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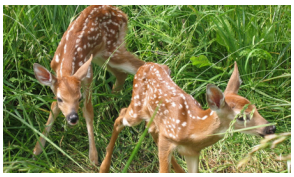






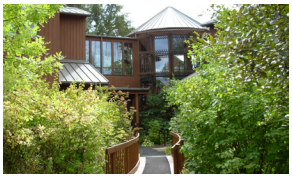


Portland Metropolitan Region

State of the Watersheds
Monitoring report

INITIAL REPORT: BASELINE WATERSHED CONDITIONS

As of December 2006

Metro | *People places. Open spaces.*

Metro gratefully acknowledges the following peer reviewers, whose comments were invaluable to the quality of this report.

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EXECUTIVE SUMMARY

The purpose of this report is to document a monitoring strategy to track watershed conditions over time using a suite of science-based, repeatable indicators and to report the baseline results for the first monitoring effort.

In 2005, Metro Council approved a new regional ordinance called Title 13 (Ordinance 05-1077C), or Nature in Neighborhoods. Nature in Neighborhoods is a region-wide initiative that brings people and governments together to help ensure a healthy urban ecosystem. It aligns the region's conservation programs behind a strategic effort to protect water quality and healthy natural areas for fish, wildlife and people. Title 13's purpose is twofold:

1. Conserve, protect and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with other streams and rivers and with their floodplains in a manner that is integrated with upland wildlife habitat and with the surrounding urban landscape; and

2. Control and prevent water pollution for the protection of public health and safety and maintain and improve water quality throughout the region.

Title 13 requires local jurisdictions to meet regional performance standards relating to fish and wildlife habitat by January 5, 2009 and asks cities and counties to report non-regulatory watershed improvement activities to Metro at the end of each odd-numbered year.

Title 13 also directs Metro staff to monitor watershed conditions over a 10-year period, with results due at the end of each even-numbered year. This is the first such report and provides baseline watershed conditions. The second report, due at the end of 2008, will compare how conditions changed over the 2-year period.

The results will help inform Council about the region's success in meeting regional performance objectives and targets. Based on this and other information, Council will revisit Title 13's effectiveness in 2015 and consider new strategies, if needed. The results are also intended to help inform the conservation efforts of cities and counties, watershed councils, nonprofits, citizens and other natural resource audiences.

BY THE NUMBERS

292
wildlife species live in the Metro region

16
amphibian species

13
reptile species

209
bird species

54
mammal species

The report is comprised of six sections. The Introduction and Background section provides more detail about Title 13, describes selected conservation efforts in the region and discusses some of the key issues relating to urban ecosystems. In addition, the introduction section highlights the difficulty and the importance of setting targets for improving watershed health.

The Water, Habitats and Species at Risk section defines watersheds and provides information on fish, wildlife, habitat and water quality issues in the Metro region. It describes Oregon Department of Fish and Wildlife's Conservation Strategy, unveiled in 2006, and how Metro's monitoring program supports the strategy. The Conservation Strategy provides a broad vision and conceptual framework for long-term conservation of Oregon's native wildlife, emphasizing the conservation of declining species and habitats to reduce the possibility of future federal or state Endangered Species Act listings.

The third section, Details about Metro's Indicators, describes the nine Title 13 indicators to be tracked in the monitoring program. An additional indicator tracks breeding bird population trends for selected species at the regional scale. Finally, this section describes a pilot approach for modeling water quality based on land use surrounding 1,500-meter stream reaches to track improvements and problem areas and identify key restoration opportunities. The model will be refined and extrapolated to the regional scale for the 2008 report, with a resulting color-coded map showing existing conditions for each stream reach.

The following two sections report the actual data, first at the regional level and then at the smaller watershed scale. The Region-wide Indicator Results section provides aggregate data for current (baseline) conditions for all watersheds combined, plus long-term breeding bird population trends for the route extending through the Metro region. The Sub-watershed Indicator Results breaks the nine Title 13 indicators down to the smaller watershed scale. Future reports will document changes over time by watershed and by jurisdiction.

The Conclusion section summarizes the overall findings for the baseline, or the starting point for the 10-year period. Approximately 39 percent of the area within 50 feet of streams and wetlands is forested and in the area between 50-150 feet, the regional average drops to 34 percent. Increasing tree cover throughout all watersheds, but particularly near streams and most wetlands would improve water quality and wildlife habitat and help the region address the Federal Clean Water Act. About 10 percent of the region's floodplains are developed, substantially degrading ground and stream water quality. Minimizing new floodplain development and restoring existing floodplain will be a key water quality strategy for the region's future and will reduce the risk of flooding.

The metro region currently provides about 80,000 acres of regionally significant fish and wildlife habitat.

Wildlife habitat results indicate a fragmented system, but one that still contains nearly 30,000 acres of high quality wildlife habitat, including some large habitat patches and many pockets of at-risk or declining habitats such as Oregon white oak. At the smaller watershed scale, a wide variety of conditions reflect the unique nature of each area in terms of natural features as well as historic development patterns.

Adaptive management is a key purpose for Title 13's monitoring program. Adaptive management is the practice of regularly collecting and monitoring data to review and update goal-oriented management strategies. This approach can provide more dynamic and informed decision-making resulting in more rapid, positive ecological changes. Over time, Metro's monitoring program will track environmental conditions at a variety of scales to indicate ecological trends at local, watershed and regional levels and ascertain whether Title 13 objectives and targets are being met. Areas with high restoration potential will be identified; some of these priorities will span political and watershed boundaries and engender new partnerships. Effective partnerships can increase restoration funding opportunities.

A million more people are expected in the region by 2025. A collective approach to monitoring, restoration prioritization and implementation will increase the likelihood of improving the region's water quality and providing high quality habitat for fish, wildlife and people.

From 2005-2007 the City of Portland and Clean Water Services planted nearly 200,000 native trees and shrubs each.

Introduction and background

INTRODUCTION AND BACKGROUND

Purpose and overview

The purpose of this report is to document an ecosystem monitoring strategy to track watershed conditions over time using a suite of science-based, repeatable indicators and to report the baseline results for the first monitoring effort.

Future monitoring reports will describe qualitative and quantitative changes at the end of each even-numbered year, with a major report to the Metro Council after 10 years. The results will help inform Council about the region's success in meeting regional performance objectives and targets. The results are also intended to help inform the conservation efforts of area cities and counties, watershed councils, nonprofits, citizens and other natural resource audiences.

Metro is in the process of gathering an improved set of aerial photo interpretation with more accurate statistics on trees, other natural features and developed areas. In addition, United States Geological Survey (USGS) watershed boundaries have changed slightly since these data were collected and that change is not reflected here. Therefore, for the first 2-year comparison report due December 2008, Metro will retroactively analyze the 2006 report data presented here based on the new watershed boundaries (which will remain static after that point) and the improved data. This will provide a more accurate baseline and comparison of change between the 2006 and 2008 report years. The 2008 report will provide results by region, watershed and jurisdictional boundary.

Title 13: Nature in Neighborhoods – basis of Metro's monitoring strategy

Watersheds, fish and wildlife habitat span political boundaries. The Metro Council has collaborated for more than 10 years with city and county leaders, state and federal agencies and thousands of citizens to develop an effective regional program to conserve, protect and restore fish and wildlife habitat.

In 2005, the Metro Council created a new regional ordinance called Title 13 (Ordinance 05-1077C), including regulatory and voluntary components. Title 13 resulted in creation of the Nature in Neighborhoods[1] program. Title 13 – Nature in Neighborhoods is a region-wide initiative that brings people and governments together to help ensure a healthy urban ecosystem. It aligns the region's conservation programs behind a strategic effort to protect water quality and ensure healthy natural areas for fish, wildlife and people.

Title 13's purpose is twofold:

- conserve, protect and restore a continuous ecologically viable streamside corridor system, from the streams' headwaters to their confluence with other streams and rivers and with their floodplains in a manner that is integrated with upland wildlife habitat and with the surrounding urban landscape
- control and prevent water pollution for the protection of public health and safety and maintain and improve water quality throughout the region

Title 13 was created to implement Oregon Statewide Planning Goal 5 (natural resources, scenic and historic areas and open spaces) and Goal 6 (air, water and land resources quality). Title 13 requires local jurisdictions to meet regional performance standards relating to fish and wildlife habitat by January 5,

[1] The full text of Title 13 is available on Metro's website: www.metro-region.org.

