

## **OCS Chapter 4. Conservation Opportunity Areas**

- Overview
- Conservation Opportunity Area Boundaries
- Conservation Opportunity Area Profiles
- Methodology

### **Overview**

Landowners and land managers throughout Oregon can contribute to conserving fish and wildlife by maintaining, restoring, and improving habitats. These conservation actions benefit Strategy Species and Strategy Habitats, and are important regardless of location. However, focusing investments in prioritized areas, or Conservation Opportunity Areas (COAs), can increase the likelihood of long-term success, maximize effectiveness over larger landscapes, improve funding efficiency, and promote cooperative efforts across ownership boundaries. COAs were developed to guide voluntary actions. Land use or other activities within these areas will not be subject to any new regulations. The ODFW COA map, dataset, and underlying profile information should only be used in ways consistent with these intentions.

COAs are delineated landscapes where broad fish and wildlife conservation goals would best be met, and have been designated for all ecoregions within the Conservation Strategy, except the Nearshore ecoregion. COAs were delineated through a complex spatial modeling analysis and expert review. Each COA is provided as a map in the Strategy and has an associated COA profile, which includes detailed information about the area's Conservation Strategy priorities, recommended actions, and ongoing conservation efforts. Voluntary conservation actions consistent with local priorities will be carried out within COAs by a variety of partners (e.g., landowners, land managers, agencies, watershed councils, local land trusts, Soil and Water Conservation Districts, etc.), and will encompass all types of land ownership and management approaches.

COAs were first developed for the 2006 Conservation Strategy through a spatial analysis that incorporated spatial vegetation models, predictive models of wildlife habitat, roads and development layers, and freshwater stream datasets [\[2006 Oregon Conservation Strategy: Appendix IV. Methods\]](#). These original COAs were developed with the best available information at the time, but were intended to be updated alongside the Conservation Strategy as new information became available. COAs were one of the most heavily utilized components within the 2006 Conservation Strategy, commonly used by various government agencies and non-profit organizations to prioritize conservation efforts in specific areas [\[link 10-year Report\]](#).

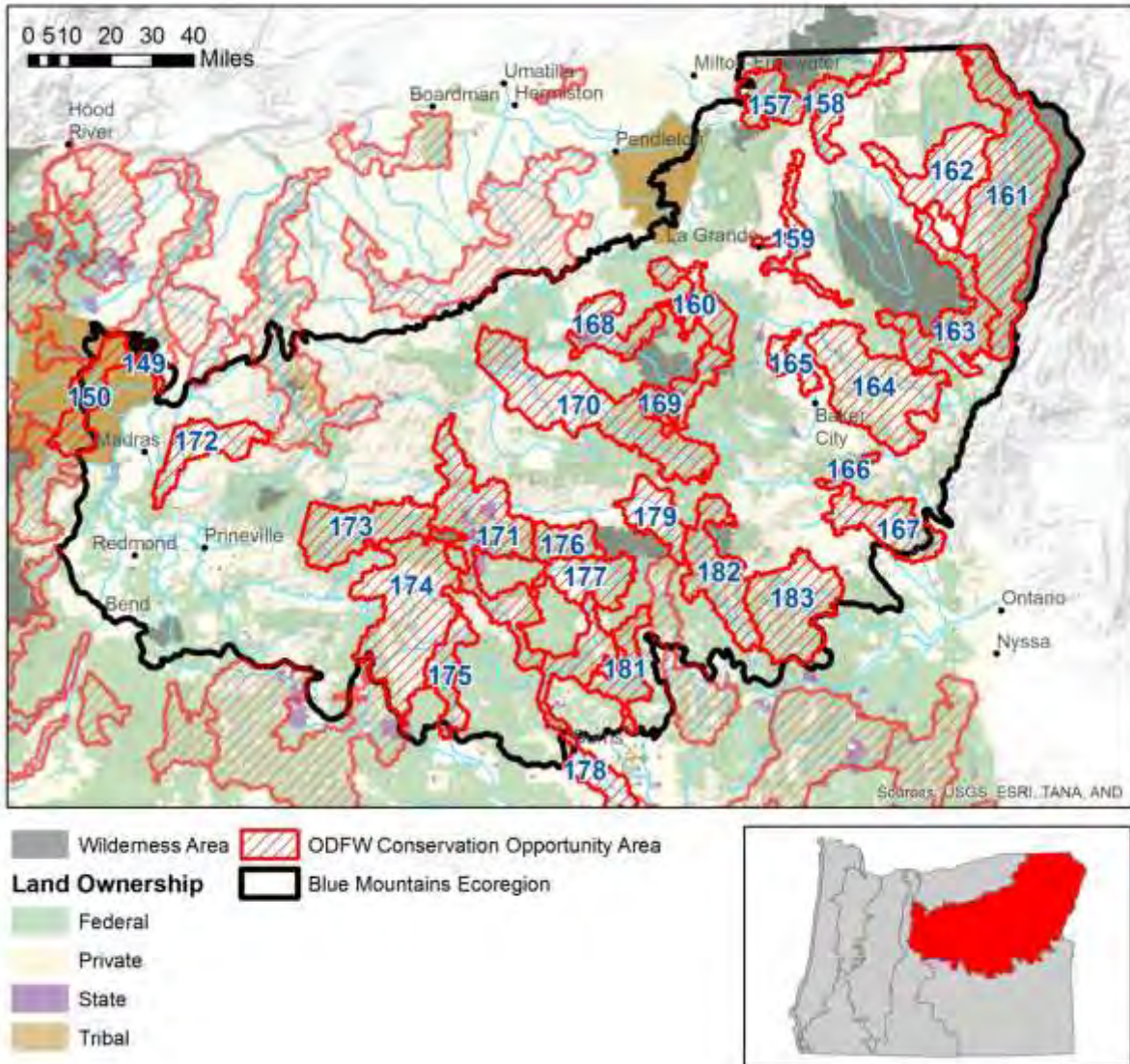
COAs were also one of the most common suggestions to undergo revision efforts, with requests from ODFW staff, partners, and the Stakeholder Advisory Committee to both incorporate new science and updated data, and also improve their usability. In order to continue the success of the 2006 COAs, the same definition, concept, and general datasets were used in the 2015 analysis. Improvements would center on: incorporating updated versions of data within the modeling analysis; undergo a more specific (and better documented) analysis; work with ODFW field staff and experts to include major changes undergone across the landscape; and standardize COA profiles to provide a more clear connections between COAs and Strategy Species, Strategy Habitats, and Key Conservation Issues. During the revision process, efforts were made to improve how COAs could work alongside Oregon's protected areas. For example, federal wilderness areas do not allow restoration or enhancement projects within them, but

do provide important protection of areas that contain high concentrations of Strategy Species and Strategy Habitats. As described in the methodology section, wilderness areas were removed from the revised COAs and instead an effort was made to include areas directly adjacent. This maximized the area within COA where conservation actions can take place, and also builds upon existing protected areas to enhance connectivity contiguous blocks of Strategy Habitats.

COAs were updated for the Oregon Conservation Strategy Revision in four primary steps: Spatial Modeling Analysis; Review; Delineation; and Profile Development all of which are extensively covered within the [Methodology section](#). The revised COA boundaries are displayed on the following pages by ecoregion. Example COA Profiles are provided to demonstrate the detailed information that will be available for each COA, and how they directly relate to Conservation Strategy components, and connect to ongoing efforts and potential partners on the ground (Note: COA profiles are currently under development and will be completed prior to the USFWS submission on October 1). Within the Conservation Strategy web application and the Compass mapping application, COAs will be provided in multiple, interactive mapping formats. Users will be able to easily determine COA boundaries and access profile information from a user friendly, graphical interface, and also have a detailed understanding of how the COAs were generated. The new online format of the Conservation Strategy will allow for Strategy Species and Habitat information within each COA to be maintained and updated, as well as the inclusion of newly developed conservation efforts, plans, and potential partners.

## Conservation Opportunity Area Boundaries

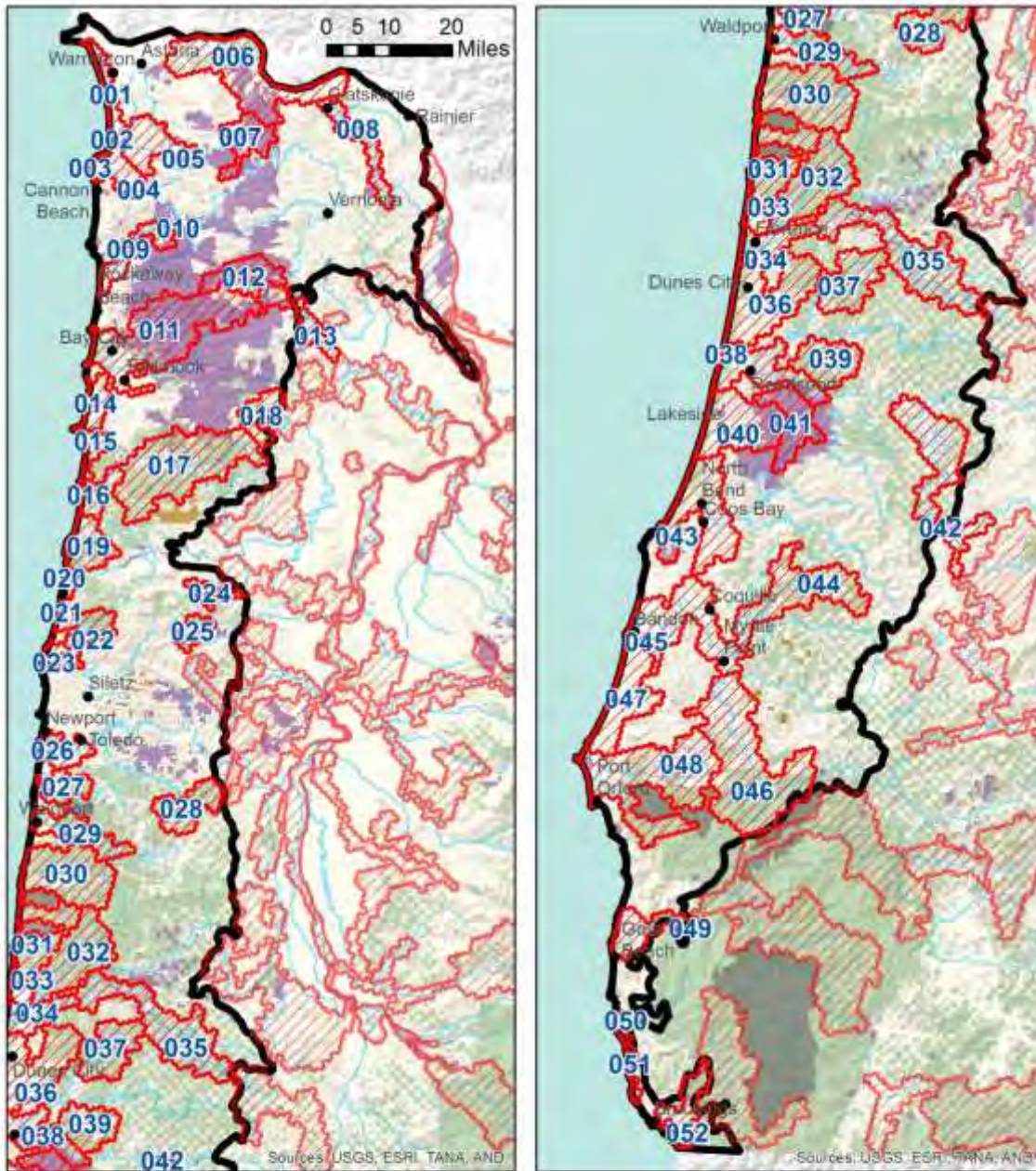
### Blue Mountains Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries



