species such as spotted owls.
- Priority habitat areas such as oak woodlands, agricultural lands, and sensitive plant habitat.

Diameter at Breast Height (DBH) - is a measure of trunk diameter at approximately 4' above the root collar/ground surface.

Ecological succession - The natural tendency of plant communities to evolve over time.

Enclose - A roadside treatment strategy, to provide visual buffers along both sides of the road using treatments, such as berms, structures, or vegetation.

Endangered species - Any species of plant or animal that is in danger of extinction throughout all or a significant portion of its range, and designated under state or federal Endangered Species Act.

Evergreen - A plant that maintains active (not dormant) foliage throughout the year.

Expose - A roadside treatment strategy, the aim of which is to preserve or open a visual sight line, or remove vegetation for operational purposes, such as in the Design Clear Zone.

Feature - A visually distinct or outstanding part, quality, or characteristic of a landscape.

Fertilizer - Any natural or artificial material added to the soil or directly to the leaves to supply one or more of the key plant nutrients. Generally, a complete fertilizer refers to a fertilizer that contains Nitrogen, Phosphorous, and Potassium (NPK).

Filter strip - Grassed strips situated along roads or parking areas that remove pollutants from runoff as it passes through, allowing some infiltration, and reductions of velocity. These areas may also have an amended soil component in addition to vegetation. Similar to Bio slopes.

Forb - A herbaceous flowering plant, such as clover or asters, not a gramoid (grass).

Form - The shape of a plant. Plant forms include upright, oval, columnar, spreading, broad spreading, weeping, etc.

Friable - A granular soil, easily crumbled by cultivation, with sufficient moisture for plant growth.

Genus - Category of biological classification between family and species. The first word in a plant's botanical name is the genus to which the plant belongs; for pine it is Pinus. For example, *Pinus contorta*, *Pinus ponderosa*, and *Pinus sabiana*.

Green Street - A street designed to meet multiple environmental objectives.

Groundcover - Low-growing plants that form a dense, extensive growth and tend to prevent weeds and soil erosion.

Hardy (Hardiness) - Hardiness usually refers to a plant's tolerance to cold temperatures; however, it could be tolerance to heat, drought, abundance of moisture, etc. as it relates to survival.

Heeling In - A method of temporary storage by covering plant roots with sawdust, mulch or a mixture of other materials capable of good moisture retention, to keep the roots from drying out.

Herb - Any flowering plant except those developing persistent woody bases and stems above ground. Similar to forb.

Herbicide - A chemical formulated to kill plants. There are two main groups:

- Pre-Emergence Herbicide acts on the seeds, bulbs, tubers, stolons, etc., as they sprout (before-emergence).
- Post-Emergence Herbicide acts on the active growing surface of a plant after the plant has emerged from the soil.

Horticultural Variety (Cultivar) – The category of biological classification after species. A plant variety originating as a result of selective breeding. Such plants are given a variety name which is added to the rest of the plant name and usually set off by single quotation marks or occasionally, all capitals i.e., *Gleditsia triacanthos* 'MORAINE'.

Humus - A layer of decomposed organic matter generally found on the upper surfaces of the soil. Humus frequently imparts a dark color to the soil. It is beneficial because of its nutrient and moisture storage capacity, as well as the soil biology it supports.

Infiltration - The process by which water on the ground surface penetrates into the soil.

Infiltration Rate - The rate at which water enters the soil. The rate is usually expressed in inchers per hour.

Inoculated Seed - Seeds of plants, usually in the legume family, that have been treated with nitrogen-fixing bacteria to enable them to make use of nitrogen from the soil and atmosphere.

Integrated Vegetation Management (IVM) – A strategy that uses the most appropriate vegetation management methods, to maintain roadsides in an environmentally and economically sound manner. For details, refer to ODOT Integrated Vegetation Management Statewide Plan.

Irrigation Systems – Water delivery system for landscape plantings.

Landscape – Areas defined by both their physical characteristics and the overlay of human presence. Landscapes reflect a synthesis of people and place that is vital to local and national identity.

Leaching - The removal of materials in solution, such as salts or nutrients, from the soil.

Leader - The main stem that forms the apex of a tree. If the leader is missing, another leader will try to establish itself. For typical street trees this is grounds to reject the tree.

Line - The geometric element that is the path of a moving point. In design it is the most basic element with which to direct attention, define shapes or communicate visually. See Section 7. Design Principles and Products, Hardscape Design, Item 1 - Line.

Live poles - A form of cutting taken from woody vegetation with a diameter greater than 2 inches. Specific bid item language used by ODOT is *plant cuttings, greater than 1 inch*

Live stakes - Is the same as "cuttings." Specific bid item language used by ODOT is *plant cuttings, less than 1 inch*.

Loam - A soil texture class that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. Loam is a desirable soil for growing plants.

Low Impact Development (LID) - A stormwater management approach intended to mimic natural hydrology using pervious pavement, vegetation and soil conditions that reduce the rate and quantity of runoff, filter out pollutants, and facilitate infiltration, detention, and evapotranspiration of stormwater

Microorganisms - Forms of life that are too small to be seen with the unaided eye. These contribute to the soil biology and fertility of healthy soils.

Mulch - Any loose material placed over soil to retain moisture, reduce weed growth, insulate soil, add structure and nutrients, or improve the general appearance of the plant bed.

Native Plant - A species indigenous to a region, as distinguished from an imported species or horticultural variety. Some horticultural varieties are derived from Oregon native plants, for example the 'Plum Passion' ® vine maple.

Noxious Weeds - a specific designation by the Oregon Department of Agriculture for plants which have been determined to pose a threat to the economy or ecology of the State of Oregon.

Pesticide - Any substance or mixture of substances intended to control insects, rodents, fungi, weeds or other forms of plants or animal life that are considered to be pests.

Photosynthesis - The process by which green plants produce their food (carbohydrates) from water, carbon dioxide, and minerals, using the sun's energy.

Pinching Back (Heading Back) - A process of pruning back to a bud or side branch. This process encourages the plant to branch out, resulting in a bushier plant.

Pioneer species - In the process of ecological succession, these are plants that arrive early in revegetating disturbed sites. Fast growing, nitrogen-fixing plants are often pioneer species.

Plant Establishment - The length of time of care and maintenance that it takes for a plant to become self-sustaining, following the plant installation. Typically refers to the maintenance and warranty period a Landscape Contractor assumes for a recent planting installation, generally for a 1 -year period beginning at acceptance of planting.

Planting Season - The time of the year when planting and/or transplanting is considered advisable from the standpoint of successful establishment following good horticultural practices. Sections 01040.41 and 01040.42 list ODOT's planting seasons.

Plant material - Trees, shrubs, ground covers, cuttings, live stakes, live poles, rhizomes, tubers, rootstock, bulbs and seedlings are referred to collectively as "plants" or "plant material."

Pore space - Total space not occupied by soil particles in a bulk volume of soil, commonly expressed as a percentage.

Puddling - Filling a planting pit with water to settle the soil and eliminate air pockets during the planting process.

Reference site - An established natural site that is used as for comparison to help determine the desired plant composition and densities for a project site. A reference site should be located near the project site, within the same watershed, and have similar landscape setting, hydrology, and topography.

Rhizome - A root-like stem, growing under or along the ground that sends out roots from its lower surface and leaves, or shoots from its upper surface.

Rhythm - In landscape design, the repetition of elements of a design. The repetition reinforces the thematic cohesion of a design.

Riparian (area, zone) - The land adjacent to a stream, river, or other fresh waterbody, which is at least periodically influenced by water from that body.

Ripping - Deep scarification, using specialized equipment, to break up compacted soils, increase pore space and improve soil structure.

Roadside restoration - The use of planning, design, construction, and maintenance to restore roadside plant communities to the desired condition.

Root Ball - Ball of earth encompassing the roots of a plant. (See balled and burlapped).

Root Bound (Pot Bound) - The condition of a container plant whose roots have become densely packed. This condition is a result of holding the plant in the container for too long. Root bound plants should be rejected.

Root Collar (Root Crown) - The line of junction between the root of the plant and its stem, usually identifiable by the swelling at that junction.

Root Pruning - Trimming the outer edges of the roots with a sharp tool to encourage more fibrous root system. This is done periodically at the nursery and prior transplanting, but this should not be done immediately prior to transplanting.

Sand - A mineral soil particle between 0.05 and 2.0 mm in diameter. A soil textural class, typically very well drained and highly erodible.

Scale - In design, refers to the size of objects in relation to the surroundings. Designers consider the size of plantings and buildings in relation to the human scale.

Scarification - Breaking through the surface of the ground to facilitate vegetative establishment and the flow of surface waters into the ground; also breaking the seed coat to enhance seed germination.

Scenic and Recreational Highways - Public roads having special scenic, historic, recreational, cultural, archeological, and/or natural qualities that have been recognized as such through legislation or some other official declaration. State Scenic Byway, National Scenic Byway, or All-American Road refers not only to the road but also to the corridor through which it passes.

Screen - The use of roadside treatments such as vegetation, berms, or walls to block undesirable views or to differentiate disparate spaces or views.

Seedlings - Plants grown from cuttings, seeds, or other approved propagation methods. They are generally less than 3 years old and under 2 feet in height.

Selective Thinning - The removal of selected trees, shrubs, or other vegetation for a specific purpose; e.g., improving sight distance, opening a vista, displaying a special attraction, removing dangerous trees or reducing plant density for other reasons.

Sensitive areas (also called critical areas) - Places in the landscape that are subject to natural hazards or that support unique, fragile, or valuable natural resources. These areas may have special regulations attached to them and can be highly susceptible to disturbance. Examples of sensitive areas include:

- Streams;
- Wetlands;
- SMAs;
- Steep slopes;
- Erosion hazard areas;
- Landslide hazard areas;
- Seismic hazard areas;
- Floodplains and smaller watersheds feeding into shellfish harvest areas.

Shrub - A low, woody plant having several stems.

Silt - A mineral soil consisting of particles of 0.002 and 0.05 mm in diameter. A soil textural class that is very erodible.

Special Management Area (SMA) - Areas that have been identified in the field by a environmental specialist as having threatened or endangered species. SMAs are marked with distinctive blue signs at the beginning and end of each location to identify for maintenance an area that requires special treatment.

Sod - A layer of topsoil including roots and grass. Sod is often sold in a slab or roll to establish turf grasses.

Soil - The unconsolidated mineral, biological and organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants.

Soil horizons - Layers of soil approximately parallel to the land's surface and differing from underlying or overlying layers in physical, chemical, and biological properties such as color, structure, texture, consistency, amount of organic matter, and pH.

Soil Mixture - A mixture of growing medium such as sand, sawdust, perlite, vermiculite, peat, and bark dust which is used to grow plant materials. The soil mixture may be combined with the native topsoil.

Soil organic matter - The upper soil strata that includes plant, animal, and soil organism residue at various stages of decomposition.

Soil structure - The arrangement of primary soil particles into secondary units. The secondary units are classified on the basis of size, shape, and degree of distinctness into classes, types, and grades. Examples are: platy, prismatic, columnar, blocky, granular, and crumb.

Species - Category of biological classification after genus. Species are the smallest groups that are consistently and persistently distinct, and distinguishable by ordinary means. Plants of the same species can breed and produce fertile offspring. *Pinus ponderosa* and *Pinus contorta* are both in pine genus, but are different species.

Stem - The main upward growing axis of a plant. The main stalk(s) or trunk(s) of a tree, shrub, or other plant.

Stormwater - That portion of precipitation that does not infiltrate into the ground but flows over land as runoff.

Subsoil - The soil layers below the A Horizon that contains little or no organic matter.

Sucker - Any unwanted shoot. Sides shoot from the roots of a plant.

Sustainability - Is the ability to maintain rates of resource harvest, pollution creation, and non-renewable resource depletion that can be continued indefinitely combined with is ability to support a defined level of economic activity indefinitely.

Swale - A natural or human-made wide, shallow ditch that stores or conveys stormwater runoff. Swales can be used to diminish the pollutant load of stormwater runoff.

Systemic - A substance (insecticide, herbicide, etc.) that, when absorbed makes the plant poisonous to certain pests and diseases. In the case of an herbicide, it can move from foliage into the root system and kill the root system.

Tap Root - A primary descending root.

Texture - The surface quality of an object that can be seen or felt. Textured surfaces in the landscape include walls, buildings, pavement, groundcovers and plants. In the relationship between leaves, branches, and form, the texture of plants can be described as coarse, medium or fine.

Thinning - The removal of some of the plants in an area, or trees in a stand, to diminish plant density. Thinning also involves the removal of branches from a single plant.

Threatened species - Any species of plant or animal that is likely to become an endangered species within the foreseeable future, throughout all or a significant portion of it range. "Threatened" is a formal listing status under state and federal regulations.

Tilth - The physical condition of soil as related to its ease of tillage.

Tolerant - The characteristic of a plant to withstanding unfavorable growing conditions (i.e., cold, heat, moisture, drought, etc.).

Topsoil - The topmost, dark-colored (A Horizon) soil strata that consists of minerals, organic matter, and microorganisms and ranging from inches to a few feet thick.

Tube Container - A tube container is a deep narrow container either single or in blocks used to produce deep root systems or unfinished nursery stock. The ODOT bid item language used to reference plants grown in a tube container is tubeling plant.

Tuber - A swollen underground stem, such as the potato, bearing buds from which new plant shoots arise.

Unity - In design, unity is thematic cohesion represented by the coordination of visual features. Unity is achieved with consistency of character between units in the landscape. Unity can be achieved by using mass planting and repetition. Unity means that all parts of the composition or landscape go together; they fit.

View - Something that is looked toward or kept in sight, especially a broad landscape or panorama. Act of looking toward an object or scene.

Vista - A view gained from a higher point in the landscape, which may be large in expanse and scale.

Visual Resources - Objects (manmade and natural) and features such as landforms and water bodies that are visible on a landscape.

Watering In (**puddling**) - The procedure of watering the backfill and planting hole during the planting procedure. The purpose is to eliminate air pockets and voids around the roots.

Watershed - An area of land surface defined by a topographic divide that collects precipitation into a stream or river. Sometimes referred to as a drainage basin.

Weed - Any plant growing in a location in which it is not desired.

Wetlands - Those land areas that are saturated by water at a frequency and duration that support vegetation adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas.

Whip - A young tree that has not started to branch.

Wildflowers - Native flowering herbaceous plants, usually with conspicuous flowers. Although grasses are flowering plants they are not considered wildflowers.