2009.[2] In addition, cities and counties are required to report to Metro no later than December 31, 2007[3] and every two years thereafter on their progress in using voluntary and incentive-based education, acquisition and restoration habitat protection efforts.

The Nature in Neighborhoods program will achieve its purposes through conservation, protection and restoration of riparian and upland fish and wildlife habitat through time using voluntary, incentive-based, educational and regulatory approaches. The program includes provisions to:

- monitor and evaluate program performance over a 10-year period to determine whether the program is achieving its objectives and targets (the purpose of this report and local jurisdictions' non-regulatory reporting)
- determine whether cities and counties are in compliance
- provide sufficient information to determine whether to amend or adjust the program in the future, with a check-in after 10 years, in 2015

Title 13 establishes minimum recommended regulatory requirements that apply only to high-value riparian areas within the urban growth boundary in 2005, when the ordinance was adopted. However, some upland habitat protection will be required for development in future urban growth boundary expansions. The standards vary depending on the economic potential of the property. For example, regulatory requirements may be reduced in areas with the greatest economic importance to the region, or for regionally significant facilities such as some colleges, universities and hospitals.

Title 13 is not intended to repeal or replace existing requirements of city and county comprehensive plans and implementing ordinances to the extent those requirements already meet the ordinance's minimum requirements. It is not intended to prohibit cites and counties from adopting and enforcing protection and restoration programs that exceed the ordinance's requirements.

Title 13 strives to conserve and protect fish and wildlife habitat through an avoid-minimize-mitigate standard (preferred approach is in that order), not to prohibit development in sensitive areas. This reflects an intended balance between watershed health, property rights and the importance of maintaining a compact urban form. A compact urban form limits the loss of agricultural and forest lands at the fringe of the metropolitan area and minimizes the extent of urban impacts on the environment. Title 13 presents additional design standards to help protect habitat and specifically addresses tree canopy conservation, erosion control and ways to develop property with the lowest impacts to the habitat.

Regionally significant fish and wildlife habitat. Prior to Metro's adoption of Title 13 in September 2005, Metro created two maps that form the basis of its fish and wildlife habitat protection and restoration program. The Regionally Significant Fish and Wildlife Habitat Inventory Map (Inventory Map, Exhibit A in Title 13: Nature in Neighborhoods[4]) identifies the areas that have been determined to contain regionally significant fish and wildlife habitat.

[2] Currently Washington County and the cities of Hillsboro, Beaverton, Tualatin, Tigard, Forest Grove, West Linn and Sherwood have complied with Title 13.

[3] To reduce the difficulty of jurisdictions' reporting requirements, Metro will revise this date to coordinate with DEQ Total Maximum Daily Load reporting due dates.

[4] Title 13's full text and attachments are available through Metro Council office or online at www.metro-region.org. The web site also offers an online habitat mapping tool.

The inventory identified approximately 80,000 acres of regionally significant habitat within Metro's jurisdictional boundary, an area of approximately 280,000 acres. The inventory identifies three quality classes each of riparian and upland habitat, subject to field verification.

The Habitat Conservation Area Map identifies the areas that are subject to performance standards and best management practices to the extent that a local jurisdiction chooses to comply with Title 13's regulatory baseline through reliance upon their comprehensive plans and implementing ordinances.

Title 13 performance objectives, targets and indicators. Title 13 performance objectives include preserving and improving streamside, wetland and floodplain habitat and connectivity; preserving large areas of contiguous habitat; preserving and improving connectivity for wildlife between riparian corridors and upland habitat; and preserving and improving special habitats of concern (Table 1 and Appendix 1). Related implementation objectives include increasing the use of habitat-friendly development practices and increasing restoration and mitigation actions to compensate for adverse environmental effects of new and existing development.

Title 13 established targets relating to each objective and listed potential indicators to measure progress towards the targets. The targets reflect consensus among stakeholders and are not necessarily science-based, although they do emphasize protecting some of the most critical resources such as streams and declining habitat types. Some of the targets call for improved conditions, such as near-stream vegetation. Other targets seek to limit loss of certain habitat elements over time such as undeveloped floodplains, which are flat, easy to develop and not always stringently regulated.

The idea behind regional objectives and targets is improving on-the-ground conditions for wildlife and water quality. However, the results of some actions such as restoration may not be immediate and could be masked by other factors such as climate change or increased population. Some of the targets may not be high enough to improve conditions to acceptable levels.

For example, riparian and water quality objectives are more ambitious than those for upland habitat, so water quality and habitat for riparian-associated species might improve over 10 years while some upland species decline. Perhaps computer mapping shows an improvement in specific conditions but field studies show declines in water quality or sensitive fish and wildlife species. Several such scenarios could be imagined. Metro incorporates field-based measures into monitoring efforts whenever possible to gain a better picture of the real situation and inform future natural resource decisions.

Table 1 summarizes the performance objectives, targets and indicators used in this report. The *Indicator details* section provides a more detailed explanation of the ecological relevance of each indicator in assessing watershed health.[5] Appendix 1 provides Title 13's full text of performance objectives, targets and suggested indicators. The indicators in Table 1, a subset of the list of potential indicators in Title 13, were selected to monitor ecological functions and because they can be monitored fairly efficiently and consistently.

Title 13 directs staff to present monitoring and program evaluation reports to the Metro Council in December 2006 and every two years thereafter. Title 13 states, "Metro will practice adaptive management by using the results of monitoring studies and the availability of new information to assess whether the goals, objectives and targets of this title are being achieved."

[5] As part of Title 13 Metro staff conducted a thorough scientific literature review that explains the importance of each of these indicators in more detail. The review is included in Title 13 as Exhibit F and is available online at www.metro-region.org or by request at the Metro Council office.

Table 1
Summary of Title 13 objectives and indicators used in this report

Performance Objective	Indicator
Preserve and improve streamside, wetland and flood area habitat connectivity	% vegetation within 50 feet of streams and wetlands % forest within 50 feet of streams and wetlands % vegetation within 50-150 feet of streams and wetlands % forest within 50-150 feet of streams and wetlands Number of acres of Class I and II high value riparian habitat Number of acres of undeveloped floodplain
Preserve large areas of contiguous habitat and avoid fragmentation	Number of acres of Class A and B high value upland habitat Number of acres of interior habitat
Preserve and improve special habitats of concern	Number of acres and categorical types of special or at-risk habitats

Additional indicators used in this report. Two additional indicators, not on the list provided in Title 13, are included in this report. The long-term Breeding Bird Survey data provides information about bird population trends at local and statewide scales. Birds respond to changes in habitat conditions and are appropriate indicators of overall habitat conditions. In addition, a smaller scale model of stream reach conditions may help identify key restoration opportunities to help water quality, fish and wildlife. The latter is a pilot project and will be expanded region-wide in the 2008 report.

Metro's conservation programs and other regional efforts

Hundreds of citizens, neighborhood groups, nonprofits, watershed councils and local jurisdictions are working to restore health to the region's watersheds. Over 800 of these projects are documented on Metro's online interactive mapping tool, the Regional Environmental Information Network (www.rein.org).

Title 13 asks local jurisdictions to report non-regulatory activities including restoration, natural area acquisition and easements and environmental education every other year, at the end of odd years. Metro will compile this information as part of its monitoring efforts.

Together with the region's citizens, the Metro Council supports the region's environmental health in many ways including conservation education, grant funding, natural area acquisition and restoration and promotion of nature-friendly development practices to meet its objectives.

Conservation education is one of Metro's most important environmental health tools. Metro's GreenScene publication lists nature events, wildlife watching opportunities, paddle trips, natural area tours and volunteer activities from more than 60 organizations around the region. GreenScene also features Nature Notes about local plants and animals, stories about outstanding people and places and news about region-wide efforts to protect water quality, fish and wildlife habitat and access to nature for future generations. Some of Metro's activities included in these resources are:

- Metro's Regional Parks and Greenspaces department offers environmental educational field trips for schools and other groups. Field trips led by experienced naturalists and educators feature outdoor, hands-on environmental education activities that foster an appreciation for nature.
- Nature University is a 12-week training course that starts people along the path of becoming naturalists and teachers. Students are introduced to time-honored techniques of nature observation and principles of discovery learning.