**Blue Mountains Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

<b>COA ID</b>	<b>COA Name</b>
<b>149</b>	Deschutes River
<b>150</b>	Metolius Bench-Mutton Mountains Wildlife Movement Corridor
<b>157</b>	Walla Walla Headwaters
<b>158</b>	Lower Grande Ronde
<b>159</b>	Grande Ronde Valley
<b>160</b>	Upper Grande Ronde River Area
<b>161</b>	Imnaha
<b>162</b>	Zumwalt Prairie Plateau
<b>163</b>	Wallowa Mountains
<b>164</b>	Powder River Sage-Grouse Core Area
<b>165</b>	Baker Valley Wetlands
<b>166</b>	Burnt River
<b>167</b>	Willow Creek-Birch Creek Area
<b>168</b>	North Fork John Day River 1
<b>169</b>	North Fork John Day River 2
<b>170</b>	Middle Fork John Day River
<b>171</b>	South John Day River
<b>172</b>	East Madras-Trout Creek Sagebrush and Grassland Area
<b>173</b>	Ochoco Mountains
<b>174</b>	South Fork Crooked River Area
<b>175</b>	Silver Creek Area
<b>176</b>	Fields Peak
<b>177</b>	Bear Valley
<b>178</b>	Upper Silvies River
<b>179</b>	Logan Valley-John Day River Headwaters
<b>181</b>	Rattlesnake Creek-Calamity Creek Area
<b>182</b>	North Fork Malheur-Monument Rock Area
<b>183</b>	Bully Creek Area

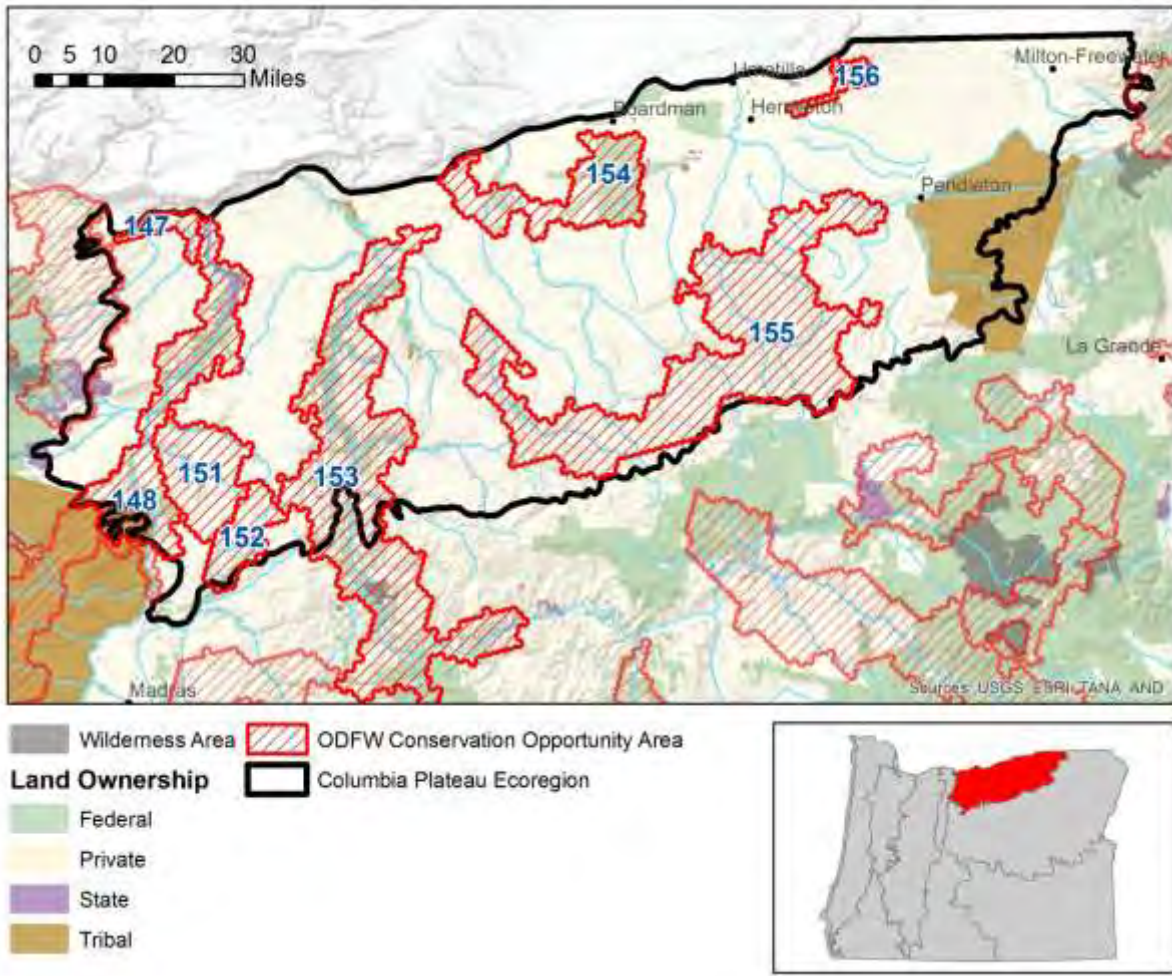
**Coast Range Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries**



**Coast Range Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

<b>COA ID</b>	<b>COA Name</b>	<b>COA ID</b>	<b>COA Name</b>
001	Clatsop Plains	027	Beaver Creek
002	Necanicum Estuary	028	Mary's Peak
003	Tillamook Head	029	Alsea Estuary-Alsea River
004	Necanicum River	030	Yachats River Area
005	Saddle Mountain	031	Heceta Head
006	Columbia River-Blind Slough Swamp	032	North Fork Siuslaw River
007	Clatsop State Forest-Jewel Meadows Area	033	Sutton Lake Area
008	Clatskanie River	034	Siuslaw River Estuary
009	Nehalem River Estuary	035	Siuslaw River
010	North Fork Nehalem Reiver	036	Tahkenitch-Siltcoos Lakes
011	Tillamook Bay and Tributaries	037	North Fork Smith River
012	Nehalem and Salmonberry River Headwaters	038	Umpqua River Estuary
013	Gales Creek	039	Wassen Creek
014	Netarts Bay	040	Tenmile Lake
015	Sand Lake Area	041	Elliot State Forest
016	Nestucca Bay	042	Umpqua River
017	Nestucca River Watershed	043	Coos Bay
018	Trask Mountain	044	Coos Mountain-Middle Creek
019	Salmon River Estuary-Cascade Head	045	Lower Coquille River
020	Devil's Lake	046	South Fork Coquille
021	Siletz Bay	047	New River Area
022	Siletz River	048	Sixes River-Elk Creek
023	Depot Bay Area	049	Lower Rogue River and Estuary
024	Mill Creek	050	Pistol River Estuary
025	Rickreall Creek and Little Luckiamute River Headwaters	051	Cape Ferrelo
026	Yaquina Bay	052	Cetco River-Winhchuck River Estuaries

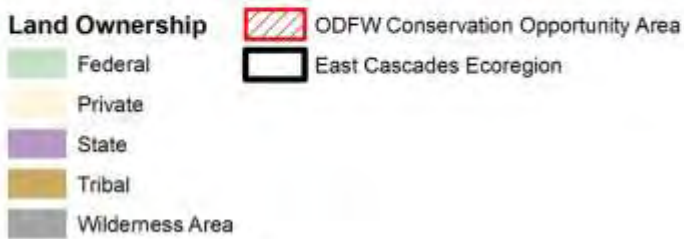
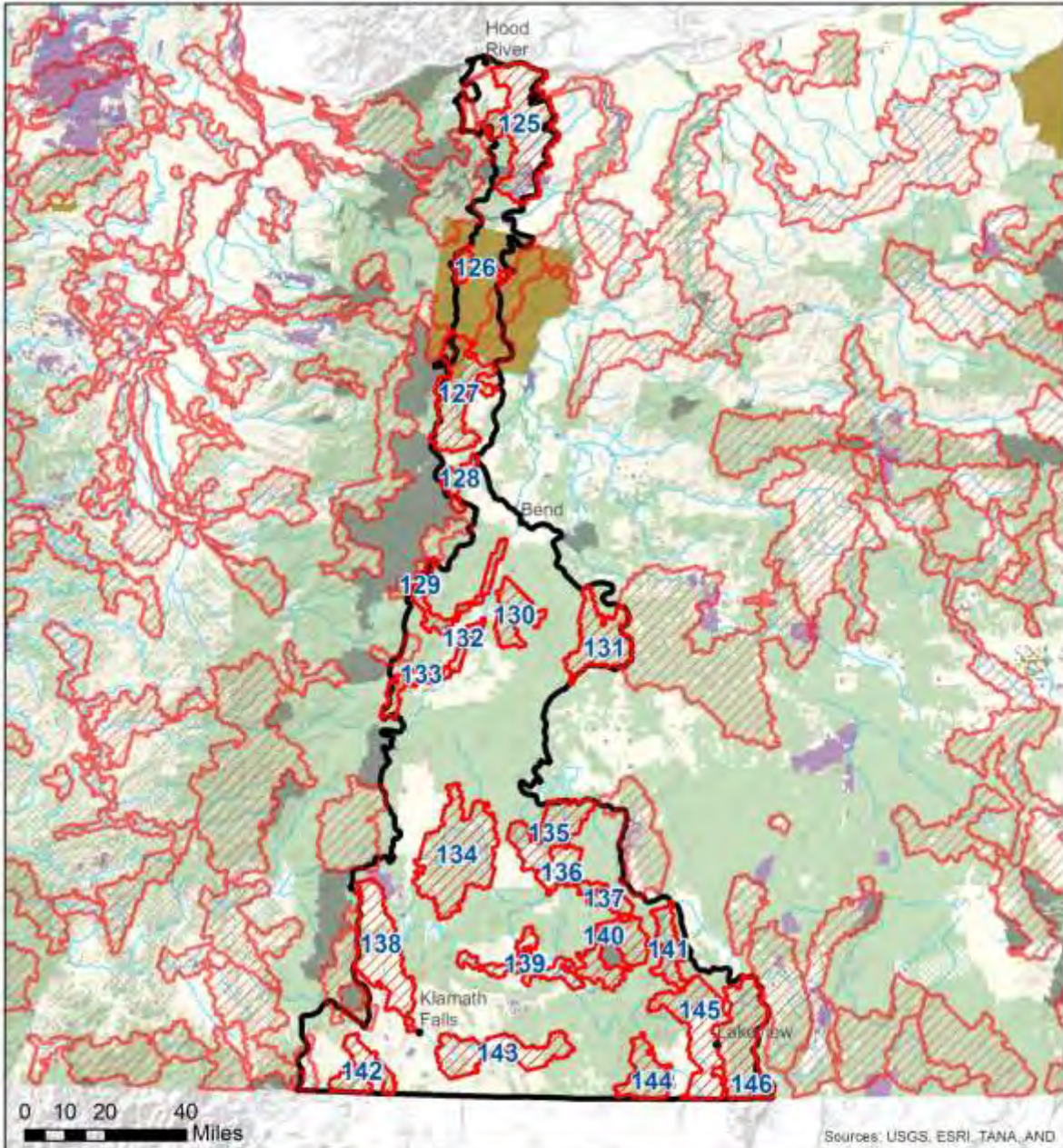
**Columbia Plateau Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries**