Xeriscape - A planting design concept based on conservation of water through the use of plant materials and land use that use only naturally occurring water.

APPENDIX B: REFERENCES

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APPENDIX C: ECOREGION BASED SEED MIXES

The EcoRegion based seed mixes provide a list of native plants endemic to each of Oregon's 10 different EcoRegions. While the list does not include every native plant the list is extensive. In developing a seed mix the intent of the seeding must first be established. If erosion control as well as revegetation are goals of the seeding the seed per square foot may be denser than if seeding is only for revegetation. See the subsection on seeding for more information. Use the **spreadsheets** shown below as linked to Roadside Development web page, to develop site specific seed mixes.

To select species for native grass seeding refer to grass worksheet shown below. For other mixes that could include native grasses, forbs, shrubs and trees, refer to the worksheets by Ecoregion. Select species appropriate to ecoregion and site and load them into the seed mix calculating spreadsheet. Look up the seeds per pound on the Seed Master spreadsheet and enter that number in the appropriate column. Other sources for seeds-per-pound include the worksheets below and many other resources provide seeds per pound quantities including seed supplier catalogs and the USDA Native Seed Production Manual. Where purity and germination are listed, these figures are estimates. Actual purity and germination are arrived at by testing seed batches and the percentages are provided on the seed sack label. Installers calculate the PLS using the actual purity and germination percentages.

The Seed Mix Calculator spreadsheet is manipulated by entering quantities in the seeds per square foot column. Manipulate the quantities of each seed in the mix to establish the desired plant combination and density. To satisfy erosion control as well as revegetation requirements a good total for number of seeds per S.F. is between 150 and 250 seeds per S.F. A companion tool to the seed mix calculator is the **Seed Master** spreadsheet. This tool provides the botanical name, common name, characteristics including seeds per pound and a link to the plant's on-line data.

Select species that are commercially available, that germinate well and grow strongly from seed (work horse species). Some plants are difficult to grow from seed. If those are needed for a project they might be better specified as live plants. Verify seed availability and seed price prior to committing it to a project.

SEED MIX CALCULATOR

FIGURE APPENDIX C.0-1 SEED MIX CALCULATOR

Botanical Name	Common Name	Bloom Period	USFWS Indicator	Seeds per Square Foot	PLS % by Composition	Seeds per Acre	Seeds per Pound	PLS Rate (lbs/ac)	PLS Rate (kg/ha)	Min. Purity	Min. Germ.	Actual Rate (lbs/ac)	Cost per Pound	Cost per Acre
Forb 1	*Forb 1*	April-August		16	7.4	696,960	2,790,000	0.25	0.28	0.95	0.85	0.31	$20.00	$6.19
Grass 1	*Grass 1*			35	16.3	1,524,600	100,000	15.25	17.08	0.95	0.85	18.88	$20.00	$377.61
Grass 2	*Grass 2*			35	16.3	1,524,600	110,000	13.86	15.52	0.95	0.85	17.16	$20.00	$343.28
Forb 2	*Forb 2*	May-Aug		2.5	1.2	108,900	200,000	0.54	0.61	0.95	0.85	0.67	$20.00	$13.49
Grass 3	*Grass 3*			52	24.2	2,265,120	450,000	5.03	5.64	0.95	0.85	6.23	$20.00	$124.67
Forb 3	*Forb 3*	May-June		0.5	0.2	21,780	23,500	0.93	1.04	0.95	0.85	1.15	$20.00	$22.96
Forb 4	*Forb 4*	april-july		14	6.5	609,840	295,000	2.07	2.32	0.95	0.85	2.56	$20.00	$51.20
Grass 4	*Grass 4*			35	16.3	1,524,600	159,000	9.59	10.74	0.95	0.85	11.87	$20.00	$237.49
Nurse Crop - sterile grain	*Nurse Crop - sterile grain*			25	11.6	1,089,000	12,000	90.75	101.64	0.95	0.85	112.38	$5.00	$561.92
Total				**215**	**100.0**			**138.27**				**171.23**		**$1,738.80**

The designer provides the number of seeds per pound and manipulates the spreadsheed by setting each seed's seeds per square foot. The seed quantity per square foot it at the designer's discretion and must account for the seed delivery method and the design function of the seeding. Seeds per square foot can vary from fewer than 50 seeds per SF for rangeland to several hundred per SF for temporary erosion control seeding.

The purity and germination rates are theoretical minimums. The final actual application rate should be based on the purity and germination rates shown on the seed certification tags provided by the supplier. This table uses the theoretical minimums to calculate an approximate **material** cost for estimating purposes.

Cost per pound is a place holder only. Verify cost and seed availability prior to submitting seed mix to project

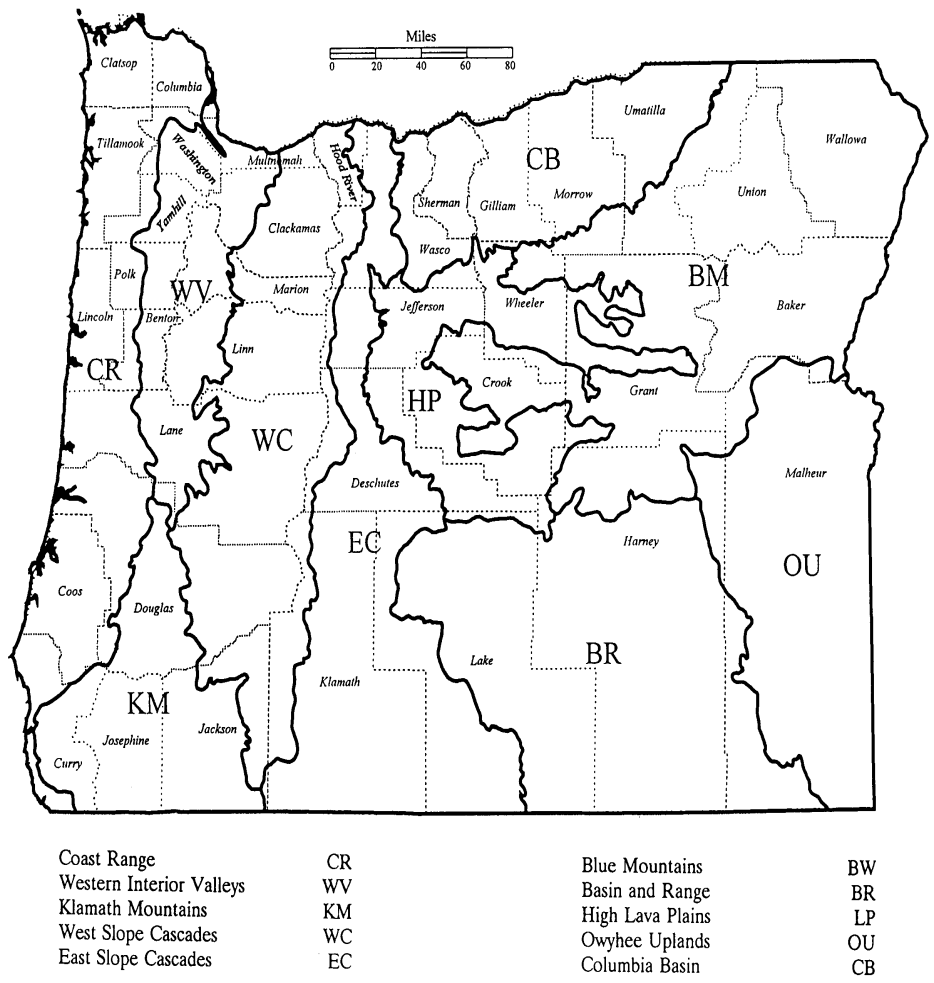
SEED MASTER

SEED TABLE WITH LINK TO PLANT INFORMATION - OREGON NATIVES

Grasses

Scientific Name	Common Name	Height	Or. Native	USFWS Indicator	Seeds per Square Foot	PLS %by Composition	Seeds per Acre	Seeds per Pound	PLS Rate (lbs/ac)	Min. Purity	Min. Germ.	Actual Rate (lbs/ac)	LINK TO WEB
Achnatherum contractum (Oryzopsis hymenoides)	contracted ricegrass	12-25"	><	FACU	1	0.7	43,560	141,000	0.309	1.00	1.00	0.31	contracted ricegrass
Achnatherum lemmonii	Lemmon's needlegrass	30"	Y	FACU	1	0.7	43,560	95,000	0.46	1.00	1.00	0.46	Lemmon's needlegrass
Achnatherum speciosum (Stipa)	desert needlegrass	12-24"	><	UPL	1	0.7	43,560	150,000	0.290	1.00	1.00	0.29	desert needlegrass
Achnatherum thurberianum	Thurber's needlegrass	12-24"	Y	FACU	1	0.7	43,560	225,000	0.19	1.00	1.00	0.19	Thurber's needlegrass
Agostis capilaris	colonial bentgrass	36"+	N	FACW	1	0.7	43,560	6,129,800	0.01	1.00	1.00	0.01	colonial bentgrass
Agrostis exarata	spike bentgrass	36"+	Y	FACW	1	0.7	43,560	3,800,000	0.01	1.00	1.00	0.01	spike bentgrass
Agrostis idahoensis	Idaho bentgrass	36"+	Y	FACW	1	0.7	43,560	4,350,000	0.0100	1.00	1.00	0.01	Idaho bentgrass
Alopecurus geniculatus	water foxtail	24-60"	N	FACW+	1	0.7	43,560	485,000	0.09	1.00	1.00	0.09	water foxtail
Andropogon gerardi	big bluestem	36"+	N (Plains)	FACU	1	0.7	43,560	130,000	0.34	1.00	1.00	0.34	big bluestem
Andropogon hallii	sand bluestem	36"+	N (mid west)	FACU	1	0.7	43,560	113,000	0.39	1.00	1.00	0.39	sand bluestem
Arctagrostis pratensis	polargrass	12-18"	Alaska	FACW	1	0.7	43,560	470,000	0.09	1.00	1.00	0.09	polargrass
Aristida purpurea	purple three-awn	1-24"	Y	OBL	1	0.7	43,560	250,000	0.17	1.00	1.00	0.17	purple three-awn
Beckmannia syzigachne	American sloughgrass	36"+	Y	OBL	1	0.7	43,560	1,150,000	0.04	1.00	1.00	0.04	American sloughgrass
Bolboschoenus robustus	sturdy bulrush	48" - 120"	><	OBL	1	0.7	43,560	550,000	0.079	1.00	1.00	0.08	sturdy bulrush
Bouteloua aristidoides	needle grama	1-12"	(Calif)	FACU	1	0.7	43,560	414,000	0.11	1.00	1.00	0.11	needle grama
Bolboschoenus fluviatilis	river bulrush	36-120"	Y	OBL	1	0.7	43,560	525,000	0.08	1.00	1.00	0.08	river bulrush
Bolboschoenus maritimus	alkali bulrush	36"+	Y	OBL	1	0.7	43,560	162,200	0.27	1.00	1.00	0.27	alkali bulrush
Bouteloua curtipendula	sideoats grama	12-25"	Y	FACU	1	0.7	43,560	191,000	0.23	1.00	1.00	0.23	sideoats grama
Bromus carinatus	California brome	13-25"+	Y	FACU	1	0.7	43,560	100,000	0.44	1.00	1.00	0.44	California brome
Bromus marginatus	mountain brome	36"+	Y	FACU	1	0.7	43,560	90,000	0.48	1.00	1.00	0.48	mountain brome
Bromus sitchensis	Sitka brome	6-18"	Y	FACU	1	0.7	43,560	125,000	0.35	1.00	1.00	0.35	Sitka brome
Bromus vulgaris	Columbia brome	12-24"	Y	FACW	1	0.7	43,560	145,000	0.30	1.00	1.00	0.30	Columbia brome
Buchloe dactyloides	Buffalograss	1-12"	N (So west)	FACU	1	0.7	43,560	56,000	0.78	1.00	1.00	0.78	Buffalograss
Calamagrostis canadensis	bluejoint reedgrass	36"	Y	FACW	1	0.7	43,560	414,000	0.11	1.00	1.00	0.11	bluejoint reedgrass
Calamagrostis rubescens	pinegrass	24-40"	Y	FAC	1	0.7	43,560	2,450,000	0.0178	1.00	1.00	0.02	pinegrass
Calamovilfa longifolia	prarie sandreed	36"+	N (Plains)	FACU	1	0.7	43,560	273,000	0.16	1.00	1.00	0.16	prarie sandreed
Carex amplifolia	big leaf sedge	20-40"	Y	FACW	1	0.7	43,560	385,000	0.11	1.00	1.00	0.11	big leaf sedge
Carex angusta	slender sedge	20-36"	Y	FACU	1	0.7	43,560	398,000	0.11	1.00	1.00	0.11	slender sedge
Carex aperta	Columbia sedge	16-28"	Y	FACW	1	0.7	43,560	345,000	0.13	1.00	1.00	0.13	Columbia sedge
Carex aquatilis	water sedge	36"+	Y	OBL	1	0.7	43,560	485,000	0.09	1.00	1.00	0.09	water sedge
Carex bebbii	Bebb's sedge	12-24"	Y	OBL	1	0.7	43,560	1,400,000	0.0311	1.00	1.00	0.03	Bebb's sedge
Carex comosa	cosmos sedge	60"	Y	OBL	1	0.7	43,560	324,000	0.1344	1.00	1.00	0.13	cosmos sedge
Carex cusickii	Cusick's sedge	16-36"	Y	OBL	1	0.7	43,560	525,000	0.0830	1.00	1.00	0.08	Cusick's sedge
Carex densa	dense-headed sedge	40"	Y	OBL	1	0.7	43,560	476,000	0.0915	1.00	1.00	0.09	dense-headed sedge
Carex deweyana	Deweys sedge	34-45"	Y	OBL	1	0.7	43,560	445,000	0.0979	1.00	1.00	0.10	Deweys sedge
Carex geyeri	elk sedge	6-14"	Y	UPL	1	0.7	43,560	91,400	0.4766	1.00	1.00	0.48	elk sedge
Carex hoodii	Hood's sedge	16-36"	Y	OBL	1	0.7	43,560	525,000	0.0830	1.00	1.00	0.08	Hood's sedge
Carex hystericina	porcupine sedge	12-18"	Y	OBL	1	0.7	43,560	385,000	0.1131	1.00	1.00	0.11	porcupine sedge
Carex lenticularis	lens sedge	16-32"	Y	OBL	1	0.7	43,560	400,000	0.1089	1.00	1.00	0.11	lens sedge

FIGURE APPENDIX C.0-2 OREGON ECOREGIONS AND COUNTIES



The lists of seed species represent seeds that are endemic to each region. Variables such as elevation, solar aspect, local hydrology or soil types or other variables make some seeds that are native to the region suitable or unsuitable for a specific site. Some seeds may not be available and some seeds may have low germination or purity which would require more of the seed than would be anticipated. Familiarity with seeds and with the cultural requirements of the plants that grow from those seeds is important in the development of a seed mix.