- Metro's Natural Gardening program provides information, workshops and a staffed demonstration site to help citizens learn how to garden without toxic chemicals and to encourage use of native plants where appropriate.
- Metro's natural techniques demonstration gardens feature seasonal floral displays, chemical free lawns, native plants, edible landscaping and childrens' gardening areas. A southeast Portland garden is open to the public from April through October and a new demonstration garden at Blue Lake Park can be visited year-round.
- The Oregon Zoo offers a variety of environmental education classes for children and adults.

Funding is another key conservation tool. Metro provides small grants through the Nature in Neighborhoods Restoration and Education grant program, which has awarded $980,682 to support 48 nonprofits, community groups, schools, businesses and local government agencies for 53 projects in 2006-2007, valued at $4.6 million including partner matches. A new $15 million Nature in Neighborhoods Capital Grants Program will fund neighborhood projects that enhance natural features and their ecological functions on public lands and will result in at least $45 million of investment in the region because of match requirements.

Metro's natural area acquisition program provides an excellent example of citizens' desire and will to preserve nature in a large urban area. In 1995, Metro region voters approved a regional $168.4 million bond measure, which led to acquisition of the largest natural area acquisition in the U.S. in several decades – more than 8,000 acres and 74 miles of stream and river frontage. Metro is actively working to stabilize, restore and open some of these properties to the public.

In 2006, the Metro Council developed and referred a successful $227.4 million bond measure initiative to purchase, from willing sellers, between 3,500 and 4,000 acres of natural areas in 27 specifically identified target areas to protect and enhance habitat for fish, wildlife and water quality. The program's goals emphasize protection of natural area lands now in urban areas or in areas where development is likely to occur. Portions of both bond measures allocated "local share" acquisition funds, to be used at the discretion of local jurisdictions.

Nature-friendly development practices protect and improve community livability, fish and wildlife habitat and water quality for this generation and those to come. Nature-friendly development practices, also called green, low impact or sustainable development, increase property values, protect water quality, fish and wildlife habitat and protect drinking water supplies, conserve resources and reduce energy use and keep our region green, unique and beautiful. Nature-friendly development practices include site design to incorporate fish and wildlife habitat and reducing stormwater and dealing with it onsite. The Title 13 – Nature in Neighborhoods ordinance asks local jurisdictions to modify their development code to better accommodate nature-friendly development practices. Metro also offers nature-friendly development practice education to developers, planners and others interested in implementing such practices.

The 2007-2008 Integrating Habitats Design Competition challenges entrants to work across disciplines in collaborative teams to create elegant and functional designs for conceptual sites typical of the Metro region. The competition emphasizes successful and innovative site designs that blend open space access, site planning and environmental preservation and restoration in construction and development.

Metro's toxics reduction programs help clean up garbage and prevent toxics from entering streams, soil and groundwater. Metro's illegal dumpsite cleanup helps citizens dispose of trash safely and legally and report locations of illegal dumpsites. The Neighborhood Cleanup Program provides funds for qualified

neighborhood associations and other nonprofits to assist in needed cleanups. Metro's popular Hazardous Waste Disposal program offers free disposal of household toxic trash and waste.

Many others in the region work towards a healthier urban environment. For example, cities such as Portland, Gresham, Lake Oswego and Wilsonville, as well as Clean Water Services in Washington County, provide environmental education and conduct substantial natural area restoration. Nonprofit organizations such as SOLV and numerous watershed councils are working hard to assess and improve watershed conditions. Schools, neighborhood groups and citizen advocates donate time and funds to help monitor and improve habitat quality.

In addition, most jurisdictions and certain agencies in the Metro region are working together to improve water quality through the federal Clean Water Act, administered through the Oregon Department of Environmental Quality (DEQ). The Clean Water Act is discussed in more detail in the *Water, habitats and species at risk* section.

M*etro's Environmental Action Team (ENACT)*, formed in 2000, meets monthly to coordinate environmental efforts, including water resource protection, resource conservation, toxics reduction and recycling and buying recycled products, at all Metro facilities. Representatives from five Metro facilities and seven departments serve on the team.

Urban ecosystems

Scientists recognize urban areas as a unique type of ecosystem, with similar characteristics worldwide. A relatively large body of scientific literature documents effects due to urbanization that are similar regardless of geographic location. Most of urbanization's adverse impacts originate from changes in the amount and timing of water runoff, loss of natural vegetation, or both. Often changes in one result in changes in the other. These systematic alterations result in water quality, wildlife habitat and sensitive species declines.

However, development patterns and the amount, environmental conditions and location of undeveloped land strongly influence urban water quality and wildlife[6]. The amount and placement of a few key landscape features – especially trees, shrubs and hard surfaces[7] – allows us to predict about one-half to three fourths of the region's water quality outcomes and the types of wildlife that can live here. Habitat type and human behavior also influence water quality and wildlife.

Trees, vegetation and certain soils soak up water during rainstorms creating a sponge effect, whereas hard surfaces create runoff without filtration, thereby increasing stormwater volume, sediment and pollutant loads. Floodplains, the flat areas near streams and rivers that are naturally subject to periodic inundation, are particularly important for this "sponge" effect. They also provide aboveground storage of stormwater, preventing the stream-damaging effects of altered hydrology. Greater stormwater volumes traveling over hard surfaces and being delivered too rapidly to streams. This results in increased stream flashiness; a "flashy" stream has rapid changes in flow during runoff events, high peak discharges, low base flows (during dry spells) and often high concentrations and transport of non-point source pollutants such as pesticides, pathogens, fertilizers and heavy metals. As a result, urbanized watersheds have less dry season water and are prone to more frequent and bigger floods.

[6] For detailed information about healthy watersheds, wildlife habitat and urban effects, see *Metro's Technical Report for Goal 5*, available online at www.metro-region.org or through Metro Council office.

[7] Hard surfaces are streets, pavement, rooftops, driveways and anywhere the rain is intercepted before falling on vegetation or soil. The term "impervious" is also used to describe hard surfaces.

For example, in King County, Washington, downstream from urbanized watersheds the largest floods were two to three times bigger than in nearby natural systems, while the frequency of smaller floods increased as much as tenfold.[8] Estimates of Pacific Northwest areas covered by impervious surfaces typical of suburban development predict 90 percent less water storage capacity than naturally forested areas of the same size.[9]

Near-stream trees and vegetation do not completely protect water quality. For example, Metro's and other water quality studies link watershed-wide tree canopy to water quality. In addition, urban stormwater sometimes travels large distances before reaching the receiving water, often bypassing riparian vegetation via pipes. And while water temperature is directly correlated to stream shade, other water pollutants in urban areas – such as total suspended solids, pathogens and pesticides – may not be significantly impacted by riparian vegetation.

Even with these limitations, near-stream trees, in combination with other land use variables, correlate to water quality at certain scales. Metro's studies in Clackamas County indicate that land use near streams can help predict water quality. Appendix 2 provides a pilot model for modeling water quality at the stream reach scale, based on Geographic Information System (GIS) and field-collected measures. Metro is currently collecting the data needed for such an analysis for the entire region and will present them in the 2008 monitoring report.

A recent study of tree cover in the Willamette/Lower Columbia Region found a reduction in tree canopy cover from 46 percent in 1972 to 24 percent at present.[10] Average tree cover in the region's urban areas was estimated to be only 12 percent, down from nearly 21 percent in 1972. Metro data indicate that 11 percent of the Metro region's natural fish and wildlife habitat areas were lost between 1989-1999, presumably with accompanying adverse effects on watershed hydrology and wildlife habitat. Groundwater, which supplies water to streams during the dry season, is also declining in volume and quality.[11]

Invasive species are a major threat to every ecosystem in the world, but urban areas are particularly vulnerable due to high levels of habitat disturbance and the many routes through which such species can be introduced. The Oregon Invasive Species Council states that next to habitat lost to land development and transformation, invasive species pose the greatest threat to the survival of native biota in the United States and many other areas of the world.[12] The Invasive Species Council defines invasive species as those species not native to the region which out-compete native species for available resources, reproduce prolifically and dominate regions and ecosystems. The group notes invasive species' lack of natural predators and potential to transform entire ecosystems, as native species and those that depend on them for food, shelter and habitat disappear.