**Columbia Plateau Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

COA ID	COA Name
147	Fifteenmile Creek
148	Lower Deschuttes River
151	Bakeoven Creek-Buckhollow Creek
152	Lawrence Grasslands
153	Lower John Day River
154	Boardman Area
155	Rock Creek-Butter Creek Grasslands
156	Cold Springs National Wildlife Refuge Area

**East Cascades Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries**



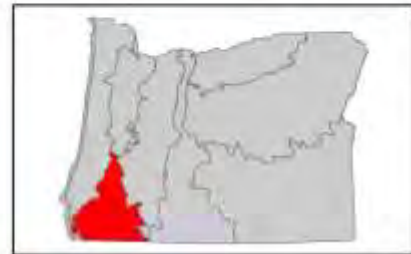
**East Cascades Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

<b>COA ID</b>	<b>COA Name</b>
<b>125</b>	Wasco Oaks
<b>126</b>	Warm Springs River
<b>127</b>	Metolius River Area
<b>128</b>	Whychus Creek
<b>129</b>	Upper Deschuttes River
<b>130</b>	Newberry Crater
<b>131</b>	Quartz Mountain
<b>132</b>	Little Deschuttes River
<b>133</b>	Big Marsh Creek
<b>134</b>	Klamath Marsh-Williamson River
<b>135</b>	Long Creek-Coyote Creek-Silver Creek
<b>136</b>	Sycan Marsh
<b>137</b>	Sycan River
<b>138</b>	Upper Klamath Lake Area
<b>139</b>	Sprague River
<b>140</b>	Gearhart Mountain-North Fork Sprague
<b>141</b>	Chewaucan River
<b>142</b>	Klamath River Canyon
<b>143</b>	Lost River Area
<b>144</b>	Dry Valley
<b>145</b>	Thomas Creek-Goose Lake
<b>146</b>	Warner Mountains

**Klamath Mountains Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries**



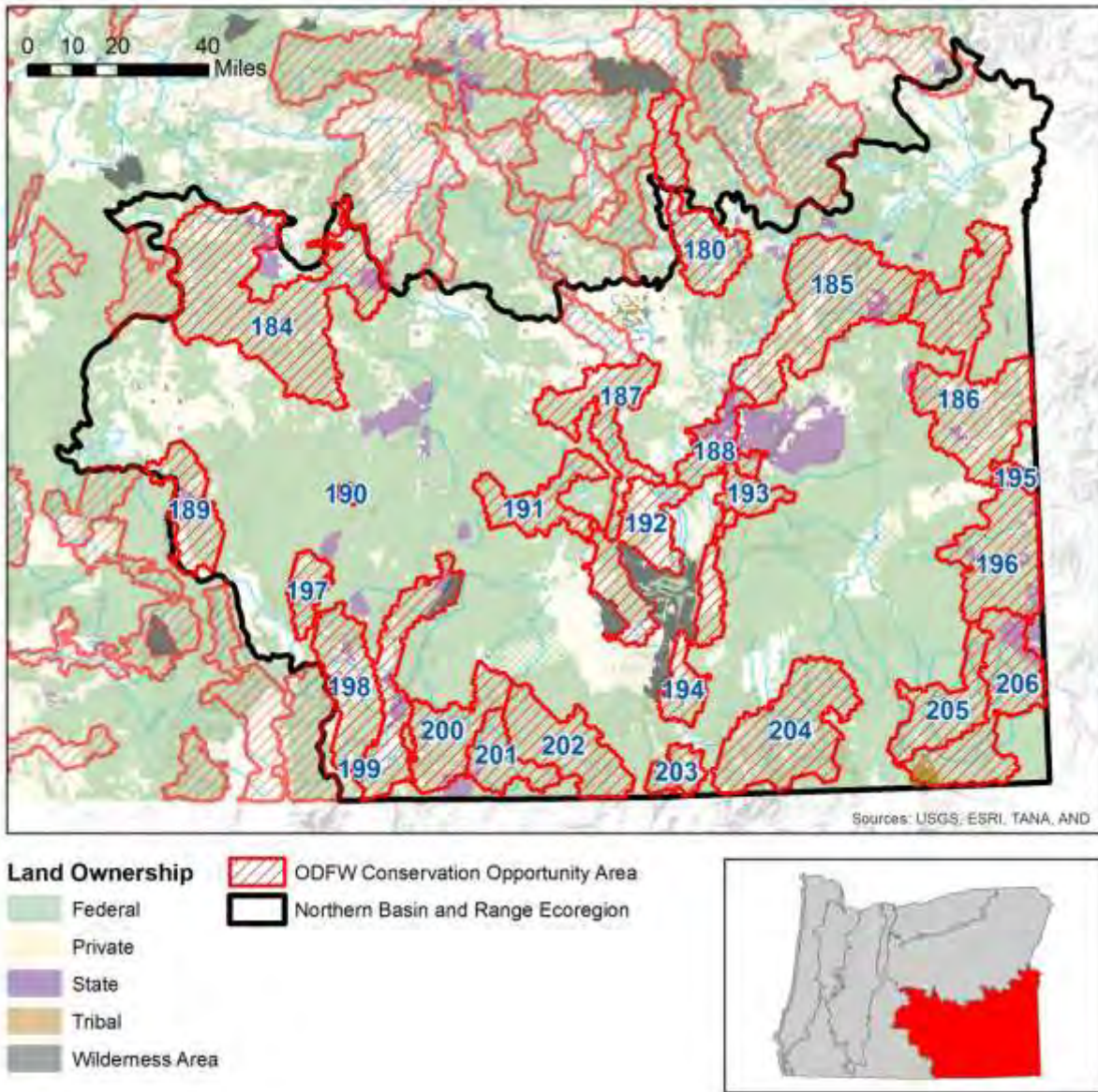
- Land Ownership**
- Federal
  - Private
  - State
  - Tribal
  - Wilderness Area
- ODFW Conservation Opportunity Area
- Klamath Mountains Ecoregion



***Klamath Mountains Ecoregion, 2015 ODFW Conservation Opportunity Area Names***

<b>COA ID</b>	<b>COA Name</b>
<b>090</b>	North Umpqua River Area
<b>091</b>	South Fork Umpqua River and Tributaries
<b>092</b>	Tenmile Area
<b>093</b>	Rogue River
<b>94</b>	Grave Creek
<b>095</b>	King Mountain Area
<b>096</b>	Illinois River-Silver Creek
<b>097</b>	North Medford Area
<b>098</b>	Shady Cove Foothills
<b>099</b>	Antelope Creek-Paynes Cliffs
<b>100</b>	Kalmiopsis Area
<b>101</b>	East Fork Illinois River
<b>102</b>	Oregon Caves-Applegate Area
<b>103</b>	Anderson Butte
<b>104</b>	Siskoyou Crest Area

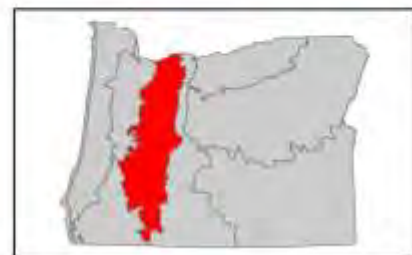
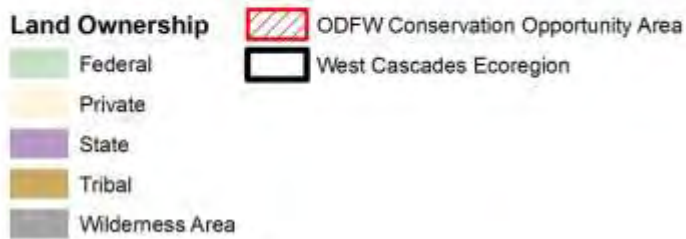
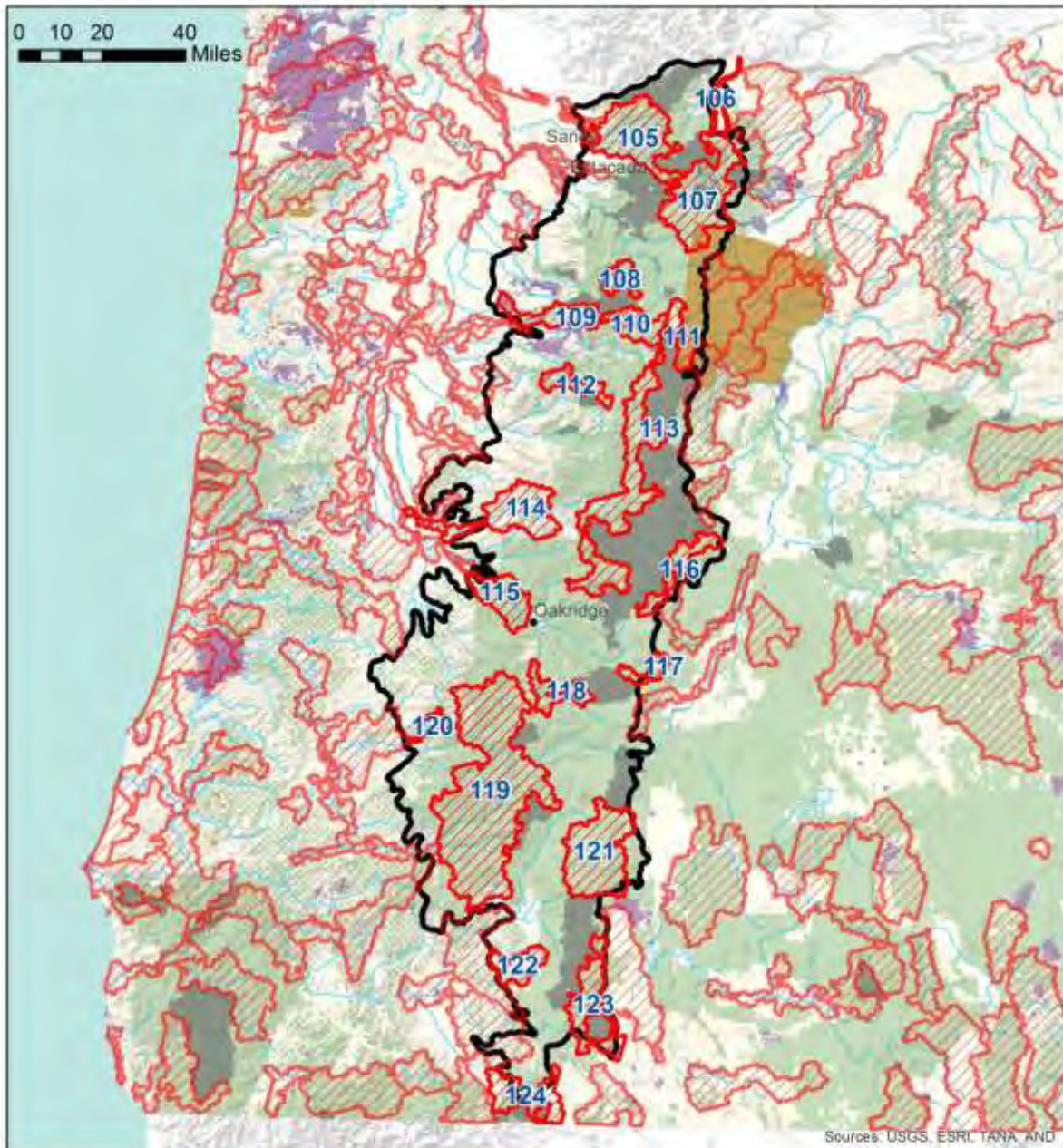
**Northern Basin and Range Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries**