Develop proportions of plant mix based on relative abundance and site goals.

BLUE MOUNTAIN ECO-REGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Abies concolor	white fir	d	FOR	C	
Abies grandis	grand fir	d	FOR	C	
Acer glabrum	Rocky Mountain maple	d/w	RIP, FOR	I	erosion control
Achnatherum hymenoides	Indian rice grass	d	GR	I	
Achnatherum thurbarianum	Thurber's needle grass	d	GR, FOR	I	
Alnus sinuata	Sitka alder	w	RIP	C	
Amelanchier alnifolia	serviceberry	d	RIP	I	
Bromus carinatus	California brome, native b.	d	GR	D	
Calamagrostis rubescens	pinegrass	d	GR, RIP	I	
Carex geyeri	Geyer's sedge	d	SW, RIP	I	
Carex utriculata	northwest territory sedge	w	GR, FOR	I	
Castilleja chromosa	desert paintbrush	d	RIP	D	
Cornus sericea	red osier dogwood	w	RIP	I	erosion control
Crataegus douglasii	Douglas' hawthorn	w	GR, RIP	I	
Deschampsia caespitosa ssp. *caespitosa*	tufted hair grass	w	GR	C	
Elymus elymoides	squirrel tail	d	GR	I	forest understory
Elymus glaucus	blue wild rye	d	SW, FOR	I	
Elymus lanceolatus	streambank wheatgrass	w	RIP, SW	I	
Elymus lanceolatus	streambank wheatgrass	w	RIP, SW	I	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Eriogonum umbellatum	sulfur-flowered buckwheat	u	GR	I	
Eriophyllum lanatum	woolly sunflower	u	GR	D	
Festuca idahoensis	Idaho fescue	d	GR, SW	I	
Festuca rubra ssp. *rubra*	native red fescue	d/w	SW	C	
Glyceria striata	fowl manna grass	w	GR, SW	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)					
*** D = Dominant, C = Common, I = infrequent or specialty*					
*** FOR = forest (upland). GR = grassland, RIP = riparian, SW = swale*					

Blue Mountain Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Koeleria macrantha	prairie junegrass	d	GR	I	
Lomatium dissectum	fern leaf biscuitroot	d	GR	I	
Lomatium triternatum	nine leaf biscuitroot	d	GR	I	
Lupinus sericeus	silky lupine	d	GR, RIP	I	
Lymus cinereus	basin wild rye	w	SW	I	
Mahonia repens	creeping Oregon grape	d	SW	C	deer resistant, erosion control
Mimulus guttatus	seep monkeyflower	w	RIP	I	
Physocarpus malvaceus	mallow ninebark	w/d	GR, FOR	C	
Pinus contorta	lodge pole pine	d	FOR	C	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	GR	C	
Populus tremuloides	quaking aspen	w	RIP, SW	C	
Potentilla gracillis	slender cinquefoil	w	SW	I	
Prunus emarginata	bitter cherry	d	FOR, RIP	C	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Prunus virginiana	western chokecherry	d/w	FOR	D	
Pseudoregneria spicatum	bluebunch wheatgrass	d	GR	I	
Pseudotsuga menziesii	Douglas-fir	d	FOR	C	
Ribes cereum	squaw current	d	RIP, FOR	I	
Salix amygdaloides	peach-leaf willow	w	RIP	D	erosion control
Salix lasiandra	Pacific willow	w	RIP	I	erosion control
Salix sessifolia	soft-leaved willow	w	SW, RIP	C	erosion control
Spirea betulifolia	birch leaf spirea	w	FOR, RIP	C	
Symphoricarpos albus	common snowberry	d	GR, FOR	I	erosion control
Trifolium macrocephalum	big-head clover	d	SW	I	
Trifolium microcephalum	small-head clover	d/w	GR, SW	I	
Vacinnium membranaceum	big huckleberry	d	FOR, RIP	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
** *D = Dominant, C = Common, I = infrequent or specialty*
** *FOR = forest (upland). GR = grassland, RIP = riparian, SW = swale*

BASIN & RANGE ECOREGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Acer glabrum	Rocky Mountain maple	d/w	RIP, FOR	I	erosion control
Achnatherum hymenoides	Indian ricegrass	d	GR, SS	I	
Achnatherum lemmonii	Lemmon's needle grass	d	GR	I	
Achnatherum lettermanii	Letterman's needle grass	d	GR	I	
Achnatherum thurbarianum	Thurber's needle grass	d	GR, SS	D	
Alnus incana	mountain alder	w	RIP	C	
Amelanchier alnifolia	serviceberry	d	RIP	I	
Artemisia ludovicina	prairie sage	d	SS	I	
Artemisia tridentata ssp. tridentata	Basin big sagebrush	d	SS	D	
Atriplex canescens	fourwing saltbush	d	SS	I	alkaline soils
Atriplext confertifolia	shadscale	d	SS	I	alkaline soils
Balsamorhiza sagittata	arrowleaf balsamroot	d	SS	C	
Bromus carinatus	California brome, native.	d	GR	I	
Bromus marginatus	mountain brome	d	GR, SS	I	
Camassia quamash	camas	w	GR, SW	I	
Carex amplifolia	bigleaf or dagger-leaf sedge	w	SW	C	deer resistant
Carex geyeri	Geyer's sedge	d	GR, SS	I	deer resistant

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)					
** *D = Dominant, C = Common, I = infrequent or specialty*					
** *GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*					

Basin & Range Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Carex hoodii	Hood's sedge	w	SW	I	
Carex nebrascensis	Nebraska sedge	w	SW, SS	D	alkaline wetlands
Carex obnupta	slough sedge	w	SW	C	erosion control
Cornus sericea	red osier dogwood	w	RIP	D	erosion control
Danthonia intermedia	timber oatgrass	d/w	GR, FOR	I	
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	w	GR, SW, RIP	I	
Distichlis spicata	Inland saltgrass	w	SW	I	alkaline wetlands
Elymus elymoides	squirreltail	d	GR, SS	D	
Elymus trachycaulis ssp. *trachycaulis*	slender wild rye	d/w	RIP, SW	I	
Erigeron linearis	desert yellow daisy, d. y. fleabane	d	SS	I	
Eriogonum umbellatum	sulfur-flowered buckwheat	u	SS	I	
Eriophyllum lanatum	woolly sunflower	u	SS	I	
Festuca idahoensis	Idaho fescue	d	GR, SS	D	
Hordeum brachyantherum	meadow barley	w	SW	I	
Juncus balticus	Baltic rush	w	SW	C	
Juncus ensifolius	dagger-leaf rush	w	SW	C	
Juniperus occidentalis	western juniper	d	SS, FOR	C	
Koeleria macrantha	prairie junegrass	d	GR, SS	I	
Krascheninnokivia lanata	winterfat	d	SS	I	alkaline soils
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)					

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
*** D = Dominant, C = Common, I = infrequent or specialty*					
*** GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*					

Basin & Range Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance **	Notes
Lomatium triternatum	nineleaf biscuitroot	d	GR, SS	I	
Lupinus sericeus	silky lupine	d	GR, SS	I	
Lymus cinereus	basin wild rye	w	GR, RIP	C	
Penstemon speciosus	showy penstemon	d	SS	I	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	GR, SS	C	
Populus tremuloides	quaking aspen	w	RIP, SW	C	
Prunus emarginata	bitter cherry	d	FOR, RIP	C	
Prunus virginiana	western chokecherry	d/w	SS, RIP	C	
Pseudoregneria spicatum	bluebunch wheatgrass	d	GR, SS	D	alkaline wetlands
Rosa nutkana	Nootka rose	w/d	RIP, SW	C	
Salix amygdaloides	peach-leaf willow	w	RIP	C	erosion control
Salix lasiandra	Pacific willow	w	RIP		erosion control
Scirpus microcarpus	Small fruited bulrush	w	SW	C	
Sporobolus airoides	alkali Sacaton	d/w	GR, SW	I	alkaline soils
Symphoricarpos albus	common snowberry	d	SS, RIP	C	erosion control
Trifolium macrocephalum	big-head clover	d	GR	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
** *D = Dominant, C = Common, I = infrequent or specialty*
** *GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*

COLUMBIA PLATEAU ECOREGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Achnatherum hymenoides	Indian ricegrass	d	GR	I	
Achnatherum thurbarianum	Thurber's needlegrass	d	GR, SS	C	
Alnus rubra	red alder	w	RIP	C	
Alnus sinuata	Sitka alder	w	RIP	C	
Amelanchier alnifolia	serviceberry	d	RIP	I	
Artemisia tridentata	big sagebrush	d	SS	D	
Balsamorhiza sagittata	arrowleaf balsamroot	d	SS	C	
Bromus carinatus	California brome, native b.	d	GR	I	
Bromus marginatus	mountain brome	d	GR, SS	I	
Camassia quamash	camas	w	GR, SW	I	
Carex geyeri	Geyer's sedge	d	GR, SS	I	deer resistant
Carex utriculata	northwest territory sedge	w	SW, RIP	I	
Castilleja chromosa	desert paintbrush	d	GR, SS	I	
Cornus sericea	red osier dogwood	w	RIP	D	erosion control
Crataegus douglasii	Douglas' hawthorn	w	RIP	I	
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	w	GR, SW, RIP	I	
Distichlis spicata	Inland saltgrass	w	SW	I	alkaline wetlands
Elymus elymoides	squirreltail	d	GR, SS	C	
Elymus trachycaulis ssp. *trachycaulis*	slender wild rye	d/w	RIP, SW	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes

*** GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*

Columbia Plateau Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Erigeron linearis	desert yellow daisy, d. y. fleabane	d	SS	I	
Eriogonum umbellatum	sulfur-flowered buckwheat	u	SS	I	
Eriophyllum lanatum	woolly sunflower	u	SS	I	
Festuca idahoensis	Idaho fescue	d	GR, SS	D	
Festuca rubra ssp. *rubra*	native red fescue	d/w	GR, SW	I	
Koeleria macrantha	prairie junegrass	d	GR, SS	I	
Linum lewisii	Lewis flax	d	GR, SS	I	
Lomatium dissectum	fernleaf biscuitroot	d	GR, SS	I	
Lomatium triternatum	nineleaf biscuitroot	d	GR, SS	I	
Lupinus sericeus	silky lupine	d	GR, SS	I	
Lymus cinereus	basin wild rye	w	GR, RIP	I	
Mahonia repens	creeping Oregon grape	d	SS	I	deer resistant, erosion control
Mimulus guttatus	seep monkeyflower	w	SW	C	
Penstemon deustus	hot-rock penstemon	d	SS	I	
Physocarpus capitatus	Pacific ninebark	d/w	RIP	C	
Pinus ponderosa	Ponderosa pine	d	RIP	I	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	GR, SS	C	
Populus balsamifera ssp. trichocarpa	black cottonwood	d/w	RIP, SW	C	
Potentilla gracillis	slender cinquefoil	w	SW	C	
Prunus virginiana	western chokecherry	d/w	SS, RIP	C	
Pseudoregneria spicatum	bluebunch wheatgrass	d	GR, SS	D	
Puccinellia distans	Alkali grass	w	GR, SW	C	alkaline wetlands
Salix amygdaloides	peach-leaf willow	w	RIP	C	erosion control

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
*** D = Dominant, C = Common, I = infrequent or specialty*					
*** GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*					

Columbia Plateau Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Salix lasiandra	Pacific willow	w	RIP	D	erosion control
Salix sessifolia	soft-leaved willow	w	RIP	I	erosion control
Sphaeralcea grossulariifolia	gooseberry-leaved globemallow	d	GR, SS	I	
Sporobolus airoides	alkali Sacaton	d/w	GR, SW	I	alkaline wetlands
Symphoricarpos albus	common snowberry	d	SS, RIP	C	erosion control
Trifolium macrocephalum	big-head clover	d	GR	I	
Trifolium microcephalum	small-head clover	d/w	SW	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
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*** GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*

COAST RANGE ECOREGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Abronia latifolia	coastal sand verbena	d	GR, SC	I	sandy soil
Acer circinatum	vine maple	d	FOR	C	
Acer glabrum	Rocky Mountain maple	d	FOR, RIP	C	
Acer macrophyllum	big leaf maple	d/w	FOR, RIP	C	caution, deer forage
Actea rubra	baneberry	d/w	RIP, FOR	I	caution, deer browse
Agrostis exarata	spikegrass	d/w	GR, SW	C	
Alnus incana	thinleaf alder	w	RIP	C	
Alnus rubra	red alder	d/w	RIP	C	
Ambrosia chamissonis	silver bur ragweed	d	GR, SC	I	sandy soil
Amelanchier alnifolia	serviceberry	d	RIP	I	caution, deer browse
Anaphalis margaritacea	western pearly everlasting	d	GR	I	
Aquileja formosa	red columbine	d	FOR	I	
Arbutus menziesii	madrone	d	FOR	I	
Arctostaphylos nevadensis	pinemat manzanita	d	FOR, SC	C	
Arctostaphylos patula	greenleaf manzanita	d	FOR, SC	C	
Arctostaphylos uva-ursi	kinnikinnick	d	FOR	C	
Artemisia douglasiana	Douglas' sagebrush	d	SC	D	deer resistant
Asclepias fascicularis	Mexican milkweed	d	FOR, SC	I	deer resistant
Asclepias speciosa	showy milkweed	w	SW	I	sandy soil
Baccharis pilularis	coyote brush	d	SC	I	caution, deer forage, sandy soil

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Balsamorhiza deltoidea	deltoid balsamroot	d	GR, SC	C	
Beckmannia syzigachne	sloughgrass	w	SW	C	
Bromus carinatus	California brome, native b.	d	GR, SC	D	
Bromus sitchensis	Sitka brome	d	GR, FOR	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*					