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[8] Booth, D.B. 2000. Forest cover, impervious-surface area, and the mitigation of urbanization impacts in King County, Washington. Center for Urban Water Resources management, Department of Civil and Environmental Engineering, University of Washington, Seattle, WA.

[9] Wigmosta, M.S., S.J. Burges, and J.M. Meena. 1994. Monitoring and modeling to predict spatial and temporal hydrologic characteristics in small catchments. Report to U.S. Geological Survey, University of Washington Water Resources Series Technical Report #137.

[10] American Forests. 2001. Regional ecosystem analysis for the Willamette/Lower Columbia region of northwestern Oregon and southwestern Washington state. Report sponsored by the U.S.D.A. Forest Service.

[11] McFarland, W.D. and D.S. Morgan. 1996. Description of the ground-water flow system in the Portland Basin, Oregon and Washington. U.S. Geological Survey Water-Supply Paper 2470A, Portland, Oregon.

[12] See www.oregon.gov/OISC/about_us.shtml. Oregon's Invasive Species Council was created in 2001 by the Oregon legislature (ORS 561.685; landru.leg.state.or.us/ors).

The City of Portland Parks and Recreation Department offers native, nuisance and prohibited plant lists on its web site.[13] The City prohibits the following plants from use in all reviewed landscaping situations within city limits: Scot's broom (*Cytisus scoparius*), English Ivy (*Hedera helix*), purple loosestrife (*Lythrum salicaria*), reed canarygrass (*Phalaris arundinacea*) and Himalayan blackberry (*Rubus discolor).*[14] Many other invasive plant species have established populations in the Metro area, including newer invaders such as knotweeds (Japanese, Himalayan, giant; *Polygonum* species), certain varieties of butterfly bush (*Buddleja davidii*), false brome (*Brachypodium sylvaticum*) and yellow flag iris (*Iris pseudacorus*).

Plants are not the only invasive species. For example, fungal infections such as Sudden Oak Death (*Phytophthora ramorum*) threaten scarce Oregon white oak, rhododendrons and other non-invasive landscaping species. Numerous invasive aquatic organisms threaten native species. Adult bullfrogs are voracious predators of aquatic, terrestrial and flying invertebrates and vertebrates. The largemouth bass (*Micropterus salmoides*), widely introduced for sport fishing, is a voracious, carnivorous, solitary ambush predator that feeds on other fish, amphibians, insects and any small living animal or bird that falls into the water. Starlings very successfully out-compete native birds for breeding habitat and forage in the region's narrow riparian areas. Nutria (*Myocaster coypus*) crowd out native muskrats, devour native riparian vegetation and burrow destablilizing holes and overrun wetlands.

Oregon Department of Fish and Wildlife (ODFW) developed the Oregon Invasive Species Action Plan in 2005. The plan notes that exclusion, early detection and rapid response are by far the most cost-effective ways of dealing with undesirable invaders. The Action Plan's goal is to facilitate efforts to keep invasive species out of the state, find invasions before they establish permanent footholds and do whatever it takes to eradicate incipient populations of undesirable species. Education and cooperation are key components to an effective strategy.

Despite these threats, at least 292 native vertebrate wildlife species occur regularly in the Metro region. Of those, 93 percent use riparian areas, with 45 percent dependent on those areas to meet life history requirements. Eighty-nine percent of all terrestrial species in the Metro region use upland habitats, with at least 28 percent depending on these habitats.

Several of the area's salmon species are listed as threatened under the federal Endangered Species Act. Numerous wildlife species are also identified as at-risk by both the state and federal agencies. However, in this region we still have substantial habitat worth protecting and restoring for the purpose of protecting water quality, retaining existing species and preventing future listings.

Metro's Title 13 fish and wildlife habitat inventory identified and mapped key features important to water quality and wildlife habitat at the regional scale. The riparian habitat inventory mapped features relating to key ecological functions, including:

- microclimate and shade
- bank stabilization and sediment control
- pollution control
- streamflow moderation
- organic matter input
- large woody debris

[13] See www.portlandonline.com/planning/index.cfm?c=45131

[14] Metro is working with computer mapping to identify large Himalayan blackbaerry patches to avoid counting them as beneficial vegetation in watershed indicators.

The wildlife habitat inventory recognized habitat patch size, shape to reduce adverse edge effects relating to invasive species and structural complexity, proximity to other habitat areas and availability of water as key elements to protect the region's biological diversity. The habitat inventory also included site-specific information about declining or special habitats such as wetlands, river islands and native oak and grasslands. The inventory's most valuable upland and riparian habitats will be tracked in this and future monitoring reports.

Spatial scale and cumulative effects

Climate, topography, geology, soil, vegetation and land use influence aquatic and terrestrial ecosystems.[15] The principles of landscape ecology, or the study of spatial variation in landscapes at a variety of scales, provide context for these factors including the biophysical and societal causes and consequences of landscape patterns and heterogeneity.

Spatial scale is the size of area at which different ecological processes occur. Spatial scale is important because the answers to ecological questions and in fact the very nature of the questions posed can change based on scale.

For example, the answers to water quality questions depend on multiple spatial scales. Information visible at one scale may disappear at other scales. Consider a case in which a small stream area's water is poor quality due to local conditions but the rest of the stream is healthy. Water quality tests conducted only at the degraded site would lead to an incorrect conclusion (that the stream is generally degraded). However, water quality tests conducted at multiple sites along the stream would show that one site is degraded but the stream is generally healthy.

As water moves downstream through urban areas, the effects of pollution often increase because there is more land area contributing runoff, more pollutants and less vegetation available to filter and cleanse the water than in natural systems. Large-scale vegetation loss and dark surfaces also tend to make urban areas warmer, a phenomenon termed the "urban heat island effect." Warmer air and less shade mean warmer water. These large-scale cumulative effects explain why water quality tends to degrade as it moves downstream in urbanized watersheds.

The factors that influence water quality also affect wildlife and habitat health. One tree can provide a home for scores of species, but habitat value is reduced if the tree is not near other habitat areas to allow for wildlife movement. Similarly, a patch of habitat is more valuable if it is connected to other habitat patches. Urban habitats are also deficient in certain key habitat elements, including standing and fallen dead trees important to both terrestrial and instream habitat.

Larger habitat patches generally provide better habitat than small patches, for two key reasons. First, science shows that large patches hold more wildlife species per acre than smaller patches. Second, large habitat patches contain less edge habitat than smaller patches, providing home to species that avoid edges or require large territories. Although traditional wildlife management strategies recognize edge habitat as an important and diverse habitat zone, in urban areas habitat near the edges of a patch is prone to non-native species invasion, subject to high disturbance and attracts a variety of predators. As a result of these cumulative effects, some of the most sensitive species decrease, while edge-loving generalist species increase. For example, small predators and jays often forage along habitat edges, to the detriment of nesting songbirds.

[15] Spence, B.C., G.A. Lomnicky, R.M. Hughes and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. ManTech Report 21TR-4501-96-6047.

Lack of long-term, large-scale data limits Metro's monitoring program. Such studies are rare for the Metro region, although a variety of studies provide information on more limited scales. For example, invertebrates provide excellent water quality indicators but are expensive to study, so researchers tend to sample them over a single or a few seasons, in study areas specific to their research interests. Even fewer scientifically rigorous wildlife studies exist, typically conducted by graduate students over one or two seasons at one or several study sites.

While smaller scale studies can and do provide important ecological and management information, they do not provide data that can be compared every two years for change assessment. There are some longer-term water chemistry or flow monitoring sites and Metro is working to map these sites for use in its monitoring and by others in the region and for integration into water quality modeling. The Breeding Bird Survey route through the Portland area provides a long-term wildlife data source, although it is limited in geographic extent. Still, the data provide important clues to the region's wildlife population trends.

To the extent possible, this report uses landscape ecology to monitor water quality, wildlife and habitat conditions. At the largest scale, composite results from all of the region's watersheds and regional bird species' trends help describe overall ecological conditions. Medium scale includes watersheds and the sub-watersheds nested within them; future reports will also track conditions by jurisdiction. At the smallest scale a pilot water quality model predicts water quality by 1,500-meter stream reaches, based on land use adjacent to streams.

Scientific fieldwork conducted by Metro and others in the region document the effects of land use, stream and tree loss and habitat fragmentation on water quality, habitat and wildlife at multiple spatial scales. That body of research indicates that **every tree matters**. Even one tree provides measurable benefits to water quality, habitat and wildlife. Although trees are not a panacea to the region's environmental health, the latter would be greatly improved if we had enough trees. The concept of "enough" is discussed in the next section.