**Northern Basin and Range Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

<b>COA ID</b>	<b>COA Name</b>
180	Malheur River Headwaters
184	Brothers-North Wagontire
185	Crowley
186	Middle Owyhee River Area
187	Harney-Malheur Area
188	Upper South Fork Malheur Area
189	Summer Lake Area
190	Alkali Lake
191	Foster Flat-Black Rim Sagebrush Area
192	Steens Mountain
193	Ten Cent Lake-Juniper Lake Area
194	Alvord Lake Basin
195	Jordan Creek Wetlands
196	Soldier Creek-Upper Owyhee River
197	Lake Abert
198	Warner West
199	Warner Basin Wetlands
200	Hart Mountain Area
201	Sage Hen Creek
202	Basque Hills Area Plains
203	Pueblo Mountain
204	Trout Creek Mountains
205	Little Louse Canyon
206	Three Forks

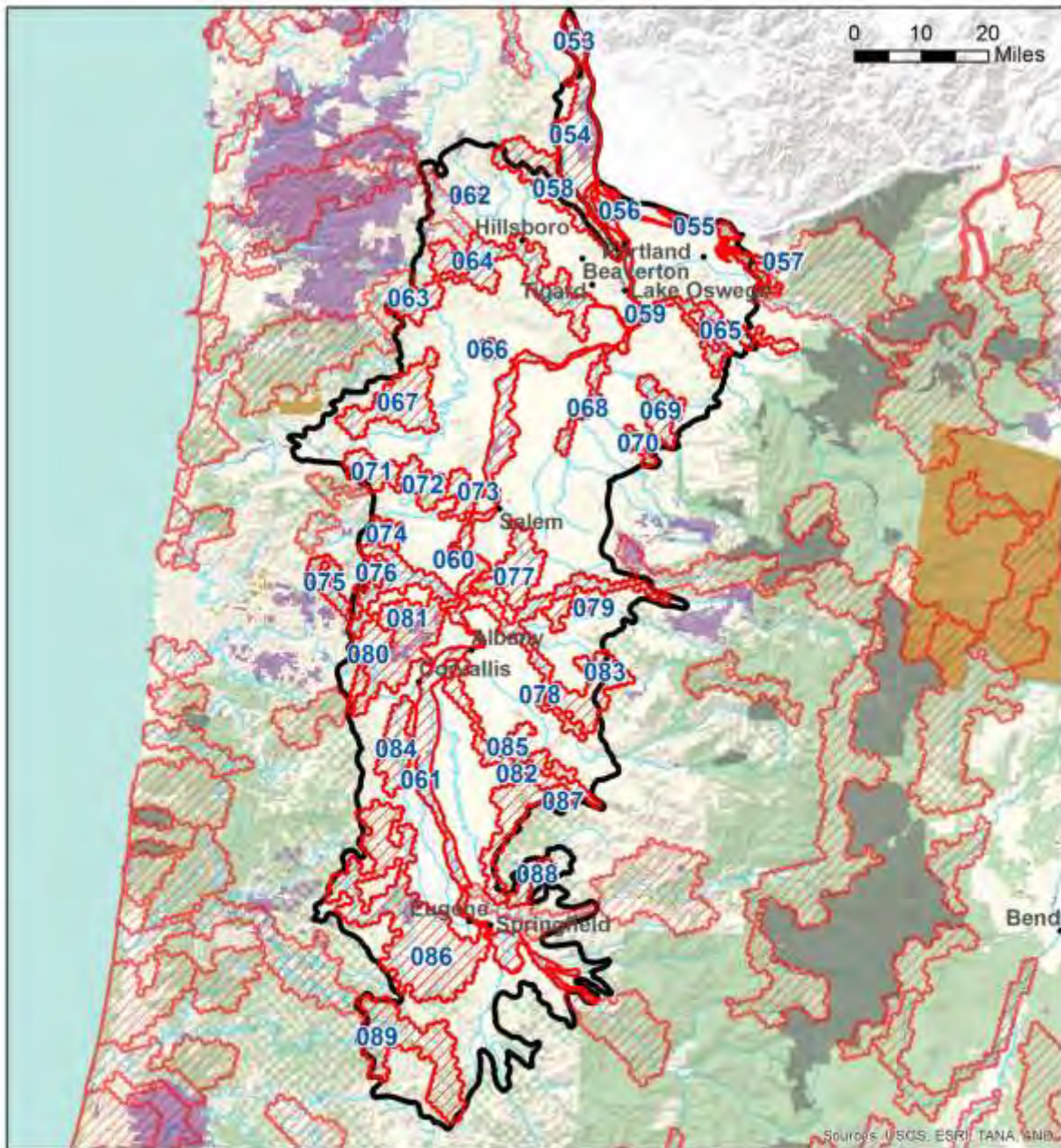
*West Cascades Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries*



**West Cascades Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

<b>COA ID</b>	<b>COA Name</b>
<b>105</b>	Bull Run-Sandy Rivers
<b>106</b>	Hood River
<b>107</b>	Mt Hood Area
<b>108</b>	Bull of the Woods, North
<b>109</b>	Little North Santiam River Area
<b>110</b>	Breitenbush River
<b>111</b>	Mt Jefferson Wilderness, North
<b>112</b>	Quartzville Creek Area
<b>113</b>	Central Cascades Crest. West
<b>114</b>	McKenzie River Area
<b>115</b>	Middle Fork Willamette River
<b>116</b>	Central Cascades Crest, Southeast
<b>117</b>	Odell Lake-Davis Lake
<b>118</b>	Middlefork Willamette River Headwaters
<b>119</b>	Umpqua Headwaters
<b>120</b>	Rock Creek
<b>121</b>	Crater Lake
<b>122</b>	Big Butte Area
<b>123</b>	Pelican Butte-Sky Lakes Area
<b>124</b>	Soda Mountain Area

*Willamette Valley Ecoregion, 2015 ODFW Conservation Opportunity Area Boundaries*



**Willamette Valley Ecoregion, 2015 ODFW Conservation Opportunity Area Names**

<b>COA ID</b>	<b>COA Name</b>	<b>COA ID</b>	<b>COA Name</b>
053	Deer Island	072	Basket Butte
054	Sauvie Island-Scappoose	073	Eola Hills
055	Hayden Island-Government Island	074	Habeck Oaks
056	Smith-Bybee Lakes and Columbia Slough	075	Luckiamute River and Tributaries
057	Lower Sandy River	076	McTimmons Valley - Airlie Savanna
058	Forest Park	077	Salem Hills-Ankeny NWR
059	Lower Willamette River Floodplain	078	Santiam Confluences
060	Middle Willamette River Floodplain	079	Kingston Prairie-Scio Oak Pine Savanna
061	Upper Willamette River Floodplain	080	Kings Valley-Woods Creek Oak Woodlands
062	Banks Swamp	081	Corvallis Area Forests and Balds
063	Scoggins Valley-Mount Richmond	082	Calapooia River
064	Tualatin River	083	One Horse Slough-Beaver Creek
065	Clackamas River and Tributaries	084	Finley-Muddy Creek Area
066	Dundee Oaks	085	Crawfordsville Oak-Washburn Butte
067	Yamhill Oaks-Willamina Oaks North	086	West Eugene Area
068	Pudding River	087	Coburg Ridge
069	Molalla River	088	Mohawk River
070	Missouri Ridge	089	Upper Siuslaw
071	Red Prairie-Mill Creek-Willamina Oaks South		

## Conservation Opportunity Area Profiles

In the 2006 Strategy, Conservation Opportunity Area (COA) profiles were provided within the Ecoregion chapters, and included some basic information about each COA, including types of species and habitats, and suggested conservation actions [[2006 Conservation Strategy: Ecoregions](#)]. For the 2015 Strategy update, the COA profiles have been standardized and expanded to focus on connecting Strategy users to more detailed information about each COA. COA profiles include information describing the general area and special features; specific Strategy Species and Habitats; Key Conservation Issues of especially high relevance; recommended conservation actions; and local conservation partners, plans and contact information. All components within a COA will provide links to sections of the Strategy they are most connected to, or links to the plans and partners that exist outside the Strategy. COA profiles also highlight priority actions to implement in individual COAs, which can range from restoration projects, to monitoring for invasive species. These recommendations were identified through existing plans, spatial analysis, and expert review. COA profiles are also intended to be dynamic, and will be updated as more information is made available, new projects begin, or new plans are approved within a given COA. COA profiles are not meant to be exhaustive, and other conservation actions within a COA are appropriate to consider, as influenced by local site characteristics and management goals. Actions need to be compatible with local priorities, local comprehensive plans and land use ordinances; as well as local, state, or federal laws. Actions on federal lands must undergo federal planning processes prior to implementation to ensure consistency with existing plans and management objectives for the area.

The revised COA Profiles are still under development, but all profiles will be completed before submission to the U.S. Fish and Wildlife Service. COA profiles are intended to be frequently updated to include new data and information as they become available, as well as new plans, projects, and potential partners as new conservation actions are initiated. The following examples provide detailed profiles for two COAs: Lower Sandy River and Summer Lake Area.

**COA Profile Example 1: Lower Sandy River**

<b>COA Name</b>	Lower Sandy River
<b>COA ID</b>	057
<b>Ecoregion</b>	Willamette Valley, West Cascades
<b>COA Description</b>	This area is comprised of the 1,500-acre Sandy River Delta at the confluence of the Sandy and Columbia Rivers, plus the Lower Sandy River and its tributaries, including Beaver Creek and the lower reaches of the Bull Run River. Located east of the Portland Metro area in the Columbia River Gorge National Scenic Area.
<b>Special Features</b>	<p>Number of observed Strategy Species: 27            Number of Strategy Habitats: 5            Includes public lands: Sandy River Delta Recreation Area, Lewis and Clark State Park, Glen Otto Community Park, Dabney State Recreation Area, Oxbow Regional Park, Dodge Park, Sandy River Wild and Scenic River            A large and diverse area of floodplain, bottomland hardwood forest, wetlands, wet prairies, sloughs, Oregon white oak, and conifer forest            Very important area for migratory birds and fish, especially salmonids            Reproducing populations of red-legged frog and western painted turtle            Priority area in Lower Columbia River Fish Conservation and Recovery Plan            Included within 2006 ODFW COA: WV-06</p>
<b>Strategy Species</b>	
<i>Amphibians</i>	Cascade Torrent Salamander (Observed)
	Cascades Frog (Modeled Habitat)
	Clouded Salamander (Modeled Habitat)
	Coastal Tailed Frog (Modeled Habitat)
	Cope's Giant Salamander (Modeled Habitat)
	Larch Mountain Salamander (Modeled Habitat)
	Oregon Slender Salamander (Observed)
	Red-Legged Frog (Observed)
	Western Toad (Modeled Habitat)
<i>Birds</i>	American Peregrine Falcon (Observed)
	Chipping Sparrow (Observed)
	Common Nighthawk (Observed)
	Grasshopper Sparrow (Observed)
	Great Gray Owl (Modeled Habitat)
	Harlequin Duck (Modeled Habitat)
	Lewis's Woodpecker (Observed)
	Northern Goshawk (Modeled Habitat)
	Northern Spotted Owl (Modeled Habitat)
	Olive-sided Flycatcher (Observed)
	Oregon Vesper Sparrow (Modeled Habitat)
	Short-eared Owl (Modeled Habitat)
	Slender-billed Nuthatch (Observed)
	Western Bluebird (Observed)
	Western Meadowlark (Observed)
	Western Purple Martin (Observed)
	Willow Flycatcher (Observed)
Yellow-breasted Chat (Observed)	
<i>Mammals</i>	California Myotis (Modeled Habitat)
	Fringed Myotis (Modeled Habitat)
	Hoary Bat (Modeled Habitat)
	Long-legged Myotis (Modeled Habitat)
	Red Tree Vole (Modeled Habitat)