Coast Range Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Bromus vulgaris	Columbia brome	d/w	GR, SW	C	
Camassia leichtlinii	great camas	w	GR, SW	I	
Camassia quamash	camas	w	GR, SW	I	
Camissonia cheiranthifolia	beach suncup	d	GR, SC	I	sandy soil
Carex amplifolia	bigleaf sedge	w	SW	I	deer resistant
Carex densa	dense sedge	w	SW	I	
Carex lyngbyei	Lyngbye's sedge	w	SW	C	
Carex obnupta	slough sedge	w	SW	C	erosion control
Ceanothus cuneatus	buckbrush	d	SC	C	
Ceanothus integerrimus	deerbrush	d	SC	C	
Clarkia amoena	farewell to spring	d	GR, SC	I	
Clarkia purpurea	winecup clarkia	d	GR, SC	I	
Collomia grandiflora	Grand collomia	d	GR	I	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Cornus nuttallii	Pacific dogwood	d	FOR, RIP	I	
Cornus sericea	red osier dogwood	w	RIP	D	erosion control
Danthonia californica	California oatgrass	d/w	GR	I	
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	d/w	GR, SW	C	
Distichlis spicata	Inland saltgrass	w	SW	I	sandy, tidal soil
Elymus glaucus	blue wild rye	d	SW, FOR	D	
Eriogonum compositum	arrowleaf buckwheat	d	GR, SC		
Eriogonum umbellatum	sulfur-flowered buckwheat	u	SS	I	
Festuca californica	California fescue	d/w	GR	I	
Festuca occidentalis	western fescue	d	GR	I	caution, deer forage
Festuca roemeri	Romer's fescue	d	GR	I	
Festuca rubra ssp. *arenaria* or *commutata*	coastal native red fescue	d/w	SW	C	caution, deer browse
Fraxinus latifolia	Oregon ash	w	RIP, SW	D	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*
*** GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*

Coast Range Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Gaultheria shallon	salal	d	FOR	C	erosion control, shade

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Glyceria occidentalis	western mannagrass	w	RIP, SW	D	
Grindelia integrifolia	Puget Sound gumweed	w/d	SW, SC	I	sandy, tidal soil
Holodiscus discolor	ocean spray	d	RIP, FOR	C	
Hordeum brachyantherum	meadow barley	w	GR, SW	I	
Koeleria macrantha	prairie junegrass	d	GR	I	
Iris tenax	Oregon iris	d	GR, FOR	I	
Juncus tenuis	poverty rush	w	SW	C	
Koeleria macrantha	prairie junegrass	d	GR, SS	I	
Lomatium dissectum	fernleaf biscuitroot	d	GR	I	
Lomatium nudicaule	barestem biscuitroot	d	GR	I	
Lomatium triternatum	nineleaf biscuitroot	d	GR, SC	I	
Lonicera involucrata	twinberry honeysuckle	d	SC, RIP	C	
Lupinus albicaulis	sickle-leaved lupine	d	GR, SC	I	
Mahonia aquifolium	tall Oregon grape, holly-leaved barberry	d	FOR	C	deer resistant, erosion control
Mimulus guttatus	yellow monkeyflower	w	SW	I	
Oenanthe sarmentosa	water-parsley	w	SW	I	
Penstemon deustus	hot-rock penstemon	d	SS	I	
Picea sitchensis	Sitka spruce	d/w	FOR, RIP	I	
Pinus contorta	Lodgepole pine	d	FOR	C	
Pinus ponderosa	Ponderosa pine	d	FOR, RIP	I	
Plectritis congesta	rosy plectritis	d	GR	I	
Polygonum lapathifolium	curly top knotweed	w	SW	C	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*
*** GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*

Coast Range Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Polygonum punctatum	punctate knotweed	w	SW	I	
Polystichum munitum	sword fern	d	FOR	I	
Potentilla glandulosa	sticky cinquefoil	w	SW	I	
Prunus virginiana	western chokecherry	d/w	FOR, SC	D	
Pseudotsuga menziesii	Douglas-fir	d	FOR	D	
Quercus garryana	Oregon white oak	d	FOR	C	
Rosa nutkana	Nootka rose	w/d	RIP, FOR	C	
Rosa pisocarpa	clustered wild rose	w/d	RIP, FOR	C	
Rubus parviflorus	thimbleberry	w/d	RIP, FOR	I	
Rubus spectabilis	salmonberry	w/d	RIP, FOR	D	
Rubus ursinus	Pacific blackberry	d	FOR	C	
Sagittaria latifolia	broadleaf arrowhead	w	GR, SW	C	sandy, tidal soil
Sambucus racemosa	red elderberry	w/d	RIP, FOR	C	
Salix hookeriana	Hooker willow	w	RIP	C	sandy, tidal soil
Salix lucida ssp lasiandra	Pacific willow	w	RIP	D	erosion control
Salix scouleriana	Scouler's willow	w	RIP	I	erosion control
Salix sitchensis	Sitka willow	w	RIP	I	erosion control
Scirpus cyperinus	woolgrass	w	SW	I	
Scirpus microcarpus	Small fruited bulrush	w	SW	C	
Sidalcea cusickii	Cusick's checkermallow	d	GR	I	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Sidalcea campestris	meadow checkermallow	d	GR	I	
Spirea douglasii	Douglas' spirea	w	RIP, SW	D	
Symphoricarpos mollis	creeping snowberry	d	GR, SC	C	erosion control
Thuja plicata	western red cedar	d	RIP, FOR	C	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale*					

Coast Range Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Trifolium microcephalum	small-head clover	d/w	SW	I	
Typha latifolia	broadleaf cattail	w	SW	I	
Umbellularia californica	California bay laurel	d	FOR, SC	I	
Vaccinium membranaceum	thinleaf huckleberry	w	RIP, SW	C	
Vaccinium parvifolium	red huckleberry	d	FOR	D	
Vancouveria hexandra	vancouveria	d	FOR	I	erosion control, shade
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *FOR = forest (upland). GR = grassland, RIP = riparian, SC = scrub, SW = swale*					

KLAMATH MOUNTAINS ECOREGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Acer glabrum	Rocky Mountain maple	d	FOR, RIP	C	erosion control
Acer macrophyllum	big leaf maple	d/w	FOR, RIP	C	
Achnatherum lemmonii	Lemmon's needlegrass	d	GR	I	caution, deer forage
Actea rubra	baneberry	d/w	RIP, FOR	I	
Alnus incana	mountain alder	w	RIP	C	caution, deer browse
Alnus rubra	red alder	d/w	RIP	C	
Anaphalis margaritacea	western pearly everlasting	d	GR	C	
Aquileja formosa	red columbine	d	FOR	I	
Arbutus menziesii	madrone	d	FOR	I	
Arctostaphylos nevadensis	pinemat manzanita	d	FOR, SC	C	
Arctostaphylos patula	greenleaf manzanita	d	FOR, SC	C	
Arctostaphylos uva-ursi	kinnikinnick	d	FOR	C	
Artemisia douglasiana	Douglas' sagebrush	d	SC	D	
Asclepias fascicularis	Mexican milkweed	d	FOR, SC	I	deer resistant
Asclepias speciosa	showy milkweed	w	SW	I	deer resistant
Baccharis pilularis	coyote brush	d	SC	I	sandy soil
Balsamorhiza deltoidea	deltoid balsamroot	d	GR, SC	C	caution, deer forage
Beckmannia syzigachne	sloughgrass	w	SW	C	
Bromus carinatus	California brome, native b.	d	GR	D	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Bromus vulgaris	Columbia brome	d/w	GR, SW	I	
Calamagrostis rubescens	pinegrass	d	FOR	I	
Calocedrus decurrens	incense-cedar	d	FOR	I	
Camassia leichtlinii	great camas	w	GR, SW	I	
Camassia quamash	camas	w	GR, SW	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *GR = grassland, RIP = riparian, SC = scrub, SW = swale, FOR = forest*					

Klamath Mountains Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Camissonia cheiranthifolia	beach suncup	d	GR, SC	I	sandy soil
Carex amplifolia	bigleaf sedge	w	SW	I	deer resistant
Carex densa	dense sedge	w	SW	C	
Carex lyngbyei	Lyngbye's sedge	w	SW	C	
Carex stipata	owlfruit sedge	w	SW	I	
Castilleja angustifolia	northwestern paintbrush	d	GR, SC	I	
Ceanothus cuneatus	buckbrush	d	SC	C	
Ceanothus integerrimus	deerbrush	d	SC	C	
Clarkia amoena	farewell to spring	d	GR, SC	I	
Clarkia purpurea	winecup clarkia	d	GR, SC	I	
Collomia grandiflora	Grand collomia	d	GR	I	
Cornus nuttallii	Pacific dogwood	d	FOR, RIP	I	
Cornus sericea	red osier dogwood	w	RIP	D	erosion control

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Danthonia californica	California oatgrass	d/w	GR	D	
Deschampsia elongata	slender hairgrass	w	GR, SW, RIP	I	
Elymus elymoides	squirreltail	d	GR	D	
Elymus glaucus	blue wild rye	d	SW, FOR	C	
Elymus trachycaulis ssp. *trachycaulis*	slender wild rye	d/w	RIP, SW	C	
Eriogonum compositum	arrowleaf buckwheat	d	GR, SC		
Eriogonum umbellatum	sulfur-flowered buckwheat	u	SS	I	
Festuca californica	California fescue	d/w	GR	C	
Festuca idahoensis	Idaho fescue	d	GR, SC	C	
Festuca occidentalis	western fescue	d	GR	C	
Festuca roemeri	Romer's fescue	d	GR	I	
Festuca rubra ssp. *rubra*	native red fescue	d/w	SW	I	
Fraxinus latifolia	Oregon ash	w	RIP, SW	D	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*
*** GR = grassland, RIP = riparian, SC = scrub, SW = swale, FOR = forest*

Klamath Mountains Ecoregion

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Glyceria occidentalis	western mannagrass	w	RIP, SW	C	
Holodiscus discolor	ocean spray	d	RIP, FOR	C	
Hordeum brachyantherum	meadow barley	w	GR, SW	I	
Iris tenax	Oregon iris	d	GR, FOR	I	
Juncus tenuis	poverty rush	w	SW	C	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Koeleria macrantha	prairie junegrass	d	GR, SS	I	alkaline wetlands
Lomatium dissectum	fernleaf biscuitroot	d	GR	I	
Lomatium nudicaule	barestem biscuitroot	d	GR	I	
Lomatium triternatum	nineleaf biscuitroot	d	GR, SC	I	alkaline soils
Lupinus albicaulis	sickle-leaved lupine	d	GR, SC	I	
Lupinus albifrons	silver lupine	d	GR, SC	I	
Mimulus guttatus	yellow monkeyflower	w	SW	I	
Oenanthe sarmentosa	water-parsley	w	SW	I	
Penstemon deustus	hot-rock penstemon	d	SS	I	
Penstemon speciosus	showy penstemon	d	SS	I	
Philadelphis lewisii	Lewis' mock orange	d	RIP	I	
Pinus contorta	Lodgepole pine	d	FOR	C	
Pinus ponderosa	Ponderosa pine	d	FOR, RIP	I	
Plectritis congesta	rosy plectritis	d	GR	I	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	FOR, RIP	D	
Polygonum lapathifolium	curly top knotweed	w	SW	C	
Polystichum imbricans	narrowleaf sword fern	d	FOR	I	erosion control, shade
Potentilla glandulosa	sticky cinquefoil	w	SW	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*
*** GR = grassland, RIP = riparian, SC = scrub, SW = swale, FOR = forest*

Klamath Mountains Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Prunus virginiana	western chokecherry	d/w	FOR, SC	D	
Pseudoregneria spicatum	bluebunch wheatgrass	d	RIP	C	
Pseudotsuga menziesii	Douglas-fir	d	FOR	D	
Quercus garryana	Oregon white oak	d	FOR	C	
Rosa nutkana	Nootka rose	w/d	RIP, FOR	C	
Rosa pisocarpa	clustered wild rose	w/d	RIP, FOR	C	
Rubus parviflorus	thimbleberry	w/d	RIP, FOR	C	
Rubus spectabilis	salmonberry	w/d	RIP, FOR	C	
Sambucus racemosa	red elderberry	w/d	RIP, FOR	C	
Salix lasiolepis	arroyo willow	w	RIP	I	erosion control
Salix lucida ssp lasiandra	Pacific willow	w	RIP	D	erosion control
Salix scouleriana	Scouler's willow	w	RIP	I	erosion control
Salix sitchensis	Sitka willow	w	RIP	I	erosion control
Scirpus microcarpus	Small fruited bulrush	w	SW	C	
Spirea douglasii	Douglas' spirea	w	RIP, SW	D	
Symphoricarpos mollis	creeping snowberry	d	GR, SC	C	erosion control

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Trifolium macrocephalum	big-head clover	d			
Trifolium microcephalum	small-head clover	d/w	SW	I	
Umbellularia californica	California bay laurel	d	FOR, SC	I	
Vaccinium membranaceum	thinleaf huckleberry	w	RIP, SW	C	
Vaccinium parvifolium	red huckleberry	d	FOR	D	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *GR = grassland, RIP = riparian, SC = scrub, SW = swale, FOR = forest*					

EAST CASCADES ECOREGION – ALL PLANT TYPES

Species Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Achnatherum lemmonii	Lemmon's needlegrass	d	GR	I	
Alnus incana	mountain alder	w	RIP	C	
Artemisia tridentata	big sagebrush	d	SS	D	
Balsamorhiza sagittata	arrowleaf balsamroot	d	SS	C	
Bromus carinatus	California brome, native b.	d	GR	D	
Camassia quamash	camas	w	GR, SW	I	
Cornus sericea	red osier dogwood	w	RIP	D	erosion control
Danthonia californica	California oatgrass	d/w	GR	D	
Deschampsia elongata	slender hairgrass	w	GR, SW, RIP	I	
Distichlis spicata	Inland saltgrass	w	SW	I	alkaline wetlands
Elymus elymoides	squirreltail	d	GR, SS	D	
Elymus glaucus	blue wild rye	d	SW, FOR	C	
Elymus trachycaulis ssp. *trachycaulis*	slender wild rye	d/w	RIP, SW	C	
Eriogonum umbellatum	sulfur-flowered buckwheat	u	SS	I	
Festuca californica	California fescue	d/w	GR	C	
Festuca idahoensis	Idaho fescue	d	GR, SS	D	
Festuca occidentalis	western fescue	d	GR	C	
Festuca roemeri	Romer's fescue	d	GR	I	
Hordeum brachyantherum	meadow barley	w	SW	I	
Koeleria macrantha	prairie junegrass	d	GR, SS	C	

Species Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Linum lewisii	Lewis flax	d	GR, SS	I	
Lomatium triternatum	nineleaf biscuitroot	d	GR, SS	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale* *** many natives are forage for wildlife; consider roadkill potential before attracting wildlife close to a highway.					