How much is enough? The importance and ambiguity of targets

The amount, types, location and arrangement of habitat influence water quality, habitat and the fish and wildlife that use these habitats. Human activities also influence habitat conditions. Development, vegetation clearing and habitat conversion, as well as habitat protection and restoration can profoundly modify fish and wildlife habitat.

The northern Willamette Valley is substantially different from the historic setting and will never again resemble pre-settlement (European or Native American) conditions. Today's Metro-region watersheds represent a range of conditions and habitat types, but declines in water quality and certain fish and wildlife species indicate that few are in excellent health compared to reference conditions.[16] In fact, we are not even sure what reference conditions mean in an urban context, because we do not know the maximum level of ecological health that could be achieved.

These factors invite several questions: what is a "healthy" urban watershed? How much conservation and restoration would be enough to correct water quality problems and reverse the decline of sensitive fish and wildlife species? Is it even possible to do so? Best available science and technology can document the existing state of the region's watersheds, but do not answer these questions. Some of the answers are

[16] In this context, reference conditions refer to exemplary healthy natural ecological conditions.

science-based but some may be political in nature because social, economic and other considerations must be weighed against ecological health.

The landscape is ever changing as a result of natural and human impacts and there will always be a need to maintain a dynamic equilibrium in the "natural" system. Dynamic equilibrium is a state of balance with respect to environmental factors and populations of organisms, including humans. Thus, the question "how much is enough" really refers to where, across the continuum of urban ecosystem potential, the region chooses to strike a stable balance between human influence and healthy natural systems.

Using data from land surveys for the General Land Office between 1851 and 1895, the Oregon Natural Heritage Program (now the Oregon Natural Heritage Information Center) created an estimated historical vegetation map for Oregon.[17] This map suggests that the pre-settlement Metro region was covered predominantly by closed and open canopy forest interspersed with prairie and oak savanna habitats, especially in the lowlands of the Tualatin, Willamette and Columbia River basins.[18]

Much of that forest is gone now, replaced by urban and agricultural habitats. In 2001, American Forests studied tree cover in the region's urban areas and found a reduction in tree canopy cover from 21 percent in 1972 to 12 percent in 2001.[19] Data collected in 1989 also illustrates ongoing habitat loss due to the continuing conversion of land for development and other uses. Between 1989 and 1997, Metro estimates that 12 percent of the region's remaining 131,167 acres of natural areas were lost to land conversion for development and other uses.[20] It is clear that today the Metro region is far less forested than it once was and some of the other co-dominant habitats such as native oak and grasslands can now be considered endangered.

Tree cover near streams in urban areas helps water quality and aquatic habitat (Figures 1a and 1b). Closed forest canopy on both sides of the stream is the typical historic condition and this is probably the optimal condition for healthy conditions today. In addition, a pair of Metro studies suggests that if two watershed areas have the same level of urbanization but one has more trees throughout the watershed, the one with more trees has better water quality. This suggests that for water quality, "enough" habitat translates to a high proportion – precisely how much is unknown – of closed forest canopy around nearly every stream and many wetlands and as many trees in the uplands as is possible given the need to accommodate urban uses.

Estimating the necessary types and amounts of habitat needed to sustain existing biodiversity is also difficult. Certainly the solution for water quality will help wildlife, and most species use riparian areas at some point in their life cycle. But other factors must be considered. For example, certain species rely on upland native oak or prairie habitat, thus the kind of forest matters and non-forest habitat is also important. Figures 1a and 1b illustrate a range of recommended forest buffer distances needed to protect riparian and wildlife functions along riparian corridors.

[17] Christy, J., E.R. Alverson, M.P. Dougherty, and S.C. Kolar. 1993. Historical vegetation for Oregon. Oregon Natural Heritage Program, The Nature Conservancy of Oregon.

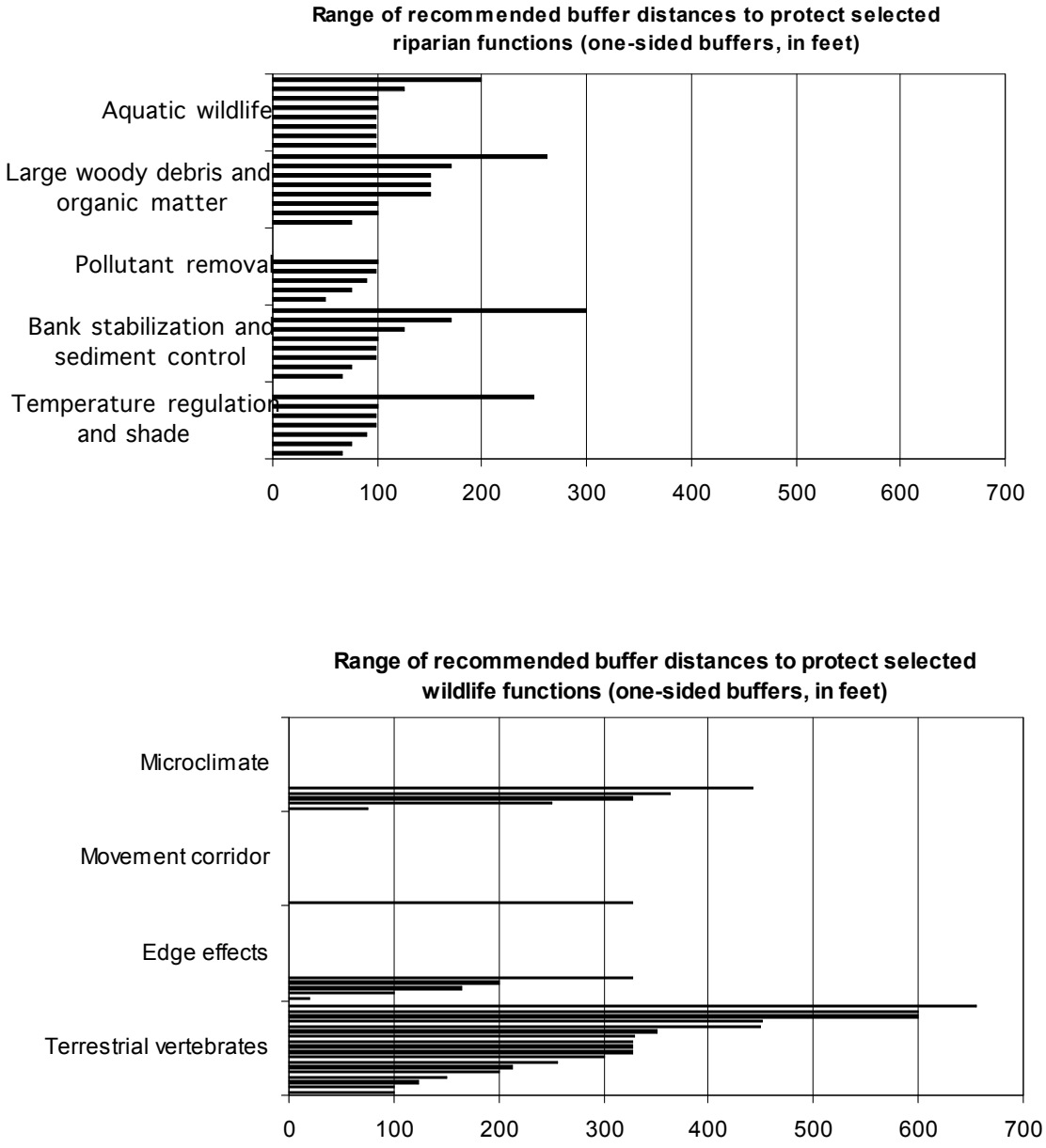
[18] A map entitled "Historical Vegetation of the Metro Region" is available on page 90 in Metro's Technical Report for Goal 5, April 2005, Attachment 2 to Exhibit F of Ordinance No. 05-1077C (Title 13, or Nature in Neighborhoods ordinance). Table 8 on page 92 in the same document shows the percentage of different habitat types (historical vs. current) for the Metro region.

[19] American Forests. 2001. Regional ecosystem analysis for the Willamette/Lower Columbia region of northwestern Oregon and southwestern Washington state. Report sponsored by the U.S.D.A. Forest Service.