	Silver-haired Bat (Modeled Habitat)
	Townsend's Big-eared Bat (Modeled Habitat)
	Western Gray Squirrel (Modeled Habitat)
<i>Fish</i>	Chinook Salmon, Fall Run
	Chinook Salmon, Spring/Summer Run
	Chum Salmon
	Coastal Cutthroat Trout
	Coho Salmon
	Pacific Lamprey
	Steelhead, Summer Run
	Steelhead, Winter Run
<i>Plants</i>	White Rock Larkspur
<i>Reptiles</i>	Northern Pacific Pond Turtle (Observed)
<i>Invertebrates</i>	Western Painted Turtle (Observed)
	California Floater (Observed)
<b>Strategy Habitats</b>	Flowing Water and Riparian
	Grasslands
	Late Successional Mixed Conifer Forests
	Oak Woodlands
	Wetland
<b>Specialized Local Habitats</b>	Tidally influenced floodplain forests, Bottomland Hardwood forest, Cottonwood Gallery Forest, Side channel habitats, Wet Prairie
<b>Recommended Conservation Actions</b>	Restore wetland, wet prairie, and riparian forest habitats.
	Maintain, improve, and expand Oregon white oak habitat.
	Maintain / restore natural hydrology and complex habitat for a variety of aquatic and terrestrial species.
	Manage public access and recreation, including off-leash dogs, to minimize conflict with habitat restoration goals.
	Maintain and improve aquatic and upland habitats for native turtle population - provide still-water habitat , nesting habitat and basking structures.
	Maintain and improve aquatic and upland habitats for red-legged frog population - provide still-water habitat, improve egg-mass attachment sites.
	Restore or create off-channel habitat and/or access to off-channel habitat.
	Protect remaining high-quality off-channel from degradation and improve habitat complexity.
	Protect instream water rights.
	Breach, lower, and remove dikes and levees to improve connectivity.
Improve water quality by identifying sources of and reducing sedimentation and by implementing stormwater management plans for urban areas and roads.	
<b>Local Conservation Actions and Plans</b>	<a href="#">Bull Run Water Supply Habitat Conservation Plan (2008)</a>
	<a href="#">Conservation Strategy for Landbirds in Lowlands and Valleys of Western Oregon and Washington (2000)</a>
	<a href="#">Habitat Conservation for Landbirds in the Coniferous Forests of Western Oregon and Washington (2012)</a>
	<a href="#">Lower Columbia River Conservation &amp; Recovery Plan for Oregon Populations of Salmon &amp; Steelhead (2010)</a>
	<a href="#">Lower Sandy River Habitat Assessment and Candidate Site Design Project (2012)</a>
	<a href="#">The Intertwine Regional Conservation Strategy (2012)</a>
	<a href="#">Salmon and Steelhead Conservation: An assessment of anchor habitat on the Sandy River, Oregon (2005)</a>
	<a href="#">Sandy Basin Vegetation Restoration Plan (2012)</a>
	<a href="#">Sandy River Basin Aquatic Habitat Restoration Strategy: An Anchor Habitat-Based Prioritization of Restoration Opportunities (2007)</a>
	<a href="#">Sandy River Basin Characterization Report (2005)</a>
	<a href="#">Sandy River Basin Initiative - Proposed Focused Investment Priority</a>

	<a href="#">Sandy River Basin Integrated Management Plan (2009)</a>
	Sandy River Delta Plan and EIS (1996)
	<a href="#">Sandy River Delta Section 536 Ecosystem Restoration Project EA (2013)</a>
	<a href="#">Short-Term Sandy River Basin Salmon Habitat Conservation and Restoration Strategy (2010)</a>
	<a href="#">Strategic Conservation Management in Oregon's Willamette Valley: Surrogate Species Pilot 1.0 (2014)</a>
	<a href="#">The Nature Conservancy Willamette Synthesis</a>
<b>Potential Partners</b>	<a href="#">Association of Northwest Steelheaders</a>
	<a href="#">Bonneville Power Administration</a>
	<a href="#">City of Portland Water Bureau</a>
	<a href="#">City of Troutdale</a>
	<a href="#">Clackamas Soil and Water Conservation District</a>
	<a href="#">East Multnomah Soil and Water Conservation District</a>
	<a href="#">Friends of the Sandy River Delta</a>
	<a href="#">Lower Columbia Estuary Partnership</a>
	<a href="#">Metro Regional Government</a>
	<a href="#">NOAA Fisheries Service</a>
	<a href="#">Oregon Department of Environmental Quality</a>
	<a href="#">Oregon Department of Fish and Wildlife</a>
	<a href="#">Oregon Parks and Recreation Department</a>
	<a href="#">Portland General Electric</a>
	<a href="#">Sandy River Basin Watershed Council</a>
	<a href="#">The Nature Conservancy in Oregon</a>
	<a href="#">US Fish and Wildlife Service</a>
	<a href="#">USDA Forest Service</a>
<a href="#">USDI Bureau of Land Management</a>	
<a href="#">Western Rivers Conservancy</a>	

**COA Example Profile 2: Summer Lake Area**

<b>COA Name</b>	Summer Lake Area
<b>COA ID</b>	189
<b>Ecoregion</b>	Northern Basin and Range
<b>COA Description</b>	This area is comprised of Summer Lake and the surrounding high desert wetlands subregion, including much of the Diablo Mountain Wilderness Study Area.
<b>Special Features</b>	<p>Number of observed Strategy Species: 23            Number of Strategy Habitats: 6            Summer Lake Wildlife Area            Diverse and expansive wetland complex (including playas, seasonal wetlands, etc.)            Important stop-over for migratory birds            Includes ODFW Sage-Grouse Core Area            Included within 2006 ODFW COA: NBR-02</p>
<b>Strategy Species</b>	
<i>Amphibians</i>	Western Toad (Modeled Habitat)
<i>Birds</i>	American White Pelican (Observed)
	Black-backed Woodpecker (Observed)
	Black-necked Stilt (Observed)
	Blue-gray Gnatcatcher (Observed)
	Caspian Tern (Observed)
	Ferruginous Hawk (Observed)
	Franklin's Gull (Observed)
	Greater Sage-grouse (Observed)
	Greater Sandhill Crane (Observed)
	Lewis's Woodpecker (Observed)
	Long-Billed Curlew (Observed)
	Northern Goshawk (Observed)
	Snowy Egret (Observed)
	Swainson's Hawk (Observed)
	Western Burrowing Owl (Observed)
	Western Snowy Plover (Observed)
	White-Faced Ibis (Observed)
	Willow Flycatcher (Observed)
	Flammulated Owl (Modeled Habitat)
	Great Gray Owl (Modeled Habitat)
Olive-sided Flycatcher (Modeled Habitat)	
White-headed Woodpecker (Modeled Habitat)	
Yellow Rail (Modeled Habitat)	
<i>Fish</i>	Redband Trout
<i>Mammals</i>	California Myotis (Observed)
	Hoary Bat (Observed)
	Long-legged Myotis (Observed)
	Silver-haired Bat (Observed)
	Pallid Bat (Modeled Habitat)

	Pygmy Rabbit (Modeled Habitat)
<b>Strategy Habitats</b>	Aspen Woodlands
	Flowing Water and Riparian
	Natural Lakes
	Ponderosa Pine Woodlands
	Sagebrush
	Wetlands
<b>Specialized and Local Habitats</b>	Alkaline lakes & wetlands, Alkali grasslands, Rock habitat, Salt desert scrub, Springs
<b>Key Conservation Issues</b>	Barriers to Fish and Wildlife Movement
<b>Recommended Conservation Actions</b>	Improve water delivery system within the Summer Lake area to improve effectiveness of wetland management.
	Maintain diverse wetland habitats.
	Restore and maintain complex, continuous sage habitat.
	Remove and control juniper encroachment into sage habitat.
	Promote early detection and suppression of invasive weeds.
	Manage livestock grazing to promote healthy wetlands and riparian areas.
<b>Local Conservation Actions and Plans</b>	<a href="#">Intermountain West Joint Venture Implementation Plan (2013)</a>
	<a href="#">Intermountain West Waterbird Conservation Plan (Ivey and Herziger 2006)</a>
	<a href="#">Coordinated Implementation Plan for Bird Conservation in Eastern Oregon (Taylor et.al. 2005)</a>
	East-side All-Bird Implementation Plan (Ivey 2000)
	Interior Columbia Basin Strategy (developed 2003, revised 2014)
	Oregon Biodiversity Project Conservation Opportunity Areas
	<a href="#">Partners in Flight Columbia Plateau Conservation Strategy (Altman and Holmes 2000)</a>
	<a href="#">Oregon's Important Bird Areas</a>
	<a href="#">Oregon Crucial Habitat Analysis</a>
	<a href="#">Oregon Aquatic Habitat and Restoration Guide. The Oregon Plan for Salmon and Watersheds (May 1999)</a>
	<a href="#">The Nature Conservancy Ecoregional Assessment</a>
	<a href="#">Wildlife Linkage Priority</a>
	<a href="#">Greater Sage-Grouse Conservation Assessment and Strategy for Oregon</a>
	Summer Lake Wildlife Area Management Plan
<b>Potential Partners</b>	<a href="#">Oregon Department of Fish and Wildlife</a>
	<a href="#">USDI Bureau of Land Management</a>
	<a href="#">Oregon Department of Transportation</a>
	<a href="#">U.S. Fish and Wildlife Service</a>
	<a href="#">The Nature Conservancy</a>
	<a href="#">Partners in Flight</a>
	<a href="#">Oregon Habitat Joint Venture</a>
	<a href="#">Intermountain West Joint Venture</a>
	<a href="#">Audubon Society of Portland</a>
<a href="#">East Cascades Audubon Society</a>	

<a href="#">Ducks Unlimited</a>
<a href="#">USDA Natural Resources Conservation Service</a>
<a href="#">Oregon Hunters Association</a>
<a href="#">The Oregon Watershed Enhancement Board</a>
<a href="#">Lake County Soil and Water District</a>

DRAFT

## Methodology

The methodology for the 2015 COA revision process included the following primary steps:

- Spatial Modeling Analysis
- Review
- Delineation
- Profile Development

A more detailed document covering the methodology for the 2015 COA process will be available within the COA metadata documentation.