East Cascades Ecoregion – All Plant Types

Species Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Lupinus sericeus	silky lupine	d	GR, SS	I	
Lymus cinereus	basin wild rye	w	GR, RIP	C	
Philadelphis lewisii	Lewis' mock orange	d	SS	I	
Pinus ponderosa	Ponderosa pine	d	FOR, RIP	I	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	GR, SS	C	
Prunus emarginata	bitter cherry	d	FOR, RIP	C	
Prunus virginiana	western chokecherry	d/w	SS, RIP	C	alkaline wetlands
Pseudoregneria spicatum	bluebunch wheatgrass	d	GR, SS	D	
Salix exigua	sandbar willow	w	RIP	C	erosion control
Salix lasiandra	Pacific willow	w	RIP	C	erosion control
Trifolium macrocephalum	big-head clover	d	GR	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *GR = grassland, RIP = riparian, SS = sagebrush scrub, SW = swale* *** many natives are forage for wildlife; consider roadkill potential before attracting wildlife close to a highway.					

WEST CASCADES ECOREGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Acer circinatum	vine maple	d	FOR	C	erosion control
Acer macrophyllum	bigleaf maple	d/w	RIP, FOR	D	
Alnus rubra	red alder	w	RIP	C	
Anaphalis margaritacea	western pearly everlasting	d	GR	C	
Aquileja formosa	red columbine	d	FOR	I	
Arctostaphylos uva-ursi	kinnikinnick	d	FOR	C	
Bromus carinatus	California brome, native b.	d	GR, FOR	D	
Bromus sitchensis	Alaska brome	d	GR, FOR	I	
Bromus vulgaris	Columbia brome	d/w	GR, SW	C	
Calamagrostis rubescens	pinegrass	d	FOR	I	
Carex utriculata	Northwest Territory sedge	w	SW	C	deer resistant
Castilleja miniata	scarlet paintbrush	d	FOR, GR	I	
Collomia grandiflora	Grand collomia	d	GR	I	
Cornus stolonifera	red osier dogwood	w	RIP	D	erosion control
Danthonia californica	California oatgrass	d/w	GR	I	
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	d/w	GR, SW	I	
Deschampsia elongata	slender hairgrass	w	GR, SW, RIP	C	
Elymus elymoides	squirreltail	d	GR	I	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Elymus glaucus ssp. glaucus	blue wild rye	d	RIP, FOR	D	
Festuca californica	California fescue	d/w	GR	I	
Festuca occidentalis	western fescue	d	GR	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *FOR = forest (upland), GR = grassland, RIP = riparian, SW = swale*					

West Cascades Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Festuca roemeri	Romer's fescue	d	GR	I	
Festuca rubra ssp. *rubra*	native red fescue	d/w	GR	C	
Fragaria vesca	woods strawberry	d	FOR, GR	I	
Fraxinus latifolia	Oregon ash	w	RIP, SW	D	
Gaultheria shallon	salal	d	FOR	C	erosion control, shade
Geum macrophyllum	large-leaved avens	d	FOR	I	
Glyceria striata	fowl mannagrass	w	RIP, SW	C	
Holodiscus discolor	ocean spray	d	RIP, FOR	C	
Hordeum brachyantherum	meadow barley	w	SW	I	
Juncus effusus	common rush	w	SW	D	
Linnea borealis	twinflower	d	FOR	I	
Lupinus latifolius	bigleaf lupine	d	GR	I	
Mahonia aquifolium	tall Oregon grape, holly-leaved barberry	d	FOR	C	deer resistant, erosion control

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Maianthemum dilitatum	false lily-of-the-valley	d	FOR	I	
Mimulus guttatus	yellow monkeyflower	w	SW	I	
Oenanthe sarmentosa	water-parsley	w	SW	I	
Physocarpus capitatus	Pacific ninebark	d	RIP, FOR	C	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	GR	I	
Polystichum munitum	sword fern	d	FOR	I	erosion control, shade
Potentilla gracillis	slender cinquefoil	w	SW	I	
Prunella vulgaris lanceolata	lance selfheal	d	GR, FOR	I	
Pseudotsuga menziesii	Douglas-fir	d	FOR	D	
Pteridium aquilinum	bracken	d/w	RIP, FOR	I	
Quercus garryana	Oregon white oak	d	FOR	C	

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*** D = Dominant, C = Common, I = infrequent or specialty*
*** FOR = forest (upland), GR = grassland, RIP = riparian, SW = swale*

West Cascades Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Ranunculus occidentalis	western buttercup	w	SW	D	
Rosa nutkana	Nootka rose	w/d	RIP, FOR	C	
Rosa pisocarpa	clustered wild rose	w/d	RIP, FOR	C	
Rubus parviflorus	thimbleberry	w/d	RIP, FOR	C	
Rubus spectabilis	salmonberry	w/d	RIP, FOR	C	
Rubus ursinus	Pacific blackberry	d	FOR	C	
Salix lasiandra	Pacific willow	w	RIP	D	erosion control
Salix scouleriana	Scouler's willow	w	RIP	C	erosion control
Salix sitchensis	Sitka willow	w	RIP	C	erosion control
Sambucus cerulea	blue elderberry	w/d	RIP, FOR	C	
Senecio triangularis	arrowleaf ragwort	w	SW	I	
Solidago canadensis	Canada goldenrod	w	SW	I	
Sorbus sitchensis	western mountain-ash	d/w	RIP, FOR	C	
Spirea douglasii	Douglas' spirea	w	RIP, SW	D	
Symphoricarpos albus	snowberry	d	FOR, GR	C	erosion control
Thuja plicata	western red cedar	d	RIP, FOR	C	
Vaccinium parvifolium	red huckleberry	d	FOR	D	
Vaccinium membranaceum	thinleaf huckleberry	w	RIP, SW	C	
Vancouveria hexandra	vancouveria	d	FOR	I	erosion control, shade
Viola sempervirens	evergreen violet	d	FOR	I	
Xerophyllum tenax	common beargrass	d/w	FOR	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
*** FOR = forest (upland), GR = grassland, RIP = riparian, SW = swale*					

WILLAMETTE VALLEY ECOREGION – ALL PLANT TYPES

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Acer circinatum	vine maple	d	FOR	C	
Acer macrophyllum	bigleaf maple	d/w	RIP, FOR	D	
Achillea millefolium	yarrow	d	GR	I	deer resistant
Achnatherum lemmonii	Lemmon's needlegrass	d	GR	I	
Agrostis exarata	spikegrass	d/w	GR, SW	I	
Alnus rubra	red alder	w	RIP	C	
Aquileja formosa	red columbine	d	FOR	I	
Asclepias speciosa	showy milkweed	w	SW	I	deer resistant
Beckmannia syzigachne	sloughgrass	w	SW, RIP	C	erosion control
Bromus carinatus	California brome, native b.	d	GR, FOR	D	
Bromus sitchensis	Alaska brome	d	FOR	C	
Bromus vulgaris	Columbia brome	d/w	GR, FOR	D	
Camassia leichtlinii	great camas	w	GR, SW	I	
Camassia quamash	blue camas	w	GR, SW	I	
Carex densa	dense sedge	w	SW	C	
Carex obnupta	slough sedge	w	SW	C	erosion control
Carex unilateralis	lateral sedge	w	SW	I	
Collomia grandiflora	Grand collomia	d	GR	I	
Cornus stolonifera	red osier dogwood	w	RIP	D	erosion control
Crataegus douglasii	Douglas' hawthorn	w/d	RIP, FOR	C	
Danthonia californica	California oatgrass	d/w	GR	D	

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	d/w	GR, SW	C	
Deschampsia elongata	slender hairgrass	w	GR, SW, RIP	I	
* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU) ** *D = Dominant, C = Common, I = infrequent or specialty* ** *FOR = forest (upland). GR = grassland, RIP = riparian, SW = swale*					

Willamette Valley Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Elymus glaucus ssp. glaucus	blue wildrye	d	RIP, FOR	D	
Eriophyllum lanatum	wooly sunflower	d	GR	C	
Festuca californica	California fescue	d/w	GR	I	
Festuca occidentalis	western fescue	d	GR	I	
Festuca roemeri	Romer's fescue	d	GR	D	
Fraxinus latifolia	Oregon ash	w	RIP, SW	D	
Glyceria striata	fowl mannagrass	w	RIP, SW	C	
Holodiscus discolor	ocean spray	d	RIP, FOR	C	
Hordeum brachyantherum	meadow barley	w	SW	I	
Iris tenax	Oregon iris	d	GR, FOR	I	
Iris tenax	Oregon iris	w/d	GR, SW	I	
Juncus tenuis	poverty rush	w	SW	C	
Koeleria macrantha	prairie junegrass	d	GR	I	
Lomatium dissectum	fernleaf biscuitroot	d	GR	I	
Lomatium nudicaule	barestem biscuitroot	d	GR	I	
Lupinus polyphylus	bigleaf lupine	d/w	GR	I	
Mahonia aquifolium	tall Oregon grape, holly-leaved barberry	d	FOR	C	deer resistant, erosion control
Mimulus guttatus	yellow monkeyflower	w	SW	I	
Physocarpus capitatus	Pacific ninebark	d	RIP, FOR	C	
Plectritis congesta	rosy plectritis	d	GR	I	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	GR	I	
Polystichum munitum	sword fern	d	FOR	I	erosion control, shade

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Potentilla gracillis	slender cinquefoil	w	SW	I	
Pseudotsuga menziesii	Douglas-fir	d	FOR	D	
Quercus garryana	Oregon white oak	d	FOR	C	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
** *D = Dominant, C = Common, I = infrequent or specialty*
** *FOR = forest (upland). GR = grassland, RIP = riparian, SW = swale*

Willamette Valley Ecoregion – All Plant Types

Species (Sci Name)	Species (Common Name)	Habit	Habitat	Relative Abundance**	Notes
Ranunculus occidentalis	western buttercup	w	SW	D	
Rosa nutkana	Nootka rose	w/d	RIP, FOR	C	
Rosa pisocarpa	clustered wild rose	w/d	RIP, FOR	C	
Rubus parviflorus	thimbleberry	w/d	RIP, FOR	C	
Rubus spectabilis	salmonberry	w/d	RIP, FOR	C	
Salix lucida ssp lasiandra	Pacific willow	w	RIP	D	
Salix scouleriana	Scouler's willow	w	RIP	C	erosion control
Salix sitchensis	Sitka willow	w	RIP	C	erosion control
Sambucus racemosa	red elderberry	w/d	RIP, FOR	C	
Sidalcea campestris	meadow checkermallow	d	GR	I	
Sidalcea virgata	rose checkermallow	d	GR	I	
Spirea douglasii	Douglas' spirea	w	RIP, SW	D	
Symphoricarpos albus	snowberry	d	FOR, GR	C	erosion control
Thuja plicata	western red cedar	d	RIP, FOR	C	
Wyethia amplexicaulis	mule's ears	d	GR	I	

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)
*** D = Dominant, C = Common, I = infrequent or specialty*
*** FOR = forest (upland). GR = grassland, RIP = riparian, SW = swale*

OREGON NATIVE GRASSES FOR SEEDING

Species	Common Name	Habit	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion***					
						West Cascades Dry/Open	West Cascades Shaded	East Cascades P-pine	East Cascades Sagebrush	Columbia Basin	Blue Mtns Sagebrush
Agrostis exarata	spikegrass	w	4,200,000								
Achnatherum hymenoides	Indian ricegrass	d	97,000	98%	80%			A	A	A	A
Achnatherum lemmonii	Lemmon's needlegrass	d	95,000								
Achnatherum lettermanii	Letterman's needlegrass	d	225,000						A		
Achnatherum thurbarianum	Thurber's needlegrass	d	148,200					A	**0.93**	**1.11**	A
Bromus carinatus	California brome, native b.	d	95,000	95%	80%	**2.13**		A	A	A	**8.6**
Bromus marginatus	mountain brome	d	90,000								
Bromus sitchensis	Alaska brome	d	125,000				**2.13**				
Bromus vulgaris	Columbia brome	d/w	145,000			**4.75**	**4.75**	**5.43**	**5.43**		
Calamagrostis rubescens	pinegrass	d	2,450,000				A				

Species	Common Name	Habit	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion***					
						West Cascades Dry/Open	West Cascades Shaded	East Cascades P-pine	East Cascades Sagebrush	Columbia Basin	Blue Mtns Sagebrush
Danthonia californica	California oatgrass	d/w	93,000			A	A				
Danthonia intermedia	timber oatgrass	d/w	150,000			A		**0.06**	**0.06**		

Based on original native grass mixes prepared by Nick Testa (shown on following pages by ecoregion), with updated taxonomy and alternatives.

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)

** Seed Count & germination based on various seed company information

*** Amount per Ecoregion based on known availability of seed (http://www.nativeseednetwork.org). Bold = first choice/main list; A = alternate choice (amount varies depending on goals and total seed mix)

Oregon Native Grasses for Seeding

Species	Common Name	Habit	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion***					
						West Cascades Dry/Open	West Cascades Shaded	East Cascades P-pine	East Cascades Sagebrush	Columbia Basin	Blue Mtns Sagebrush
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	d/w	1,650,000			**0.27**	A			A	
Deschampsia elongata	slender hairgrass	w				A	**0.27**				
Distichlis spicata	inland saltgrass	w	600,000						A		
Elymus elymoides	squirreltail	d	185,000	90%	80%		A	**2.11**	**2.11**	**1.41**	**1.42**
Elymus glaucus	blue wildrye	d/w	135,000	90%	80%	**2.55**	**2.55**				**1.7**

Species	Common Name	Habit	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion***					
						West Cascades Dry/Open	West Cascades Shaded	East Cascades P-pine	East Cascades Sagebrush	Columbia Basin	Blue Mtns Sagebrush
ssp. *glaucus*											
Elymus trachycaulis ssp. *trachycaulis*	slender wildrye	d/w	150,000					A	A	A	**2.3**
Festuca californica	California fescue	d/w	175,000	90%	65%		A				
Festuca idahoensis	Idaho fescue	d	450,000	90%	75%			**1.5**	**1.5**	**1.2**	**1.2**
Festuca occidentalis	western fescue	d				A	A				
Festuca roemeri	Romer's fescue	d	500,000	95%	85%	A					
Festuca rubra ssp. *arenaria* or *commutata*	coastal native red fescue	d/w	450,000	95%	80%						
Festuca rubra ssp. *rubra*	native red fescue	d/w	450,000	95%	80%	**0.65**	**0.65**			A	

Based on original native grass mixes prepared by Nick Testa (shown on following pages by ecoregion), with updated taxonomy and alternatives.