[20] Metro. 1997. Loss of Natural Areas, 1989-1998, Parks and Greenspaces Department. Portland, OR.

Figures 1a and 1b

Range of recommended forest buffer distances to protect riparian and wildlife functions along riparian corridors



Derived from Metro's Technical Report for Goal 5, April 2005, Attachment 2 to Exhibit F of Ordinance No. 05-1077C (Title 13, or Nature in Neighborhoods ordinance).

At present there is no way to know the highest potential for health in the region's urbanized watersheds. Yet without aiming for some higher goal we run the risk of simply recording continued natural resource declines. Targets give the region something to strive towards and measure progress towards objectives.

To measure progress towards Title 13 objectives, the Metro Council set specific natural resource targets for a 10-year period to improve watershed health. The targets sometimes aim for habitat increases, requiring restoration. Recognizing the urban nature and the fact that 1 million more residents are expected in the region by 2025, other targets aim to limit the loss of sensitive habitats. Each biennial monitoring report provides a benchmark, or a point of comparison, that may be used to help judge whether the targets are being reached and over the full 10-year period, whether the targets are sufficient or realistic. This provides a means to improve conditions without explicitly defining dynamic equilibrium. It also enables an adaptive rather than prescriptive approach.

Adaptive management is the practice of regularly collecting and monitoring data to review and update goal-oriented management strategies. Monitoring results can be analyzed and evaluated to identify key geographic areas and activities to improve water quality. Adaptive management can provide more dynamic and informed decision-making, resulting in more rapid ecological changes. Metro will use the monitoring results to inform an adaptive management process to track changes in watershed health over time and inform Metro's management and policy decisions relating to water quality and environmental health.

Sources used for this report

This report is based on five primary information resources:

- All of the computer-based measures were generated via Metro's Data Resource Center's Regional Land Information System, hand-digitized forest canopy data and Metro's Regionally Significant Fish and Wildlife Habitat inventory.
- Analyses completed for Metro's Title 13 (including appendices) were incorporated as appropriate. For example, two of the environmental indicators used in this report track the most valuable riparian (water-related; Class I and II) and upland (Class A and B) regionally significant fish and wildlife habitat areas.
- Sub-basin and watershed descriptions are drawn in their majority from DEQ's Total Maximum Daily Load (TMDL) reports, with permission.
- The Breeding Bird Survey data was obtained from a publicly available dataset (Sauer, J. R., J. E. Hines and J. Fallon. 2005. The North American Breeding Bird Survey, Results and Analysis 1966 - 2005. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD).
- The stream reach analysis model (Appendix 2) was initially developed in partnership with Clackamas County Water Environment Services, based on GIS information and field data collected by Metro in 2003. The model has been refined and statistically analyzed in more detail for this report. Field data for the model was collected from a variety of sources.

Metro recently acquired a new software technology, Features Analyst and is in the process of collecting refined computer-based vegetation measures. We anticipate that this may change the baseline numbers and if so, we will re-calculate these baseline numbers to reflect the highest quality data available. This will provide the most accurate assessment of any vegetation changes that occur during the first 2-year monitoring period.

Water, habitat and species at risk

WATER, HABITATS AND SPECIES AT RISK

What is a watershed?

A watershed is any area of land from which water, sediment and organic and dissolved materials drain to a common point, such as a stream, river, pond, lake or ocean. Large watersheds contain a series of smaller watersheds. Under this loose definition, the entire planet is our largest watershed, draining to the world's oceans.

For purposes of comparison it is desirable to use the most widely accepted standard for watershed delineation. In the mid-1970s, the USGS developed a standardized hydrologic unit system, referred to as the Hydrologic Unit Code system. A hydrologic unit is a drainage area, organized numerically by location and size. The underlying concept of this system is a topographically defined set of drainage areas, based on scientific hydrologic and mapping principles, organized by size. The advantage of this system is that it is nationally consistent, allowing for efficient sharing of information and resources and assuring the geospatial database is usable with other related GIS databases.

Table 2 shows the six different Hydrologic Unit Code levels, or "fields," Metro region examples of names at each Hydrogic Unit Code level, average Hydrogic Unit Code watershed size and the hydrologic numeric coding. In this report we address the following Hydrogic Unit Code levels: 4th field (sub-basin), 5th field (watershed) and 6th field (sub-watershed). Outside of the formal Hydrogic Unit Code system, these might all be called "watersheds" or "drainages." For clarity, this report calls them sub-basins, watersheds and sub-watersheds. Table 3 shows the sub-watersheds with part or all of their boundaries within the Metro region and Appendix 3 provides a watershed map.

Table 2
Hydrologic Unit Code (HUC) system

Hydrologic Unit Level	Name of level	Size	Example Name	Numeric Code
1st field HUC	Region	Average: 177,560 sq. mi.	Pacific Northwest	**17**
2nd field HUC	Sub-region	Average: 16,800 sq. mi.	Willamette River	17**09**
3rd field HUC	Basin	Average: 10,596 sq. mi.	Willamette River	1709**00**
4th field HUC	Sub-basin	Average: 450,000 acres	Lower Willamette River	170900**12**
5th field HUC	Watershed	40,000-250,000 acres	Johnson Creek	17090012**01**
6th field HUC	Sub-watershed	10,000-40,000 acres	Kelley Creek	170900120**102**

It is important to develop plans to address habitat declines and needed improvements as we document environmental conditions. The remaining sections will describe how Metro will track watershed conditions over time and provide a roadmap to finding the most important areas and activities to improve the health of our watersheds.

Table 3
Sub-basins, watersheds and sub-watersheds in the Portland metro region

Sub-Basin	Watershed	Sub-Watershed	12-Digit Code	Acres in Metro Jurisdiction	% of Total Metro Region
Clackamas	Lower Clackamas River	Christensen Cr./Tualatin R.	170900110607	734	0.2%
		Deep Cr./N. Fork Deep Cr.	170900110606	4,476	1.5%
Lower Columbia-Sandy	Columbia Gorge Tributary	Latourell Creek	170800010704	2,069	0.7%
Lower Willamette	Columbia River - Hayden Island	Coffee Lake Creek	170900120501	7,365	2.5%
		Columbia River Islands	170900120501	10,095	3.4%
	Columbia Slough–Willamette R.	Willamette R. – Columbia R.	170900120302	40,182	13.6%
		Columbia Slough	170900120301	37,060	12.5%
	Johnson Creek	Kellogg Creek	170900120103	11,067	3.7%
		Lower Johnson Creek	170900120102	15,859	5.4%
		Upper Johnson Creek	170900120101	15,116	5.1%
		Willamette R./Oswego Cr.	170900120104	16,389	5.5%
	Scappoose Creek	Gilbert River	170900120205	700	0.2%
Middle Willamette	Abernethy Creek	Abernethy Creek	170900070404	3,212	1.1%
		Beaver Creek	170900070403	13,997	4.7%
		Clackamas R./Rock Cr.	170900070402	13,227	4.5%
		Corral Creek	170900070401	128	0.0%
		Tanner Creek	170900070405	5,839	2.0%
Molalla-Pudding	Lower Molalla River	Molalla R./Willamette R.	170900090607	40	0.0%
Tualatin	Dairy Creek	Lower Dairy Creek	170900100108	3,383	1.1%
		Lower McKay Creek	170900100107	3,368	1.1%
		Lower W. Fork Dairy Cr.	170900100103	50	0.0%
	Gales Creek	Lower Gales Creek	170900100203	733	0.2%
		Tualatin River	170900100204	2,009	0.7%
	Lower Tualatin River	Beaverton Creek	170900100502	24,212	8.2%
		Fanno Creek	170900100503	20,156	6.8%
		Rock Cr./Lower Tualatin R.	170900100501	5,435	1.8%
		Saum Cr./Lower Tualatin R.	170900100504	14,696	5.0%
	Rock Creek-Tualatin River	Beaver Cr./Willamette R.	170900100403	2,725	0.9%
		Chicken Creek	170900100405	1,906	0.6%
		Lower Rock Cr./Tualatin R.	170900100401	12,461	4.2%
		Upper Rock Cr./Tualatin R.	170900100402	7,339	2.5%
GRAND TOTALS				296,028	100.0%

Total Maximum Daily Loads and water quality issues

As with any urban area, the Metro region faces significant water quality challenges. In 1978[21] the Environmental Protection Agency passed into law the federal Clean Water Act. Total Maximum Daily Loads (TMDLs) identified by DEQ are the Clean Water Act's state-level implementation. A TMDL is the calculated pollutant amount a waterbody can receive and still meet state water quality standards. TMDLs identify agencies and organizations, termed Designated Management Agencies, which play key roles in improving water quality.