### ***Spatial Modeling Analysis***

*ODFW would like to acknowledge:*

- *The Nature Conservancy for their assistance with the data and documentation described below. Some of the following text has been taken verbatim, with permission, from the TNC report "Conserving Nature's Stage: Identifying Resilient Terrestrial Landscapes in the Pacific Northwest" available for download from <http://nature.ly/resilienceNW>.*
- *The U.S. Fish and Wildlife Service, Portland Office for their assistance with Marxan training, providing scripts and tools, and overall support throughout the COA spatial modeling analysis.*

The process to update the COA boundaries included a rigorous spatial analysis, using a conservation prioritization and spatial modeling program called Marxan [<http://www.uq.edu.au/marxan/>]. Marxan provides decision support within the design of conservation areas, using best available data to focus on concentrations of Strategy Species, Strategy Habitats, and additional datasets related to select Key Conservation Issues (Climate Change, Disruption of Disturbance Regimes, and Barriers to Animal Movement). The Marxan spatial modeling analysis includes the following primary steps:

- 1) Compiling data into assessment units
  - 2) Setting Marxan goals for all Species, Habitats, and additional datasets
  - 3) Establishing a Suitability Index
  - 4) Variable Calibration
  - 5) Marxan Analysis
- 
- 1) Compiling data into assessment units

The first step in the planning process is to select conservation targets, based on available datasets. Conservation targets are those elements of biodiversity – plants, animals, and habitats – that are included in the list of Strategy Species and Habitats. Additionally, Ecological systems are used as a coarse filter for areas without strategy habitats, but are also in semi-natural condition. All targets are then attributed to assessment units, wall-to-wall polygonal features from which the conservation portfolio will be constructed.

In November, 2014 ODFW Conservation Staff met with a Technical Advisory Team (including representatives from The Nature Conservancy, Natural Resources Conservation Service (NRCS), US Fish and Wildlife Service, ODFW Fish Division Conservation and Recovery, The Wetlands Conservancy, Klamath Bird Observatory, Oregon Biodiversity Information Center, and Institute for Applied Ecology) to discuss which conservation targets, and associated datasets should be included within the 2015 COA

analysis. After additional research and discussion, the following datasets were determined to provide the best available information on each associated Strategy component.

Datasets used within the 2015 ODFW COA Analysis:

Strategy Component	Dataset	Source
Strategy Species: Wildlife (Amphibians, Birds, Mammals, Reptiles)	ORBIC Element Occurrences	<a href="http://orbic.pdx.edu/">http://orbic.pdx.edu/</a>
	ORBIC Point Observation Dataset	<a href="http://orbic.pdx.edu/">http://orbic.pdx.edu/</a>
	ODFW Observation Data	Many of the datasets listed here: <a href="http://dfw.state.or.us/maps/compass/md_terrestrial_species.asp">http://dfw.state.or.us/maps/compass/md_terrestrial_species.asp</a>
	eBird	<a href="http://ebird.org">http://ebird.org</a>
	ORBIC Species Models	<a href="http://orbic.pdx.edu/">http://orbic.pdx.edu/</a>
	Audubon Important Bird Areas	<a href="http://audubonportland.org/local-birding/iba">http://audubonportland.org/local-birding/iba</a>
Strategy Species: Fish	ODFW Crucial Habitat Assessment: Aquatic Species of Concern	<a href="http://dfw.state.or.us/maps/compass/md_aquatic_species.asp">http://dfw.state.or.us/maps/compass/md_aquatic_species.asp</a>
Strategy Habitats	2015 Conservation Strategy Habitat Map	Developed by ORBIC and ODFW. When completed, will replace: <a href="https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&amp;XMLname=892.xml">https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&amp;XMLname=892.xml</a>
Strategy Habitats: Flowing Water and Riparian	2010 ORBIC Ecological Systems	<a href="http://spatialdata.oregonexplorer.info/geoportal/catalog/search/resource/details.page?uuid={776E6118-422B-429C-8C30-24F289F9F192}">http://spatialdata.oregonexplorer.info/geoportal/catalog/search/resource/details.page?uuid={776E6118-422B-429C-8C30-24F289F9F192}</a>
	2011 National Land Cover Dataset	<a href="http://www.mrlc.gov/nlcd2011.php">http://www.mrlc.gov/nlcd2011.php</a>
	Wetland Restoration Planning Tool Dataset	<a href="http://oe.oregonexplorer.info/wetlands/restoration/">http://oe.oregonexplorer.info/wetlands/restoration/</a>
	Sage-Grouse Conservation Partnership (SageCON) Data	<a href="http://orsolutions.org/osproject/sagecon">http://orsolutions.org/osproject/sagecon</a>
	Confluences	Data derived from NHD stream intersections: <a href="http://nhd.usgs.gov/">http://nhd.usgs.gov/</a>
Key Conservation Issue: Climate Change	Willamette River Cold Water Sources	<a href="http://ise.uoregon.edu/slices/main.html">http://ise.uoregon.edu/slices/main.html</a>
	The Nature Conservancy Topo-Climate Diversity Model	<a href="http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/science/Pages/Resilient-Landscapes.aspx">http://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/science/Pages/Resilient-Landscapes.aspx</a>
Key Conservation Issue: Disruption of Disturbance Regimes	Floodplains (FEMA 100 year flood zones)	<a href="https://msc.fema.gov/portal">https://msc.fema.gov/portal</a>
Key Conservation	The Nature Conservancy	<a href="http://www.conservationgateway.org/">http://www.conservationgateway.org/</a>

Issue: Barriers to Animal Movement	Resistance Model	<a href="http://www.conservationsgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/science/Pages/Resilient-Landscapes.aspx">ConservationByGeography/NorthAmerica/UnitedStates/oregon/science/Pages/Resilient-Landscapes.aspx</a>
	The Nature Conservancy Species Permeability Model	<a href="http://www.conservationsgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/science/Pages/Resilient-Landscapes.aspx">http://www.conservationsgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/oregon/science/Pages/Resilient-Landscapes.aspx</a>
	USGS Protected Areas Database. Used to incorporate amount of private/public lands.	<a href="http://gapanalysis.usgs.gov/padus/">http://gapanalysis.usgs.gov/padus/</a>

Marxan requires the establishment of assessment units, which are contiguous portions of the landscape broken up into finer areas. The 2006 COA analysis used HUC level 6 watersheds, which vary in size and shape across the landscape. The 2015 COA analysis uses a finer resolution, 1-square mile hexagon grid of assessment units, which is the same base data used in many other projects including the Western Association of Fish and Wildlife Agencies Crucial Habitat Assessment Tool (<http://wafwachat.org/>), the ODFW Crucial Habitat Assessment work presented in ODFW [Compass](#), and the decision support system currently under development within the Oregon Sage-Grouse Conservation Partnership. Not only is this a finer-scaled assessment unit (allowing for more detail and precision within the analysis); but also all assessment units are the same size and shape (providing for a more statistically sound analysis).

2) Setting Marxan goals for all Species, Habitats, and additional datasets

After compiling all available data, the next step of the spatial modeling process involved setting goals for the representation (number of occurrences and geographic distribution) of each target with the overarching goal being the long-term viability of each. These goals are based on the number of populations or amount of area occupied, the distribution of each target across the geography, and target rarity and degree of endangerment. The latter ensures that each target is treated equally, allowing each to be represented in multiple COAs (where possible) as a hedge against stochastic events (e.g. disease, fire) and to buffer against the anticipated impacts of climate change.

Strategy Species and Habitat goals were generated using an overall range of 30% (recommended minimum amount of habitat needed to sustain imperiled populations) to 60% (recommended maximum amount of habitat to be included while still focusing on prioritized areas). The goal range was at times further adjusted to account for additional data characteristics (data that was more reliable were given higher goal percentages). Specific goals were then established based on the following matrices, with an emphasis on including higher percentages of Strategy Species and Habitats declared in smaller number of ecoregions. The overall objective of this process was to normalize all Species and Habitats throughout the COA analysis, providing higher goals for Species/Habitats that are represented in only 1 ecoregion, and lower goals for Species/Habitats represented in all ecoregions.

Terrestrial Strategy Species Goals: Matrix includes the number of ecoregions for each species, versus the NatureServe State Rank [<http://explorer.natureserve.org/ranking.htm>]. Goals were established for both species observations (higher percentage) and species modeling (lower percentage). 'XX' indicates no species occurred within those combinations.

		Number of Ecoregions							
		1	2	3	4	5	6	7	8
Strank	S1	60%/30%	XX	XX	XX	XX	50%/25%	XX	XX
	S2	60%/30%	50%/25%	50%/25%	50%/25%	50%/25%	40%/20%	40%/20%	40%/20%
	S3	60%/30%	50%/25%	50%/25%	50%/25%	40%/20%	40%/20%	40%/20%	40%/20%
	S4	50%/25%	50%/25%	XX	XX	40%/20%	XX	XX	XX
	S5	50%/25%	XX	40%/20%	XX	XX	XX	XX	XX

Aquatic (Fish) Strategy Species Goals: Matrix includes the number of ecoregions for each species, versus the priority rank established within the Aquatic Species of Concern Crucial Habitat Assessment [[http://www.dfw.state.or.us/maps/compass/md\\_aquatic\\_species.asp](http://www.dfw.state.or.us/maps/compass/md_aquatic_species.asp)].

		Number of Ecoregions						
		1	2	3	4	5	6	7
Aquatic SOC (CHAT) Priority	1	50%	40%	40%	40%	30%	30%	30%
	2	50%	40%	40%	30%	30%	30%	30%
	3	40%	40%	40%	30%	30%	30%	30%

Habitat Goals were established based on qualitative assessments of each habitats amount of impairment, data quality, and the number of ecoregions containing each habitat. (Additional data related to the Sagebrush and Wetlands habitats were incorporated to further prioritize especially high value habitat locations.)

Habitat	Ecoregion								
	BM	CR	CP	EC	KM	NBR	WC	WV	
Aspen Woodlands	60%			60%		60%			
Coastal Dunes		50%							
Estuaries		40%							
Natural Lakes	40%	40%	40%	40%	40%	40%	40%	40%	
Grasslands	50%	50%	50%		40%		40%	40%	
Late Successional Mixed Conifer Forests	40%	40%		40%	40%		40%		
Oak Woodlands		60%		60%	60%		60%	60%	
Ponderosa Pine Woodlands	40%			40%	50%				
Riparian and Flowing Water Habitats	40%	40%	40%	40%	40%	40%	40%	40%	
Sagebrush Habitats	50%		40%	50%		50%			
Sagebrush - "Degraded"	30%		NA	30%		30%			
Wetlands	40%	30%	40%	40%	30%	40%	30%	30%	
Wetlands - high conservation significance	60%	50%	60%	60%	50%	60%	50%	50%	

Remaining dataset goals were established primarily based on data quality:

Confluences: 30%

Floodplains: 20%

Topo-Climate Diversity: 40%

### 3) Establishing a Suitability Index

The suitability of each assessment unit is described based on features such as road density, GAP management status, land conversion/use and other factors related to the quality and condition of the area of the assessment unit. Overall, the suitability values denote the “cost” of conservation, or the impediments to conservation. In this case, information on landscape permeability will also be used as an indication of local connectivity with areas beyond the hexagon boundaries.

Three primary components will make up the SWAP Marxan suitability index:

- Anthropogenic conversion/Resistance
- Local connectivity/Permeability
- Protection Status per modified PAD US

#### *Resistance*

Resistance is measure of impediment to species movement and ecological flows created by anthropogenic landscape modification. In this case, we are only describing the direct impacts associated with conversion from semi-natural conditions, as opposed to indirect impacts such as behavioral responses to human modified landscapes.

Each cell in the resistance surface was assigned a value, or weighting, representing its hardness/impermeability to species movement and ecological flows. Higher values are more difficult to cross, while lower values are easier. Natural lands are assigned a value of 1, meaning the cost to move across the cell is equal to the Euclidean distance, allowing relatively free flow of ecological processes at that location.