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)

** Seed Count & germination based on various seed company information

*** Amount per Ecoregion based on known availability of seed (http://www.nativeseednetwork.org). Bold = first choice/main list; A = alternate choice (amount varies depending on goals and total seed mix)

Oregon Native Grasses for Seeding

Species	Common Name	Habit	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion***					
						West Cascades Dry/Open	West Cascades Shaded	East Cascades P-pine	East Cascades Sagebrush	Columbia Basin	Blue Mtns Sagebrush
Glyceria occidentalis	northwestern mannagrass	w	201,000				**0.65**				
Glyceria striata	fowl mannagrass	w	180,000			**0.65**					A
Hordeum brachyantherum	meadow barley	w	68,000	90%	80%	A	A				
Koeleria macrantha	prairie junegrass	d	2,000,000			A		**0.93**	A	A	
Leymus cinereus	basin wildrye	w	130,000					A	A	**1.16**	
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	900,000					**0.48**	**0.48**	**0.8**	**0.61**
Pseudoregneria spicatum	bluebunch wheatgrass	d	117,500					**3.62**	**3.62**	**4.52**	**1.5**
Puccinellia distans	Alkali grass	w	1,200,000							**0.18**	
Total Amount (lbs/acre)						11	11	14.13	14.13	10.38	17.33

Based on original native grass mixes prepared by Nick Testa (shown on following pages by ecoregion), with updated taxonomy and alternatives.

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)

** Seed Count & germination based on various seed company information

*** Amount per Ecoregion based on known availability of seed (http://www.nativeseednetwork.org). Bold = first choice/main list; A = alternate choice (amount varies depending on goals and total seed mix). Application rates are for revegetation. For erosion control add sterile wheatgrass (or other nurse crop) at about 40 Lbs/ Acre.

Oregon Native Grasses for Seeding

Species	Common Name	Habit*	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion ***			
						Blue Mtns P-pine	Basin & Range Mixed Conifer For	Basin & Range Sagebrush & Grassland	Owhee Uplands
Agrostis exarata	spikegrass	w	4,200,000						
Achnatherum hymenoides	Indian ricegrass	d	97,000	98%	80%			A	A
Achnatherum lemmonii	Lemmon's needlegrass	d	95,000					A	
Achnatherum lettermanii	Letterman's needlegrass	d	225,000						A
Achnatherum thurbarianum	Thurber's needlegrass	d	225,000				A	**0.93**	**1.11**
Bromus carinatus	California brome, native b.	d	95,000	95%	80%	**8.6**	A		
Bromus marginatus	mountain brome	d	90,000				**0.93**		A
Bromus sitchensis	Alaska brome	d	125,000						
Bromus vulgaris	Columbia brome	d/w	145,000						
Calamagrostis rubescens	pinegrass	d	2,450,000			A	A		
Danthonia californica	California oatgrass	d/w	93,000						
Danthonia intermedia	timber oatgrass	d/w	150,000						
Deschampsia caespitosa ssp. *caespitosa*	tufted hairgrass	d/w	1,650,000						
Deschampsia elongata	slender hairgrass	w	1,950,000						
Distichlis spicata	inland saltgrass	w	600,000				**0.11**		A
Elymus elymoides	squirreltail	d	185,000	90%	80%	**1.42**	**1.41**	**1.41**	
Elymus glaucus ssp. *glaucus*	blue wildrye	d/w	135,000	90%	80%	**1.7**			
Elymus trachycaulis ssp. *trachycaulis*	slender wildrye	d/w	150,000			**2.3**			
Festuca californica	California fescue	d/w	175,000	90%	65%				
Festuca idahoensis	Idaho fescue	d	450,000	90%	75%	**1.2**	**1.41**	**1.41**	**1.2**

Based on original native grass mixes prepared by Nick Testa (shown on following pages by ecoregion), with updated taxonomy and alternatives.

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)

** Seed Count & germination based on various seed company information

*** Amount per Ecoregion based on known availability of seed (http://www.nativeseednetwork.org). Bold = first choice/main list; A = alternate choice (amount varies depending on goals and total seed mix)

Oregon Native Grasses for Seeding

Species	Common Name	Habit*	Count PLS** Seeds/lb	Min % Purity	Min % Germ **	Amount (lbs/acre) by Ecoregion ***			
						Blue Mtns P-pine	Basin & Range Mixed Conifer For	Basin & Range Sagebrush & Grassland	Owhee Uplands
Festuca occidentalis	western fescue	d	535,000						
Festuca roemeri	Romer's fescue	d	500,000	95%	85%				
Festuca rubra ssp. *arenaria* or *commutata*	coastal native red fescue	d/w	450,000	95%	80%				
Festuca rubra ssp. *rubra*	native red fescue	d/w	450,000	95%	80%				
Glyceria occidentalis	northwestern mannagrass	w	201,000						
Glyceria striata	fowl mannagrass	w	180,000			A			
Hordeum brachyantherum	meadow barley	w	68,000	90%	80%				
Koeleria macrantha	prairie junegrass	d	2,000,000			A	**0.11**	**0.11**	A
Lymus cinereus	basin wildrye	w						A	**1.16**
Poa secunda ssp. *secunda*	Sandbergs bluegrass	d	900,000			**0.61**	**0.63**	**0.63**	**0.8**
Pseudoregneria spicatum	bluebunch wheatgrass	d	117,500			**1.5**	**4.52**	**4.52**	**4.52**
Puccinellia distans	Alkali grass	w	1,200,000					**0.11**	**0.11**
Total Amount (lbs/acre)						17.33	9.12	9.12	8.9

Based on original native grass mixes prepared by Nick Testa (shown on following pages by ecoregion), with updated taxonomy and alternatives.

* d = dry, upland (UPL), w = wetland, mesic (W, FACW); d/w = dry or wet (FAC, FACU)

** Seed Count & germination based on various seed company information

*** Amount per Ecoregion based on known availability of seed. Bold = first choice/main list; A = alternate choice (amount varies depending on goals and total seed mix

Refer to **Seeding** section of Manual and use spreadsheet seed mix calculator in developing project and site specific seed mixes. Potential Species tables are for idea generation.

Always verify species availability and cost during design.

POTENTIAL SPECIES FOR SEED MIXES FOR BLUE MOUNTAINS / HIGH LAVA PLAINS ECOREGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Agropyron trachycaulum	Slender Wheatgrass	X		
Asclepias speciosa	Showy Milkweed	X	X	X
Bromus carinatus	California Brome	X		
Castilleja chromosa	Desert Paintbrush	X		X
Deschampsia caespitosa ssp. Caespitosa	Tufted Hairgrass		X	
Elymus glaucus	Blue Wildrye	X	X	X
Eriophyllum lanatum	Wooly Sunflower	X		
Festuca idahoensis	Idaho Fescue	X	X	X
Festuca rubra ss. Rubra	Native Red Fescue	X	X	X
Glyceria striata	Fowl Mannagrass		X	
Koeleria macrantha	Prairie Junegrass	X		
Lupinus polyphylus	Large-leaved Lupine	X	X	
Lupinus sericeus	Silky Lupine	X		
Mimulus guttatus	Seep Monkeyflower		X	X
Poa secunda ssp. Secunda	Sandbergs Bluegrass	X		
Potentilla gracillis	Slender Cinquefoil		X	
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations and Plant Species commonly used by Sage Grouse.

POTENTIAL SPECIES FOR SEED MIXES FOR COLUMBIA BASIN ECO-REGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Achillea millefolium	Western Yarrow	X		X
Artemisia tridentata ssp. Tridentata	Big Basin Sagebrush	X		
Asclepias speciosa	Showy milkweed	X	X	X
Balsamorhiza sagittata	Arrowleaf Balsamroot	X		
Camassia quamash	Common Camas		X	
Carex nebrascensis	Nebraska Sedge		X	
Elymus elymoides	Squirrel-tail Wheatgrass	X		
Elymus trachycaulis	Slender Wheatgrass	X	X	X
Eriogonum umbellatum	Sulfur-flowered Buckwheat	X		
Festuca idahoensis	Idaho Fescue	X		X
Juncus ensifolius	Dagger-leaf Rush		X	X
Lupinus sericeus	Silky Lupine	X		X
Poa secunda ssp. Secunda	Sandbergs Bluegrass	X		
Pseudoroegeria spicata	Bluebunch Wheatgrass	X	X	
Scirpus microcarpus	Small-fruited Bulrush		X	
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations and Plant Species commonly used by Sage Grouse.

POTENTIAL SPECIES FOR SEED MIXES FOR COAST RANGE ECOREGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Agrostis exarata	Spikegrass	X	X	X
Asclepias speciosa	Showy milkweed	X	X	X
Balsamorhiza deltoidea	Deltoid balsamroot	X		
Beckmannia syzigachne	Sloughgrass		X	
Bromus carinatus	California brome	X		
Camassia quamash	Common Camas		X	
Deschampsia caespitosa ssp. Caespitosa	Tufted hairgrass		X	X
Elymus glauca	Blue wildrye	X		
Eriogonum umbellatum	Sulfur-flowered Buckwheat	X		
Festuca roemeri	Romer's fescue	X		
Glyceria occidentalis	Western mannagrass		X	
Juncus tenuis	Poverty rush		X	X
Lupinus polyphylus	Big-leaved lupine	X	X	X
Scirpus microcarpus	Small-fruited Bulrush		X	
Solidago canadensis	Canada goldenrod		X	X
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations (Native Seed Network and Xerces Society)

POTENTIAL SPECIES FOR SEED MIXES FOR KLAMATH MOUNTAINS ECOREGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Asclepias speciosa	Showy milkweed	X	X	X
Balsamorhiza deltoidea	Deltoid balsamroot	X		
Beckmannia syzigachne	Sloughgrass		X	
Bromus carinatus	California brome	X		
Camassia quamash	Common Camas		X	
Carex densa	Dense sedge		X	
Elymus elymoides	Squirreltail	X		
Eriogonum umbellatum	Sulfur-flowered Buckwheat	X		
Festuca occidentalis	Western fescue	X		
Glyceria occidentalis	Western mannagrass		X	
Hordeum brachyantherum	Meadow barley		X	X
Juncus tenuis	Poverty rush		X	X
Scirpus microcarpus	Small-fruited Bulrush		X	
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations (Native Seed Network)

POTENTIAL SPECIES FOR SEED MIXES FOR EAST CASCADES ECOREGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Asclepias speciosa	Showy milkweed	X	X	X
Balsamorhiza deltoidea	Deltoid balsamroot	X		X
Bromus carinatus	California brome	X		
Danthonia californica	California oatgrass	X	X	X
Deschampsia elongata	Slender hairgrass		X	X
Elymus elymoides	Squirreltail	X		
Elymus trachycaulis ssp. Trachycaulis	Slender wildrye	X	X	X
Eriogonum umbellatum	Sulfur-flowered Buckwheat	X		
Festuca idahoensis	Idaho fescue	X		
Hordeum brachyantherum	Meadow barley		X	X
Lomatium triternatum	Nineleaf biscuitroot	X		
Lupinus sericeus	Silky Lupine	X		X
Lymus cinereus	Basin wildrye		X	X
Trifolium macrocephalum	Big-head clover	X		X
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations (Native Seed Network)

POTENTIAL SPECIES FOR SEED MIXES FOR WEST CASCADES ECOREGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Anaphalis margaritacea	Western pearly everlasting	X		
Asclepias speciosa	Showy milkweed	X	X	X
Bromus carinatus	California brome	X		X
Carex utriculata	NW Territory Sedge		X	
Elymus glaucus ssp. glaucus	Blue wildrye	X		X
Festuca rubra ssp. rubra	Red Fescue	X	X	X
Glyceria striata	Fowl mannagrass		X	X
Juncus effusus	Common rush		X	
Lupinus latifolius	Bigleaf lupine	X		
Mimulus guttatus	Yellow Monkeyflower		X	
Oenanthe sarmentosa	Water Parsley		X	
Ranunculus occidentalis	Western buttercup		X	X
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations (Native Seed Network)

POTENTIAL SPECIES FOR SEED MIXES FOR WEST CASCADES ECOREGION

Species		**Upland?**	**Wetland?**	**Riparian?**
Botanical Name	**Common Name**			
Achillea millefolium	Yarrow	X		X
Asclepias speciosa	Showy milkweed	X	X	X
Bromus carinatus	California brome	X		X
Carex obnupta	Slough sedge		X	
Danthonia californica	California oatgrass	X	X	X
Deschampsia caespitosa ssp. caespitosa	Tufted Hairgrass	X	X	X
Elymus glaucus ssp. glaucus	Blue wildrye	X		X
Eriophyllum lanatum	Wooly sunflower	X		
Festuca roemeri	Romer's fescue	X		X
Glyceria striata	Fowl mannagrass		X	X
Hordeum brachyantherum	Meadow barley		X	X
Juncus tenuis	Poverty rush		X	X
Lupinus polyphylus	Large leaf lupine	X	X	X
Potentilla gracillis	Slender cinquefoil		X	
Ranunculus occidentalis	Western buttercup		X	X
Sidalcea campestris	Meadow checkermallow	X		
Wyethia angustifolia	Mule's ears	X		
	Sterile Annual Grass	X		X

Above list developed from Original Grass Seed Mixture for Maintenance Use (Testa, 2000), Ecoregion Seed Lists (Testa, Trask, 2009), Ecoregion Recommendations (Native Seed Network)

APPENDIX D: SCOPING FORMS FOR ROADSIDE DEVELOPMENT AND VISUAL RESOURCES

ENVIRONMENTAL SCOPING CHECKLIST

Please fill in the requested information

Please check the boxes to indicate the existing or potential impacts, or to indicate action taken.

Add clarifying comments as necessary.

Summarize scoping findings in the narrative.