In 2006, the DEQ issued a TMDL for the Willamette Basin. The Willamette TMDL listed bacteria, mercury and high water temperature as pollutants that need to be addressed in the Metro region. DEQ identified Metro as one of the Designated Management Agencies for the Willamette Basin. Metro's TMDL roles relate primarily to land ownership, restoration and regional environmental policies.

Each of the six sub-basins in the Metro region has partial or full TMDLs. Sometimes TMDLs relate to an entire sub-basin and sometimes they pinpoint specific issues and locations in a stream or river. Appendix 4 provides a flowchart of the region's current TMDL pollutants.

In the past, the Clean Water Act dealt largely with point-source pollutants, but current TMDLs address both point and non-point sources. For non-point source pollution, planting trees near streams can be a highly effective means of improving water quality, providing multiple ecological functions such as temperature reduction and toxics and sediment filtration. It also provides fish and wildlife habitat, unlike many engineered solutions.

Several of the environmental indicators monitored in this report will support TMDLs and help track the region's progress towards meeting conservation performance objectives for clean water and salmon and steelhead recovery. Specifically, indicators measuring near-stream trees and vegetation, undeveloped floodplains and the water quality/land use GIS model described in Appendix 2 can help guide regional efforts by tracking trends and identifying areas in need of restoration and enhancement.

TMDLs deal directly with water quality, which in turn relates to fish and wildlife habitat. The next few pages provide information about the region's fish and wildlife species.

Fish and wildlife in the Metro area

There are at least 292 native vertebrate species in the Metro region. Ninety-three percent use riparian areas at some point, with 45 percent regularly dependent on those areas. Eighty-nine percent of terrestrial vertebrate species are associated with upland habitats, with at least 28 percent regularly depending on these habitats. Upland and riparian habitats are necessary to maintain the region's existing wildlife diversity.

[21] The Clean Water Act is an act of the U.S. legislature passed in 1972. The Clean Water Act serves as the primary means of protecting and regulating the surface water quality of the United States, with the goal of eliminating the discharge of contaminants into United States waters and achieving a level of water quality capable of supporting propagation of fish and wildlife and water-based recreation.

Fish

The Metro region provides habitat for 26 native fish species, plus at least one extirpated species. Fifteen more species (37 percent) are nonnative. Seven anadromous[22] salmon species, all in the scientific genus *Oncorhynchus*, occur in the Metro region. Out of the entire genus, only resident rainbow trout are not considered to be at risk.

Four important factors influence salmon and other aquatic wildlife habitat: water quality (including temperature, dissolved oxygen level, turbidity), streamflow, physical structure of the stream and food supply.

Large salmon runs were once common in the Metro area, but National Oceanic and Atmospheric Administration (NOAA) Fisheries states that most salmon stocks throughout the Northwest are at a fraction of their historic levels. Past reasons included poor ocean conditions, reduced populations already weakened by loss of freshwater and estuary habitat, fishing pressures and hatchery practices. Recent improved ocean conditions have led to increased salmon returns in some areas, also helped by improvements in habitat, the hydrosystem and hatchery management.

Most recently the major cause of salmon declines is loss of freshwater habitat.[23] As a result, most remaining salmon populations in the Metro region are listed as Threatened under the federal Endangered Species Act. Other native fish, such as Pacific lamprey and coastal cutthroat trout, are at risk due to many of the same factors that have led to salmonid declines, but not yet Endangered Species Act listed.

NOAA Fisheries identified Evolutionarily Significant Units of salmon in Oregon. An Evolutionarily Significant Unit is a population or group of populations that is substantially reproductively isolated from other non-specific populations and that represents an important component of the evolutionary legacy of the species. Each Evolutionarily Significant Unit is treated as a separate species under the Endangered Species Act[24].

NOAA Fisheries designated "Critical Habitat" to promote protection and restoration for these populations.[25] Under the Endangered Species Act, Critical Habitat is defined as:

- the specific areas within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species and that may require special management considerations or protection
- specific areas outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species

Table 4 provides a summary of threatened Metro region Evolutionarily Significant Units. Critical habitat areas, when applicable, are described under each watershed.

[22] Fish that are hatched in freshwater, spend a significant portion of their life in the ocean, and return to natal streams as adults to spawn.

[23] ESA Salmon Listings. 2007. National Oceanic and Atmospheric Administration National Marine Fisheries Service web site, www.nwr.noaa.gov/ESA-Salmon-Listings.

[24] Available online at www.nwr.noaa.gov/ESA-Salmon-Listings/Salmon-Populations/Chinook/Index.cfm.

[25] NOAA Fisheries. 2000. Rules and Regulations. Designated Critical Habitat: Critical Habitat for 19 Evolutionarily Significant Units of Salmon and Steelhead in WA, OR, ID, and CA. Final Rule. Federal Register 65(32).

Table 4
Evolutionarily Significant Units in the Portland metro region[26]

Evolutionarily Significant Units	Evolutionarily Significant Unit listing status	Endangered Species Act Critical Habitat designations
Chinook salmon *Oncorhynchus tshawytscha*	Lower Columbia River: Threatened (6/28/05)	Designated 9/2/05
Coho salmon *Oncorhynchus kisutch*	Lower Columbia River: Threatened (6/28/05)	Under development
Steelhead *Oncorhynchus mykiss*	Lower Columbia River: Threatened (1/5/06)	Designated 9/2/05

Amphibians

Sixteen native amphibian species live in the Metro region, including 12 salamander and five frog species (plus one extirpated frog species). Bullfrogs are introduced and place considerable pressure on native species. In the Metro region, 69 percent of native amphibian species (salamanders, toads and frogs) rely exclusively on stream or wetland related riparian habitat for foraging, cover, reproduction sites and habitat for aquatic larvae. Six Metro-region amphibian species are state-listed species at risk; four species are considered at risk at the federal level.

Amphibians require both aquatic and terrestrial habitats to complete their life cycle thus changes to either ecosystem may interfere with their success.[27] Small non-fish bearing streams and beaver ponds may be important because they are free from competition and predation by fish. As with salmonids, amphibians have specific habitat requirements and are sensitive to environmental change. Clean, relatively sediment-free water, rocky stream beds and woody debris are important to the region's amphibians.

Amphibians have suffered worldwide declines over the past 20 years, with particularly noteworthy declines in the Pacific Northwest. Thus this may be the group most sensitive to human-induced habitat loss and alteration such as microclimate changes. For example, habitat fragmentation creates edge habitat and edge habitats tend to have elevated temperatures and reduced humidity. Unlike other species groups, amphibians' skin is not waterproof, nor are their eggs and such edge-induced changes may be lethal. Fragmentation and wetland isolation is also a problem because amphibians have small home ranges and cannot travel as freely as other animals.

Pacific Northwest research links amphibian declines with riparian forest loss, altered hydrology and urbanization and documents the importance of small wetlands, often overlooked in conservation planning, to species richness.

Reptiles

Thirteen native reptile species live in the Metro region, including two turtle, four lizard and seven snake species. Two more turtle species, snapping turtles and red-eared sliders, are non-native. Although most lizards and snakes are upland associated, many species use riparian areas extensively for foraging because of the high density of prey species and vegetation. All of the turtle species are riparian/wetland obligates and rely on large wood in streams and lakes for basking. The two native turtle species are listed as at risk at state and/or federal levels.

[26] Complete report available online at www.nwr.noaa.gov/Salmon-Habitat/Critical-Habitat/Redesignations/Index.cfm.

[27] See Metro's Technical Report for Goal 5, August 2005.

Reptiles are cold-blooded and some species have special habitat requirements in order to collect the sun's energy. For example, most lizard and snake species rely on upland cliffs and rocky outcrops to gather heat during cool periods. Crevices within these structures also provide important refuge during hot spells.