The constituent datasets for the resistance surface included:

- ❖ 2011 National Land Cover Dataset, produced by the U.S. Geological Survey, used to map development classes, agriculture, natural lands, and open water across the project area.
- ❖ Publication transportation dataset (roads), produced by the U.S. Bureau of Land management, used west of the Cascade crest. Based on visual inspection against NAIP imagery, this dataset captured roads on private timberlands much better than TIGER.
- ❖ 2014 TIGER roads and highways, produced by the U.S. Census Bureau, were used throughout most of the remainder of the project area.
- ❖ EV Energy Map layer, produced by Ventyx Inc. (proprietary subscription service), was used to map all significant transmission lines, wind towers and natural gas pipelines across the project area.
- ❖ 2012 Railroads, digitized at 24k by the Oregon Department of Transportation, were used for the rialroads west of the Cascade crest. Abandoned lines are flagged.

- ❖ The 2013 Federal Railroad dataset, produced by the U.S. Railway Administration, was used for all areas east of the Cascade crest. Abandoned lines are flagged. Scale is 1:100k or better, though on visual inspection against NAIP imagery the data aligned well with the state-based railroad data at 24k.
- ❖ The 2010 *Population and Housing Unit Counts* Report, produced by the U.S. Census Bureau, were used in conjunction with census tract polygons (clipped to private lands) to calculate 8 classes of 'Block Housing Density' (BHD) on private lands across the study area. These data, obtained from David Theobald (Conservation Science Partners), were included to represent the non-specific impacts associated with increasing human densities. These impacts include noise, pollution, predation by household pets, modification of native vegetation, etc.

Development of the Resistance surface began with processing of the NLCD 2011 dataset. Removing linear developed features (such as roads) was the primary modification made to these data. Roads and developed classes within NLCD are poorly differentiated. Road cells are often classified as "Developed, high intensity," though many roads do not appear at all. Roads were therefore removed entirely from NLCD, following work by the Washington Wildlife Habitat Connectivity Working Group (WHCWG 2012). This was accomplished with the 'Shrink' tool (*Spatial Analyst Tools.tbx > Generalization > Shrink*), shrinking all developed classes by 1 cell and replacing those cells with their nearest neighbor values.

We developed expert-based resistance scores for all classes in each input dataset, representing the resistance to movement created by each landscape feature (Resistance Values Table). These data were input into the Resistance and Habitat Calculator of Gnarly Landscape Utilities (McRae et al. 2013, <http://www.circuitscape.org/gnarly-landscape-utilities>.) The resulting raster represented the maximum resistance across all input layers at a 30m cell size. We then used the Raster Cell Size Coarsener in Gnarly Landscape Utilities to aggregate these data to 90m. We took the mean of all cells within each 90m cell, using the option to smooth input data before aggregating.

#### Resistance Values Table

Data Layer	Class Description	Resistance
BHD2010	Undeveloped <sup>1</sup>	1
BHD2010	Residential - rural low (0.001-.0.006 dua)	1.2
BHD2010	Residential - rural (0.006-0.025 dua)	1.5
BHD2010	Residential - exurban low (0.025-0.1 dua)	2.5
BHD2010	Residential - exurban (0.1-0.4 dua)	4
BHD2010	Residential - low (0.4-1.6 dua)	7
BHD2010	Residential - med (1.6-10 dua)	16
BHD2010	Residential - high (>10 dua)	20
ENERGY	Wind Towers	10
ENERGY	Inner wind tower buffer (< 90m)	8
ENERGY	Outer wind tower buffer (90-180m)	6
ENERGY	Transmission line – Step-up -161 Volts	3
ENERGY	Transmission line - 230-287 Volts	4
ENERGY	Transmission line – 345-500 Volts	5
ENERGY	Transmission line - DC Line	5
ENERGY	NG Pipelines	3
NLCD	Open Water	1

NLCD	Perennial Ice/Snow	2
NLCD	Developed, Open Space	4
NLCD	Developed, Low Intensity	9
NLCD	Developed, Medium Intensity	20
NLCD	Developed, High Intensity	20
NLCD	Barren Land (Natural)	1
NLCD	Deciduous Forest (Deciduous, Evergreen, Mixed)	1
NLCD	Shrub/Scrub	1
NLCD	Grassland/Herbaceous	1
NLCD	Pasture/Hay	4
NLCD	Cultivated Crops	7
NLCD	Woody Wetlands	1
NLCD	Emergent Herbaceous Wetlands	1
RAIL_ACTIVE	Actively used / maintained rail lines	5
RAIL_ACTIVE	Abandoned lines based on inspection	3
TIGER_ROADS	Interstate, ramps <sup>2</sup>	20
TIGER_ROADS	State and local highways, major secondary roads <sup>3</sup>	20
TIGER_ROADS	City and rural streets, Unpaved and AWD (west of the Cascades crest)	3
ROADS – BLM	ALL BLM roads except highways (east of the Cascades crest)	3

<sup>1</sup>All lands with GAP 1, 2, or 3 protection status were considered undeveloped in housing density resistance calculations.

<sup>2</sup>Interstates, Highways, and interchange ramps were widened by one cell in resistance calculations

Each hexagon was imputed with the mean of the resistance values within it as a measure of the degree of conversion and corresponding loss of semi-natural habitat.

### Local Connectivity/Permeability

A highly permeable landscape is needed to maintain ecological processes, genetic diversity and adaptation potential of populations, and the ability of species to move as the climate changes. For species to take advantage of alternative locales, they need to be able to move across the landscape. In human-dominated landscapes, habitat conversion and fragmentation constrain the ability of many species to move even short distances. This inability to move and take advantage of newly available or alternative habitats may reduce the local diversity of native species in favor of habitat generalist species. Moreover, landscape and regional connectivity will be critical in allowing species to shift their ranges in response to climate changes (Heller and Zavaleta 2009) and to maintain species adaptive capacity by promoting gene flow (Sexton et al. 2011).

We are following the convention of Anderson et al. (2012) using the terms “permeability” and “connectedness” instead of “connectivity” and “corridors.” The conservation literature commonly defines “connectivity” as the capacity of individual species to move between blocks of habitat via corridors and linkage zones. As used here, permeability is not based on the needs of individual species, but is a measure of *the hardness of barriers, the connectedness of natural cover, and the arrangement of land uses* (Anderson et al. 2012). Meiklejohn et al. (2010) defined permeability as *the degree to which regional landscapes, encompassing a variety of natural, semi-natural and developed land cover types, will sustain ecological processes and are conducive to the movement of many types of organisms.*

Local permeability analyses measure how robust the structural connections are between natural systems within a local landscape. Roads, buildings, infrastructure, disturbance, and other aspects of an altered landscape directly affect processes and create resistance to species movement. Estimating permeability is important because it indicates whether a process is likely to be disrupted or how much access a species has to alternative climate niches and vegetation types within its given neighborhood.

Permeability analysis evaluates the connectivity of a focal cell to its ecological neighborhood when the cell is viewed as a source; in other words, it asks the question: “to what extent are ecological movements outward from that cell impeded or facilitated by the surrounding landscape?” Thus, permeability analysis starts with a focal cell and looks at the resistance to ecological movement outward in all directions through the local neighborhood. As resistance increases, movement or flow is impeded or stopped altogether. Areas of no resistance allow the flow to proceed until a user-specified maximum distance is achieved. Therefore, cells grow further in directions of low resistance.

TNC used kernel analysis (Compton et al. 2007, <http://www.umasscaps.org/>) to map local permeability. Each cell of a resistance grid is assigned a resistance value based on weights that the user assigns to each land cover and land use type. The modeled flow, or growth, outward from a focal cell is a function of the resistance values and distances to the neighboring cells out to a maximum distance of three kilometers. When each focal cell has grown to its maximum extent, it is scored by the number of neighborhood cells that it was able to grow into. Higher scores—larger numbers of cells a focal cell’s resistant kernel—indicate the landscape is more permeable to movement from the cell. Each focal cell is assigned a permeability value based on the number of cells in its resistant kernel.

Importantly, higher resistant kernel scores also indicate high potential for flow into a cell from the surrounding landscape. This means that cells with high scores can serve as destinations for local movements.

The inclusion of the permeability values in the Oregon Conservation Strategy COA update will provide important landscape context for each assessment unit. Though the value imputed to each hexagon will include some information on the permeability within the hexagon, the bulk of the score actually reflects the permeability of the neighborhood beyond the hexagon. This will encourage Marxan to preferentially select hexagons in permeable and well connected landscapes.

All pixels within the permeability and resistance values that included water (based on NLCD2011 data) were edited so that water did serve as a resistance to movement within this analysis. Each hexagon was imputed with the mean of the permeability and resistance values within it as a measure of its local landscape connectivity.

#### *Protection Status*

The USGS GAP program manages a nationwide *Protected Areas Database* that describes land ownership and management. Each combination of landowner and management category is attributed to one of 4 status categories. Those are:

- GAP Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
- GAP Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may

receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

- GAP Status 3: An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging, OHV recreation) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.
- GAP Status 4: There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout or management intent is unknown.

In some cases, management categories overlap, e.g. Wilderness areas (GAP 1 or 2) within National Forests (GAP 3). This version of the data has been processed to “flatten” these cases, such that only the highest protection status is retained in areas with overlapping management designations.

In addition, private land without any management status (GAP Status ‘0’) was inferred within each hexagon using the following calculation:

$$(\text{Area of hexagon} - (\text{GAP 1 area} + \text{GAP2 area} + \text{GAP3 area} + \text{GAP4 area}))$$

Each hexagon was imputed with the proportion (0 – 1) of its area within each of these 5 GAP Status categories.

#### *Calculating the Suitability Index*

Marxan requires a single numerical value to represent the total “cost” of each hexagon. As that single value is comprised from multiple factors, a robust method of combining these factors must be used. A commonly used method for combining such factors is the weighted geometric mean (United States Fish and Wildlife Service, *Standards for the development of habitat suitability index models*, 103 ESM. Division of Ecological Services, Department of the Interior, Washington, DC, 1981):

$$\text{COST} = [N(\text{factor 1})^X * N(\text{factor 2})^Y]^{[1 / (X+Y)]}$$

If  $X + Y = 1$ , then the equation simplifies to:

$$\text{COST} = N(\text{factor 1})^X * N(\text{factor 2})^Y$$

We used the geometric mean for two reasons. First, the factor exponents are an intuitive and explicit reflection of the factor weighting, and secondly, the suitability factors based upon landscape conversion (resistance and permeability) are grossly incommensurate with land management status, and therefore, should not be summed.

To calculate the index, we first decided the relative importance of the factors describing the conditions within the hexagon vs. local connectivity/conditions beyond the hexagon:

$$\text{COST} = (\text{Resistance and GAP Status})^X * (\text{Permeability})^Y$$

In this case, the relative weightings were set at  $X = 0.7$  and  $Y = 0.3$ .

Next, we decomposed the relative weightings of the Resistance and GAP status factors:

$$\text{COST} = ((\text{Resistance})^X * (\text{GAP Status})^Y)^{0.7} * (\text{Permeability})^{0.3}$$

In this case, the relative weightings were set at X = 0.6 and Y = 0.4.