Project Name			
Key Number			
Highway Name			
Highway Number			
Route Number			
Mile Points	TO	Length=	Miles
Project Type			
Prepared By			
Date			

Environmental Contact for Project	
Environmental Classification	

Environmental Baseline Report Required? Yes ☐ No ☐

Visual Resource Impacts:	**Yes**	**No**	**N/A**	**Comment / Clarification**
Noticeable change in physical character?	☐	☐	☐	Landform, structures, walls, railings, vegetation
Compatibility with context	☐	☐	☐	Complement or contrast?
Level of local concern	☐	☐	☐	High / Moderate / Low / Negligible
Extensive visual impact mitigation required?	☐	☐	☐	Extensive / Some / None

Cumulative impacts likely?	☐	☐	☐	Likely soon / Likely later / None
Potential for Controversy or Opposition	☐	☐	☐	High / Moderate / Low
Sensitivity and Number of viewers	☐	☐	☐	High / Moderate / Low / None
Compatibility with local standards and laws	☐	☐	☐	Low / Moderate / High
Regulatory permits required?	☐	☐	☐	Yes / Maybe / Low
Is a more detailed visual analysis justified?	☐	☐	☐	Yes / Maybe / Low
Scenic Highway	☐	☐	☐	
Scenic Waterways	☐	☐	☐	
Wild and Scenic Waterways	☐	☐	☐	
Adjacent to Federal Lands	☐	☐	☐	
Funding	☐	☐	☐	
Federal Enhancement	☐	☐	☐	
Scenic Byway Program	☐	☐	☐	
Oregon Historic Highway (ORS 377.100)	☐	☐	☐	
Oregon Scenic Area (ORS 377.505)	☐	☐	☐	
Scenic-Forest Practices Act (ORS 527.755)	☐	☐	☐	

Narrative:

APPENDIX E: VISUAL IMPACT ASSESSMENT SCOPING QUESTIONNAIRE

Federal Highway Administration

GUIDELINES FOR THE VISUAL IMPACT ASSESSMENT OF HIGHWAY PROJECTS

APPENDICES

VIA Scoping Questionnaire

The following ten questions can be used to determine the appropriate level of effort for assessing the impacts on visual quality that may result from a proposed highway project. The first set of five questions is concerned with environmental compatibility impacts on the visual resources of the affected environment. The second set of five questions deals with the sensitivity of the affected population of viewers to those impacts.

Consider each of the ten questions on the questionnaire and select the response that most closely applies to the project in question. Each response has a corresponding point value. After the questionnaire is completed, the total score will represent the type of VIA document suitable for the project.

It is important that this scoring system be used as a preliminary guide only. Although these questions provide some guidelines for determining if a VIA is necessary, it should not, but itself, be considered definitive. If there is any hint that visual issues may be a factor in assessing impacts, it is recommended that a VIA be conducted. Although the total score will direct the user toward a particular level of VIA documentation, circumstances may necessitate selecting a different level of analysis and documentation based on previous experience, local concerns, or professional judgment. This checklist is meant to assist the writer of the VIA to understand the degree and breadth of the possible visual issues. The goal is to develop an analysis and document strategy that is appropriately thorough, efficient, and defensible.

Project Name:	Site Visit Date: Day, 00/00/000
Location:	Time: 0:00 a.m. / p.m.
Special Conditions/Notes:	Conducted By:

Environmental Compatibility

1. *Will the project result in a noticeable change in the physical characteristics of the existing environment?* (Consider all project components and construction impacts – both permanent and temporary, including landform changes, structures, noise barriers, vegetation removal, railing, signage, and contractor activities.)

- ☐ High level of permanent change (3)
- ☐ Moderate level of permanent change (2)
- ☐ Low level of permanent or temporary change (1)
- ☐ No Noticeable Change (0)

2. *Will the project complement or contrast with the visual character desired by the community?* (Evaluate the scale and extent of the project features compared to the surrounding scale of the community. Is the project likely to give an urban appearance to an existing rural or suburban community? Do you anticipate that the change will be viewed by the public as positive or negative? Research planning documents, or talk with local planners and community representatives to understand the type of visual environment local residents envision for their community.)

- ☐ Low compatibility (3)
- ☐ Moderate compatibility (2)
- ☐ High compatibility (1)

3. *What level of local concern is there for the types of project features (e.g., bridge structures, large excavations, sound barriers, or median planting removal) and construction impacts that are proposed?* (Certain project improvements can be of social interest to local citizens, causing a heightened level of public concern, and requiring a more focused visual analysis.)

- ☐ Low concern (3)
- ☐ Moderate concern (2)

- ☐ Low concern (1)
- ☐ Negligible project features (0)

4. *Is it anticipated that to mitigate impacts, it may be necessary to develop extensive or novel mitigation strategies to avoid, minimize, or compensate for adverse impacts or will using conventional mitigation strategies, such as landscape or architectural treatment adequately mitigate adverse visual impacts?*

- ☐ Extensive non-conventional mitigation likely (3)
- ☐ Some non-conventional mitigation likely (2)
- ☐ Only conventional mitigation likely (1)
- ☐ No mitigation likely (0)

5. *Will this project, when seen collectively with other projects, result in an aggregate adverse change (cumulative impacts) in overall visual quality or character?* (Identify any projects [both state and local] in the area that have been constructed in recent years and those currently planned for future construction. The window of time and the extent of area applicable to possible cumulative impacts should be based on a reasonable anticipation of the viewing public's perception.)

- ☐ Cumulative impacts likely: 0-5 years (3)
- ☐ Cumulative impacts likely: 6-10 years (2)
- ☐ Cumulative impacts unlikely (1)

Viewer Sensitivity

1. What is the potential that the project proposal may be controversial within the community, or opposed by any organized group? (This can be researched initially by talking with the state DOT and local agency management and staff familiar with the affected community's sentiments as evidenced by past projects and/or current information.)

- ☐ High potential (3)
- ☐ Moderate potential (2)
- ☐ Low potential (1)
- ☐ No potential (0)

2. *How sensitive are potential viewer-groups likely to be regarding visible changes proposed by the project?* (Consider, among other factors, the number of viewers within the group, probable viewer expectations, activities, viewing duration, and orientation. The expected viewer sensitivity level may be scoped by applying professional judgment, and by soliciting information from other DOT staff, local agencies, and community representatives familiar with the affected community's sentiments and demonstrated concerns.)

☐ High sensitivity (3) ☐ Moderate sensitivity (2)

☐ Low sensitivity (1)

3. *To what degree does the project's aesthetic approach appear to be consistent with applicable laws, ordinances, regulations, policies, or standards?*

☐ Low compatibility (3) ☐ Moderate compatibility (2)

☐ High compatibility (1)

4. *Are permits going to be required by outside regulatory agencies (e.g., Federal, State, or local)?* (Permit requirements can have an unintended consequence on the visual environment. Anticipated permits, as well as specific permit requirements (which are defined by the permitter) may be determined by talking with the project environmental planner and project engineer. Note: coordinate with the state DOT representative responsible for obtaining the permit prior to communicating directly with any permitting agency. Permits that may benefit from additional analysis include permits that may result in visible built features such as infiltration basins or devices under a storm water permit or a retaining wall for wetland avoidance or permits for work in sensitive areas such as coastal development permits or on Federal Lands, such as impacts to Wild and Scenic Rivers.

☐ Yes (3) ☐ Maybe (2)

☐ No (1)

5. *Will the proper sponsor or public benefit from a more detailed visual analysis in order to help reach consensus on a course of action to address potential visual impacts?* (Consider the proposed project features, possible visual impacts, and probable mitigation recommendations.)

- ☐ Yes (3)
- ☐ Maybe (2)
- ☐ No (1)

Determining the Level of Visual Impact Assessment

Total the scores of the answers to all ten questions on the Visual Assessment Scoping Questionnaire. Use the total score from the questionnaire as an indicator of the appropriate level of VIA to perform for the project. Confirm that the level suggested by the checklist is consistent with the project team's professional judgments. If there remains doubt about whether a VIA needs to be completed, it may be prudent to conduct an Abbreviated VIA. If there remains doubt about the level of the VIA, begin with the simpler VIA process. If visual impacts emerge as a more substantial concern than anticipated, the level of VIA documentation can always be increased.

The level of the VIA can initially be based on the following ranges of total scores:

- ☐ *Score 25-30*

An Expanded VIA is probably necessary. It is recommended that it should be proceeded by a formal visual scoping study prior to beginning the VIA to alert the project team to potential highly adverse impacts and to develop new project alternatives to avoid those impacts. These technical studies will likely receive statewide, even national, public review. Extensive use of visual simulations and a comprehensive public involvement program would be typical.

- ☐ *Score 20-24*

A Standard VIA is recommended. This technical study will likely receive extensive local, perhaps statewide, public review. It would typically include several visual simulations. It would also include a thorough examination of public planning and policy documents supplemented with a direct public engagement process to determine visual preferences.

- ☐ *Score 15-19*

An Abbreviated VIA would briefly describe project features, impacts, and mitigation requirements. Visual simulations would be optional. An Abbreviated VIA would receive little direct public interest beyond a summary of its findings in the project's environmental documents. Visual preferences would be based on observation and review of planning and policy documents by local jurisdictions.

☐ *Score 10-14*

A VIA Memorandum addressing minor visual issues that indicate the nature of the limited impacts and any necessary mitigation strategies that should be implemented would likely be sufficient along with an explanation of why no formal analysis is required.

☐ *Score 6-9*

No noticeable physical changes to the environment are proposed and no further analysis is required. Print a copy of this completed questionnaire for your project file to document that there is no effect. *A VIA Memorandum* may be used to document that there is no effect and to explain the approach used for the determination.

APPENDIX F: TYPES OF VISUAL IMPACT ASSESSMENT DOCUMENTS

Federal Highway Administration

GUIDELINES FOR THE VISUAL IMPACT

ASSESSMENT OF HIGHWAY PROJECTS

APPENDICES

Types of VIA Documents

When it is determined that a VIA is needed, there are four distinct possible levels of reporting. Help to determine the appropriate level of VIA document is provided in Chapter 3 of the VIA Guidelines. These four levels, listed by increasing complexity, are:

1. VIA Memorandum
2. Abbreviated VIA
3. Standard VIA
4. Expanded VIA

Basic descriptions of each level of VIA document are described in this Appendix.

VIA Memorandum

A VIA Memorandum is simply a short memorandum from the VIA author to the NEPA project manager stating that the potential for the project to cause adverse or beneficial impacts to visual resources, viewers, or visual quality is negligible and explaining the approach used to reach that conclusion. A VIA Memorandum is usually reserved for projects that are Categorical Exclusions (CEs) but may include Environmental Assessment (EA) or Environmental Impact Statement (EIS)-level projects with little or no visual impacts.

Abbreviated VIA

An abbreviated VIA is a document that succinctly reports the findings of a VIA. It includes a brief project description and a report of the findings of the VIA's establishment, inventory, analysis, and mitigation phases. Maps, aerial photography and photographs are used sparingly and only when such illustrations reduce the need for text. An Abbreviated VIA is typically used for an EA or EIS-level project when it has been

---

identified during scoping that there are minimal visual concerns. It may also be used for CEs if a VIA Memorandum will not suffice and a slightly more detailed analysis is needed to address visual impacts.

To report the establishment phase, identify the location and extent of the project corridor on a map, along with the area of visual effect. Provide a brief project description. Typically, for an Abbreviated VIA, it is not necessary to delineate view sheds or landscape units.

To report the inventory phase, briefly identify visual resources of the natural, cultural, and project environments as a description of the visual character of the project corridor, briefly identify the viewing experience of neighbors and travelers; and finally, identify existing visual quality as what viewers like and dislike about the existing environment.

To report the analysis phase, define how the visual character of the corridor will change as a result of the project. Describe impacts to visual resources and the experience of viewers. Define the degree of impacts as being beneficial, adverse, or neutral.

To report the mitigation phase, describe how mitigation strategies avoid, minimize, or compensate for adverse visual impacts and how beneficial visual impacts will be incorporated in the project.

Standard VIA

A Standard VIA would typically be used for EA or EIS projects that are anticipated as having substantial adverse or beneficial visual impacts. In the Standard VIA document, report the findings of the establishment, inventory, analysis, and mitigation phases of the VIA process. The Standard VIA is developed with input from the NEPA public involvement process to directly and accurately ascertain viewer preferences. It is suggested that these findings be presented in

a manner more traditional with how environmental review documents are produced by presenting the findings in the following chapters:

Chapter 1: Project Description. Report the project's purpose and need and identifying issues of visual quality. Define and map the project location. Provide a project description, including descriptions of alternatives and any associated plans or cross-sections, as appropriate.

Chapter 2: Methodology. Describe the purpose of the VIA and how it will be used to inform location, design, and mitigation decisions of the transportation agency. Describe the assessment methodology, noting the use of the FHWA VIA guidelines and any modifications to the methodology recommended in the guidelines. The VIA Flow Chart (see Figure 3-1 in the guidelines) can be inserted into the document to illustrate the process, if preferred.

Chapter 3: Affected Environment. Describe the regulatory setting, listing any federal, state, or local laws, rules, ordinances, or other regulations that are related to visual issues, visual resources, visual character, visual quality, or the visual experience of viewers. Define and map the area of visual effect, and show the location of distinct landscape units and associated key views.

Provide representative images and descriptions of the visual character of the landscape units, identifying in particular the visual resources of the natural, cultural, and project environments.

Describe the visual character of the project. These descriptions can be documented by landscape units, if the visual character of the project in each landscape unit is unique.

Briefly describe who are the neighbors and travelers, their self-interest, their sensitivity to visual change, and their visual preferences.

Define existing visual quality by identifying viewer's impressions of existing visual character, especially their impressions of natural harmony, cultural order, and project coherence.

Chapter 4: Impact Analysis and Mitigation. Describe how the proposed project will alter the visual character of the area of visual effect, and, consequently, the experience of visual quality by viewers. Define the impacts to visual quality using the concepts of changes to natural harmony, cultural order, and project coherence.

Describe in common language the visual impacts to natural harmony, cultural order, and project coherence. Discuss this in terms of the compatibility or incompatibility of the visual character

of the proposed project with the visual character, which currently exists in the area of visual effects and how visual quality would be affected. Discuss how key views would be affected. Use before and after images to illustrate impacts, in cases where simulations are used. Provide a narrative discussion with the simulations discussing how they relate to the public's viewer preferences. Describe the expected viewer sensitivity to these changes. Define impacts as being adverse, beneficial, or neutral. Describe any anticipated cumulative impacts to existing visual quality associated with the project.

Suggest how to avoid, minimize, or compensate for adverse impacts and how to incorporate beneficial impacts into the project as enhancements. Recognize that mitigation and enhancements can affect either visual resources or viewers, as noted in Chapter 7.