Finally, the GAP Status term is decomposed. GAP 1 and 2 lands are generally considered well protected and an obvious choice for inclusion in COAs whenever feasible. Therefore, we considered those “free”, and didn’t include any cost for them in the equation. The remaining classes, 3, 4 and 0 were then ranked against each other. As the GAP Status categories are not incommensurate, and we don’t want low proportions of any single status to drive that portion of the index down in value, those terms should be summed.

$$\text{COST} = ((\text{Resistance})^{0.6} * ((\text{GAP } 3)^X + (\text{GAP } 4)^Y + (\text{GAP } 0)^Z)^{0.4})^{0.7} * (\text{Permeability})^{0.3}$$

In this case, the relative weightings were set at X = 0.1 and Y = 0.35 and Z = 0.55. The final suitability equation was therefore:

$$\text{COST} = ((\text{Resistance})^{0.6} * ((\text{GAP } 3)^{0.1} + (\text{GAP } 4)^{0.35} + (\text{GAP } 0)^{0.55})^{0.4})^{0.7} * (\text{Permeability})^{0.3}$$

To apply this equation to the hexagons, the mean of resistance and mean of permeability were both scaled from 0 – 1 using the following equation:

$$((\text{Factor Value} - \text{Minimum Factor value}) / (\text{Maximum Factor value} - \text{Minimum Factor value}))$$

As the GAP status information had been originally attributed as a proportion between 0 – 1, those values did not require rescaling. The scaled terms were then plugged into the equation to generate a base cost value for each hexagon. This value was, in turn, scaled up to an appropriate range to balance against the other factors Marxan uses when crafting solutions, and normalized to provide the exact same scale across all ecoregions.

#### 4) Variable Calibration

The Marxan spatial modeling software provides the ability to input specific variables to customize the analysis. Two of the most important variables are the Number of Iterations, and Boundary Length Modifier.

The “Number of Iterations” determines how close Marxan gets to the optimal solution (or at least a very good solution). The number should start high (e.g. 1000000) and then be increased (e.g. 10 million or more is commonly applied on large scale datasets) until there is no substantial improvement in score as iterations continues to increase. At some point, the extra time required by a higher number of iterations will be better spent doing more runs than spending a long time on each run. Choose an acceptable trade-off between solution efficiency (score, or number of planning units) and execution time (number of iterations) (Marxan Users Manual, [http://www.uq.edu.au/marxan/docs/Marxan\\_User\\_Manual\\_2008.pdf](http://www.uq.edu.au/marxan/docs/Marxan_User_Manual_2008.pdf)).

The “Boundary Length Modifier” is used to determine how much emphasis should be placed on minimizing the overall reserve system boundary length. Minimizing this length will produce a more compact reserve system, which may be desirable for a variety of pragmatic reasons. Emphasizing the importance of a compact network will mean that your targets are likely to be met in a smaller number of large reserves, generally resulting in on overall larger and more expensive reserve system.

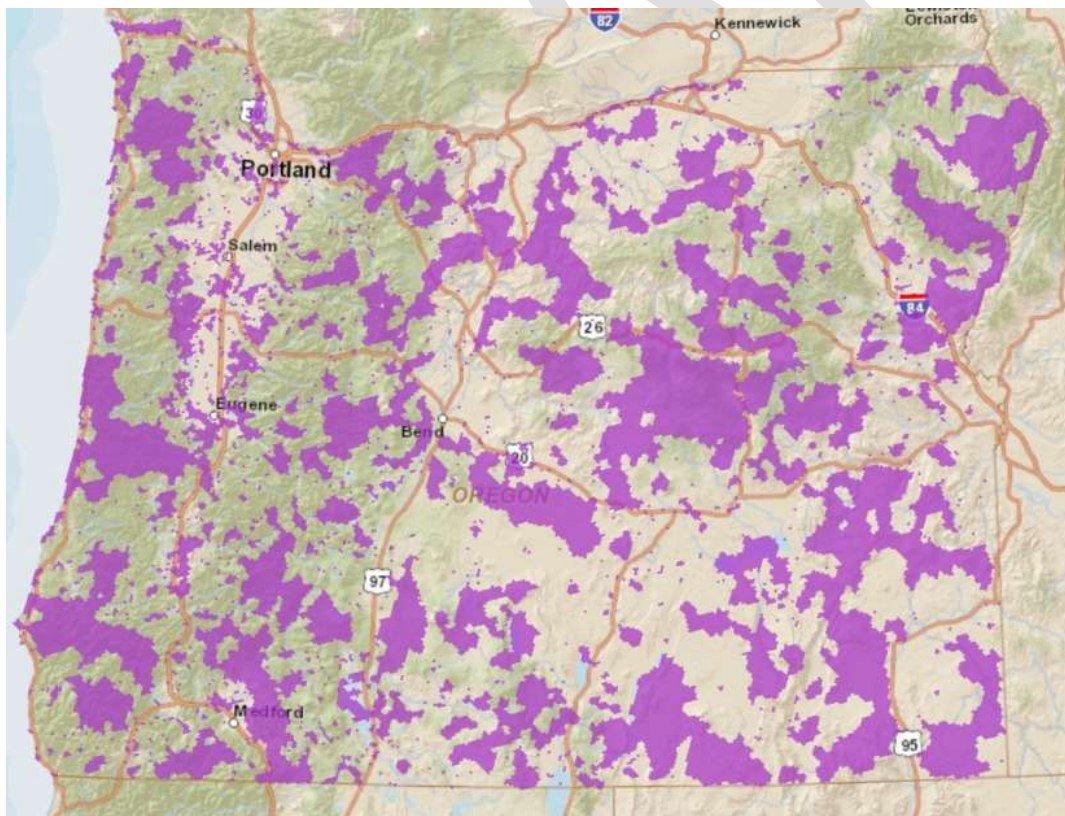
Scripts were utilized to find the optimal calibration settings for these variables (more detail will be provided in COA metadata documentation).

Calibration results:

Ecoregion	Number of Iterations	Boundary Length Modifier
Blue Mountains	2,000,000,000	0.16
Coast Range	600,000,000	0.11
Columbia Plateau	1,000,000,000	0.11
East Cascades	650,000,000	0.14
Klamath Mountains	900,000,000	0.14
Northern Basin & Range	2,000,000,000	0.16
West Cascades	500,000,000	0.19
Willamette Valley	600,000,000	0.11
Statewide	2,000,000,000	0.14

#### 5) Marxan Analysis

After all ecoregions were completed, those results were used as a seed to run a final statewide model (more detail will be provided in COA metadata documentation). The results of the final, statewide model are depicted in the below figure.



## Review

The results of the spatial modeling analysis underwent a detailed review process by ODFW Fish and Wildlife Biologists, as well as the Strategy Stakeholder Advisory Committee. The following review sessions were held, with a detailed presentation of the modeling process, and discussion about specific results:

- May 11, 2015: initial modeling results are finalized and completed.
- May 13 – June 5, 2015: Presentation and detailed discussion of COA modeling process held with following field offices. Webinar was provided for each meeting, and heavily utilized by field staff that could not travel to meeting locations. Some specific feedback provided during these discussions, but primarily focused on overview of process.
  - May 13, 2015: Willamette Valley – discussion held with Willamette Wildlife Mitigation Program, TNC, and USFWS
  - May 14, 2015: ODFW Umpqua District
  - May 18, 2015: Corvallis – focused review on Western Oregon (Coast Range, Willamette Valley, Klamath Mountains)
  - May 21, 2015: La Grande (webinar) – focused review on Blue Mountains
  - May 29, 2015: Bend/Sisters – focused review on East and West Cascades
  - June 2, 2015: Webinar with The Dalles and Hepner Offices – focused review on Columbia Plateau
  - June 3, 2015: Klamath Falls – focused review on the Northern Basin and Range
  - June 5, 2015: Corvallis – discussion with ODFW Fish Division Conservation and Recovery program.
  - May 27, 2015: Salem – presentation of modeling results and process to the Strategy Stakeholder Advisory Committee.
- May 27, 2015 – Online mapping application and PDF map of model results provided to all field staff, along with multiple formats to provide review and comments. Feedback deadline of June 10<sup>th</sup> was requested, but comments received until June 17.
- June 10 -30, 2015:

A variety of comments, feedback, questions and suggestions were received during this process (additional detail will be provided within the COA metadata documentation). All comments and feedback for specific areas were converted into a spatial format.

## Delineation

The final step in producing the revised COA boundaries was to compile all available information into one final boundary dataset. Layers utilized during this process included:

- Results of the statewide, ODFW 2015 COA Spatial Modeling Analysis
- Results of the ecoregion specific, ODFW 2015 COA Spatial Modeling Analysis
- ODFW Conservation Opportunity Areas produced in 2006
- Feedback provided during the 2015 COA review process
- The Nature Conservancy Ecoregional Assessment Portfolio, and Willamette Synthesis Conservation Opportunity Areas
- ODFW Sage-Grouse Core Areas
- Western Association of Fish and Wildlife Agencies Crucial Habitat Assessment Tool (WAFWA CHAT); Connectivity Zones and Large Intact Blocks of Contiguous Habitat

Communicating with ODFW Field Biologists as need, the ODFW Conservation staff examined the Oregon landscape, and selected square-mile assessment units to include in the revised COA boundaries. With minimal exceptions, the following criteria were observed:

- Maintain any assessment units that were highlighted within the solution of the ODFW 2015 COA Spatial Modeling Analysis and were included as a 2006 ODFW COA.
- Include assessment units that were highlighted within the solution of the ODFW 2015 COA Spatial Modeling Analysis and were highlighted during the review process by ODFW field staff and/or Strategy Stakeholders.
- Maintain any assessment units that were highlighted within the solution of the ODFW 2015 COA Spatial Modeling Analysis and are included as an ODFW Sage-Grouse Core Area.
- Include 2006 ODFW COAs that were requested to be maintained by ODFW field staff and/or Strategy Stakeholders.
- Include assessment units that includes at least 3 of the layers listed above.
- Remove all Wilderness Areas from COA delineation.
- Connect COAs as much as possible, often following streams, or similar OCS Habitats.
- Do not exceed more than 35% of the Oregon landscape.
- Do not exceed more than 38% within an individual ecoregion.
- Maintain a mix of public and private land (include at least 30% private land, statewide).
- The final COA boundaries should meet at least 75% of the Marxan Goals set during the Spatial Modeling Analysis (additional detail will be provided in the COA metadata documentation).

After selecting hexagons to include in the final solution, the final steps were to divide areas into separate COA's, following similar habitats and/or watershed where possible, and then name each COA. This was done with the support of ODFW field staff and the Strategy Stakeholder Advisory Committee. Additional boundary edits were also undergone during this process.

## Profile Development

The final step in the COA process is currently underway, but will be completed by the October 1<sup>st</sup> submission to the US Fish and Wildlife Service. Profiles for each COA will be developed using available data to provide detailed lists of Strategy Species and Habitats within each COA. Additionally, ODFW Conservation Staff will work to include as much information as possible related to recommended conservation actions, local plans, and potential partners within each COA. COA profiles will have the capability to be updated on a regular basis, so additional information will be included as it becomes available. Additional data layers will be utilized to capture an overlay with an ODFW COAs.

Datasets used within profile development:

- ODFW Conservation Opportunity Areas produced in 2006
- The Nature Conservancy Ecoregional Assessment Portfolio, and Willamette Synthesis Conservation Opportunity Areas
- ODFW Sage-Grouse Core Areas
- Western Association of Fish and Wildlife Agencies Crucial Habitat Assessment Tool (WAFWA CHAT); Connectivity Zones and Large Intact Blocks of Contiguous Habitat
- Oregon's Important Bird Areas
- USGS GAP Protected Areas Dataset (provides Land Ownership and protection status)
- ODFW Wildlife Linkages
- ODFW Fish Passage and Barriers Priority Database