Expanded VIA

An Expanded VIA is usually reserved for very complex or controversial projects where resolving visual issues has been identified as being key to public acceptance of a

project. To report an Expanded VIA, follow the same outline as a Standard VIA, except report findings with more detail. In particular, the inventory of Landscape Units and Viewers Groups may be more fine-grained, rendering more subtlety in defining existing visual quality and impacts to it. For an Expanded VIA, alternative alignments or alternative designs may be fully and separately inventoried and analyzed. For an Expanded VIA, utilizing an effective public participation strategy to accurately ascertain viewer preferences is key for determining impacts to visual quality and designing effective mitigation strategies. Provide a description of how the public was involved in the VIA process. The development of simulations showing impacts and mitigation is especially necessary for reporting the findings of an Expanded VIA.

APPENDIX G: DRAFT ODOT LANDSCAPE OPERATION & MAINTENANCE MANUAL

OREGON DEPARTMENT OF TRANSPORTATION

LANDSCAPE OPERATION & MAINTENANCE MANUAL

Location:
_____

Landscape Types: _____

Options for Landscape Types:

Urban Forest

Street Trees (Streetscape)

Ornamental Planting

Native Planting

Perennial / Grass Areas

Native Landscape Restoration Areas

Wetlands or Habitat Developments

Riparian Areas

Insert Facility Photograph Here

Month, Year

Note to Designers: Instructions are highlighted in green. Delete these instructions and this note before finalizing the manual.

Fill in the areas highlighted in yellow. Delete any guidance text and remove the yellow highlight before finalizing the manual.

Landscape Management Authorization

This Operations and Maintenance Manual documents the Design Decisions, Regulatory and Policy foundations, and the Agreements made to appropriately manage this site through time. The following individuals reviewed this Manual for accuracy and agree to support the landscape site management identified herein.

_____

District Maintenance Manager Date

_____

Region Environmental Unit Manager Date

Landscape Site Identification

Landscape ID:	**[DXXXXX]**
Landscape Types:	[Facility Type]
Construction Drawings:	(V-File Number) [xxV-xxx]
Date Constructed:	[Month Year]

Location and Size:	District: X
	Highway No.: XXX
	Mile Post: [xxx.xxx; xxx.xxx (begin/end)]
	Description: This facility is located [e.g. Approximately 0.75 acres On West Side of Willamette River just N. of Bridge. South of Macadam Ave and North of Moody Ave. Access via Moody Ave.]

Landscape Contact Information:

Contact the Professional of Record (Region Landscape Architect / Landscape Resource Specialist / Designer) for:

Operational clarification

Maintenance clarification

Repair or restoration assistance

Landscape Contacts:

Professional of Record (POR): Region Technical Center Landscape Architect / Landscape Resource Specialist / other Licensed Designer

Or

Region Environmental Unit Manager

Construction:

Agency Project Manager: [Name, Phone number]

Contractor: [Construction Company]

Permits, Agreements, and Policies:

Permit Type:	[Jurisdiction, Name, Phone number] Permit Duration – [Month/Year]
Agreement(s):	IGA/MOU – [Name, Phone number]
Policies Applicable:	TS Directives / Bulletins / Advisories

Design Intent and Purpose:

Explain why project was built as it was and the desired outcome through time.

Management Overview and Landscape Types

General Notes: The information below is provided as the general approach to maintenance activities.

Pruning – Pruning is generally not recommended unless sight distance, transient issues, and public safety require alternative methods of tree management or removal, or to remove branches that are dead, diseased, have crossing branches or cause long-term issues for the tree or public safety. Tree pruning should not include "topping" or "hat racking". Trees and shrubs are selected for their natural form; any pruning should accent this form. Plants should not be pruned into geometric shapes like balls or squares. Plants that are massed together should not be individually pruned. Unnecessary maintenance exposes soil, allows erosion, and provides more opportunity to trap trash. Problem plants should be removed or thinned out in coordination with Region Landscape Architect/Landscape Resource Specialist. Tree maintenance and any pruning should follow the recommended practices as described in the current ANSI A300 Standard Practices:

Thinning – In areas where issues reoccur, such as transient camps, limbing up to open views and clear sight distance is appropriate. In some cases removal may be the best option with plant replacement being provided as necessary. Coordinate thinning and plant removal with Region Landscape Architect/Landscape Resource Specialist.

Urban Forest

Urban forest landscapes (reforestation or afforestation) may occur in areas that are already wooded or in previously existing mowed or non-mowed areas. Avoid pruning young trees except to eliminate dead branches or ones that cross over each other. Pruning lower branches on young trees is not recommended, unless needed for security reasons (visibility, accidents). Do not top trees and do not remove more than 15% of tree limbs unless limbs are considered hazardous to public safety. See current ANSI A300 Standard Practices for tree pruning and care:

Mow Replacement Areas – These are areas being converted from mown landscapes to forest. During tree establishment, mowing may occur once a year between August 1st and September 30th, allowing for grasses and forbs to set seed. Mowing then disperses the seed, renewing the site with seed for next season. Spot spray with herbicide to manage remaining noxious weeds in early fall and/or early spring. Mechanical and/or manual weed removal may be necessary. As the landscape matures plant thinning may benefit these areas. Coordinate any thinning activities with your Region Landscape Architect/Landscape Resource Specialist.

Non-Mow Areas – These are areas not regularly maintained but which may need infrequent spot spraying to prevent establishment and spreading of noxious weeds. The intent is to increase the forest canopy by supplemental plantings of trees and/or by managing the environment to allow the natural succession of desirable trees, thereby allowing this landscape to mature as a relatively "wild" landscape.

Street Trees (Streetscape)

Street Tree maintenance should follow the recommended practices as described in the current ANSI A300 Standard Practices:

Street Trees may be pruned to provide adequate clearance over sidewalks and streets, per the Oregon Highway Design Manual:

Streetscape may also have shrubs and groundcover; these areas should be maintained to ensure proper mulching and weed management. Shrubs shall not be pruned unless needed to maintain sight lines and safety for the traveling public (including bicyclists and pedestrians). Plants have been selected for their natural habit/flowering qualities and should not be pruned into individual shapes but maintain their intended massing and form. Plants should be replaced with the same species unless approved by the Agency Landscape Architect/Landscape Resource Specialist.

Ornamental Planting

Ornamental planting areas often include a variety of plant types, both native and non-native. Areas planted for this purpose often include interchanges and public building facilities. Plants should not be pruned into individual shapes but maintain their intended massing and form. Plants should be replaced with the same species unless approved by Agency Landscape Architect/Landscape Resource Specialist.

Native Planting

Native planting areas are often part of roadside development projects, with selection and use driven by regulations and policies of State, Federal (FHWA), DOT, and local jurisdictions. Plants in the landscape should be grown to maturity and shall not be pruned into individual shapes but maintain their intended massing and form and allowed to “knit together” with other plants by growing into each other to form plant masses. Plants may be selectively thinned to allow room for growth and to prevent crowding. Plants should be replaced with the same species. Thinning and plant replacement shall be coordinated and approved by Agency Landscape Architect/Landscape Resource Specialist.

Perennial/Grass Areas

Areas with perennials, forbs, and grasses do not need for frequent mowing (annually or every 2-3 years). Spot spraying with herbicide to manage noxious weeds should be done in early fall

and/or early spring as needed. Typically, mowing should occur no more than once a year. Mow between August 1st and September 30th (after risk of starting grass fires has subsided) to allow for grasses and forbs to set seed; the mower will then disperse the seed.

Native Landscape Restoration Areas

These areas often include a combination of Urban Forest, Native Planting, and Perennial/Grass Areas. Their landscape maintenance is usually driven by permit and monitoring requirements. Coordinate landscape management with Region Landscape Architect/Landscape Resource Specialist prior to starting work in these types of areas.

Wetlands

These areas require weed management and plant replacement as necessary during establishment (typically Contractor's responsibility for 1 to 3 years) and periodically thereafter if noxious weeds become established. Once established, no maintenance should be required unless sight lines, facility structures, or public safety becomes an issue. Coordinate landscape management with Wetland Specialist/Region Landscape Architect prior to starting work in these types of areas.

Riparian Areas

Landscape management in Riparian Areas is usually driven by permit and monitoring requirements. Once established, no maintenance should be required unless sight lines, facility structures, or public safety becomes an issue. Like wetlands, riparian landscapes should be left to function naturally. Some weed management and plant replacement may be necessary during establishment and periodically thereafter. Coordinate landscape management with Region Landscape Architect/Landscape Resource Specialist prior to starting work in these types of areas.

[This section tells how the system works, and it makes reference to detailed material in the remainder of the report and the appendices. Describe the following:]

Landscape Type by utilizing one of the sample text sections above

Location

Access

Permits

Agreements

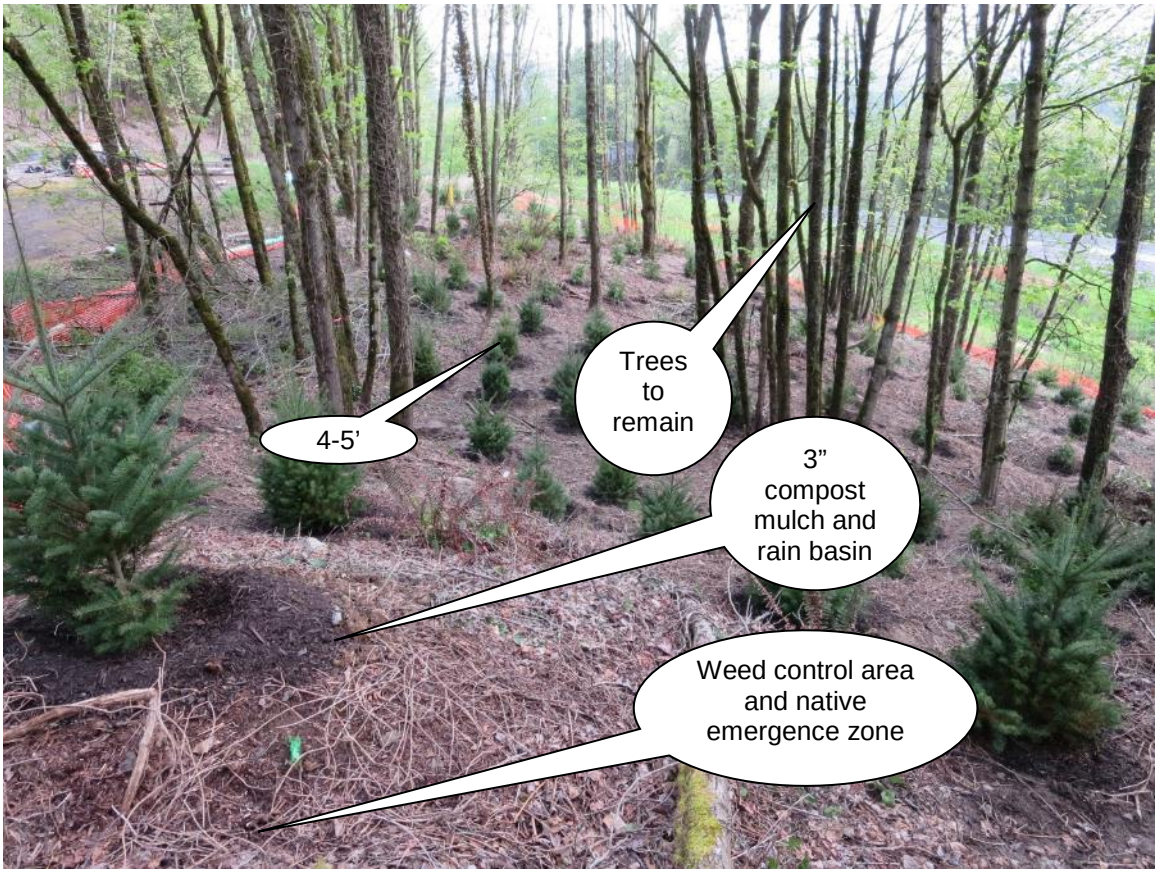
Maintenance equipment access:

Describe how equipment and maintenance crew will access the facility.

Special Features:

- ☐ Amended Soils
- ☐ Sidewalks / Trail
- ☐ Pavers
- ☐ Underdrains
- ☐ Trees
- ☐ Walls
- ☐ Railing / Fence
- ☐ Noxious Weed Management
- ☐ Walls
- ☐ No-Work Areas
- ☐ Water Control Structures
- ☐ Drainages

Photo 1: **Reforestation I-5 Iowa Street Viaduct, Phase 2 northeast view.**



Maintenance / Management Requirements:

The ODOT Routine Road Maintenance, Water Quality and Habitat Guide can be viewed at the following website:

Routine Road Maintenance

The following Landscape activities should be used to maintain the landscape identified in this Operation and Maintenance Manual and/or follow the Maintenance requirements outlined in Appendix C when permits are required:

Mark as Required:

- ☐ Weed Control
  - Explain procedure and outcome
- ☐ Plant Replacement
  - Follow Plans, approval replacement
- ☐ Mulching
  - Provide expectation (use of chippings from cutting / pruning
- ☐ Irrigation
  - System availability and management
- ☐ Manual Watering
  - Provide schedule, quantity, and guidance
- ☐ Seeding
  - Type, signs that require reseeding
- ☐ Fertilization
  - Type, signs that indicate need
- ☐ Mowing
  - Provide schedule guidance for mowing
- ☐ Thinning and Pruning
  - Provide guidance and intent. Pruning shall follow current ANSI A-300 standard. Consider pruning seasons/cycles.
- ☐ General Labor
  - General labor needs, tree stake removal, dri-water container removal, etc.
- ☐ Special Management / Maintenance requirements

  [Insert special maintenance requirements here, such as noxious weed control, seasonality, etc.]

Waste Material Handling:

Material removed from the facility as defined as waste by DEQ. Refer to the road waste section of the ODOT Maintenance Yard Environmental Management System (EMS).

(EMS) Policy and Procedures Manual for disposal options:

Contact any of the following for more detailed information about management of waste materials found on site:

ODOT Clean Water Unit	503.986.3008
ODOT Statewide Hazmat Coordinator	503.229.5129
ODOT Region Hazmat Coordinator	_____
ODEQ Northwest Region Office	503.229.5263

[Phone numbers are to be filled in specifically for each project by Region; determine ODOT Region Hazmat Contacts and delete this note when completed.]

APPENDIX H: LIST OF FIGURES


Oregon
Department
of Transportation