Some reptiles prefer riparian areas, fulfilling complex life history needs through the structural and functional diversity provided by riparian forests. For example, the common garter snake forages for amphibians, small fish and earthworms and needs riparian denning sites with good cover, such as downed wood and good shrub and understory. Western pond turtles eat a variety of foods such as insects, mollusks, fish, amphibians and carrion. These animals require about six inches of forest leaf litter in which to overwinter and five or more inches of soil and close proximity to water for nesting. In Oregon, Western pond turtles are in serious jeopardy due to habitat loss and predation on hatchlings and have dangerously restricted gene pools in the Metro region due to isolation.

Birds

Birds often represent a majority of vertebrate diversity in a region and the 209 native bird species comprise about two-thirds of the region's native vertebrate species. An additional four non-native species have established breeding populations in the area.

Urban bird communities are typically less diverse compared to undisturbed habitats, but contain higher numbers of birds due to domination by a few nonnative and urban-associated species. There tends to be a loss of species, particularly habitat specialists, over time.

About half of the region's native bird species depend on riparian habitats for their daily needs and most species use riparian habitats at various times during their lives. Twenty-two bird species on Metro's list are state or federal species at risk; 19 of these are riparian obligates or regularly use water-based habitats. An additional riparian obligate, the Yellow-billed Cuckoo, is extirpated (locally extinct) in the Metro region.

European Starlings, an abundant non-native species, are closely associated with the region's riparian habitats and can comprise 50 percent or more of total birds in the region's narrow riparian forests. Starlings out-compete natives for food and breeding habitat. Neotropical migratory birds[28] appear to respond negatively to development and rely heavily on riparian areas for breeding and migratory stopover habitat. Neotropical migratory bird population trends are declining, in the Metro region. Whether this is due to disturbance, habitat quality or other factors is not yet known.

Some bird species, such as Rufous Hummingbirds, Winter Wrens, Brown Creepers and Pacific-slope Flycatchers, may be particularly sensitive to habitat fragmentation in the Metro area and appear to require large habitat patches during the breeding season.

Mammals

Mammals are another diverse group of species in the Metro region, with 54 native species. Of native species, 28 percent are closely associated with riparian habitats, with another 64 percent using these habitats at various points during their lives. Six out of nine bat species are state or federal species at risk. Three native rodent species are similarly listed.

[28] Neotropical migrants are species in which the majority of individuals breed here, but migrate south of the U.S. border to overwinter.

This is the terrestrial group with the highest number of non-native species (eight species; most are rodents). Nutria and pets can be detrimental to wildlife. Nutria inflict wetland and agricultural damage and compete with beaver and muskrat for resources. Cats and dogs are disruptive and often lethal to native birds and small mammals.

Riparian resources are important to mammals for many of the same reasons they are important to amphibians and birds – diverse habitat structure, woody debris, good connectivity, access to water and a wealth of food resources. Riparian forests usually contain high amounts of coarse woody debris and this may be why some studies document higher small mammal abundance in riparian habitats than in uplands.

Bats in the Pacific Northwest are more abundant and diverse in habitats with increased roost availability and diversity, including a variety of tree, cliff and cave roosts. Canopy cover and structural complexity is very important to this sensitive group. Bats often roost in artificial structures and bat-friendly habitats may be provided in both new and existing bridges and other structures at little or no extra cost.

Mammals can profoundly influence habitat conditions. Beaver, a keystone riparian species, play a critical role in the creation and maintenance of wetlands and stream complexity and may have broad effects on physical, chemical and biological characteristics within a watershed. Medium-sized carnivores limit rodent and small predator populations. Bats help regulate insect populations and may contribute to nutrient cycling, particularly in riparian areas.

Graduate level research at Portland State University[29] suggests that the following small mammals may need habitat patches of 10 hectares (24.7 acres) or greater: shorttail weasel, Oregon vole, Northern flying squirrel, shrew-mole, white-footed mouse, Trowbridge's shrew, vagrant shrew, Douglas squirrel, Western gray squirrel and Townsend chipmunk. The study also found that non-native mammal abundance decreased in larger patches.

Habitat quality and biological diversity are important to human health. A Portland State University graduate student[30] recently linked urban park size and habitat quality to lower levels of hantavirus in small mammal populations, probably related to increased biological diversity. Multnomah County, Oregon Vector Control staff documented decreased mosquito abundance in residential areas with higher quality wildlife habitat, possibly relating to increased predation on the mosquitoes.[31]

Loss of habitat, connectivity, forest structural diversity and large woody debris common in urban areas probably reduce the region's mammal populations and leads to local extinctions over time.

Oregon Department of Fish and Wildlife's Conservation Strategy

In 2006, ODFW developed a statewide habitat Conservation Strategy that synthesizes the best available data, science and knowledge into a broad vision and conceptual framework for long-term conservation of Oregon's native wildlife.[32] The strategy emphasizes the conservation of declining species and habitats to reduce the possibility of future federal or state Endangered Species Act listings.

[29] Lichti, N.I. and M.T. Murphy. 2003. Determinants of Mammal Biodiversity in Urban Forests. Proceedings of the 2003 Urban Ecology & Conservation Symposium, Portland, Oregon.

[30] Dizney, L., P. Jones and L. Ruedas. 2007. Healthy ecosystems are good for your health. Proceedings of the 2007 Urban Ecology & Conservation Symposium, Portland, Oregon.

[31] Personal communication, 2007, Chris Wirth, Multnomah County Vector Control.

[32] Oregon Department of Fish and Wildlife. 2006. Oregon Conservation Strategy. Oregon Department of Fish and Wildlife, Salem, Oregon. The Comprehensive Conservation Strategy is available on ODFW's web site (www.dfw.state.or.us) or by contacting ODFW directly. The Strategy Species List is included in that document.

The strategy documented species present in the state with small or declining populations or that are otherwise at risk.[33] It identified special needs, limiting factors and data gaps regarding these species and recommended conservation actions to help conserve these at-risk species. The Strategy Species list includes 17 amphibians, 62 birds, 65 fish, 59 invertebrates, 18 mammals, 60 plants and five reptile species. Not all of these occur in the Metro area and survey data is sparse for species groups such as plants and invertebrates. At least 31 of ODFW's terrestrial vertebrate Strategy Species are likely to be found, or were formerly present, somewhere in the Metro area. Appendix 5 documents the Strategy species that occur in the Metro region.

Metro monitors several Strategy species on its properties, also documented in Appendix 5. Such monitoring efforts are important to Metro's adaptive management strategies, but are not necessarily useful in assessing region-wide conditions for these species because Metro's monitoring is typically designed to measure site-specific wildlife response to restoration and enhancement work.

As part of Title 13 Metro developed a Vertebrate Species List for all known species that can be expected to occur in the Metro region at least once per year and species' habitat associations. This list is provided in Appendix 6.

ODFW Conservation Opportunity Areas. Conservation opportunity areas are landscapes where broad fish and wildlife conservation goals can best be met. Working in these landscapes can increase effectiveness of conservation actions at larger scales than individual projects scattered throughout the state. While conservation actions and incentive programs are not, and should not be, limited to conservation opportunity areas, these are the primary areas ODFW will promote as investment priorities for voluntary conservation tools. ODFW's conservation opportunity areas overlap extensively with Metro's 1995 bond measure acquisitions, as well as with the 2006 bond measure's generalized target areas (Appendix 7). The Conservation Opportunity Areas are typically associated with declining or rare habitat types. Metro's inventory includes similar information through Habitats of Concern.

Metro supports ODFW's Strategy by:

- participating in advisory committees for monitoring and other scientific work
- including Conservation Opportunity Areas and declining or rare habitat types as criteria for prioritizing natural area acquisition
- acquiring habitats that support ODFW's Conservation Strategy such as Oregon white oak, native prairie, wetland and streamside areas
- restoring and maintaining Strategy habitats
- providing selected key habitat elements for Strategy species such as nest boxes, downed wood and native plant species
- monitoring (including citizen monitoring) several Strategy Species on selected Metro properties and using the results to inform habitat management
- including Conservation Opportunity Areas in Metro's New Look at 2040 regarding where and how the region might grow based on predicted population increases

[33] The Comprehensive Conservation Strategy is available on ODFW's web site (www.dfw.state.or.us) or by contacting ODFW directly. The Strategy Species List is included in that document.

Table 5

Description of overlap between Oregon Department of Fish and Wildlife's Conservation Opportunity Areas and Metro's Habitats of Concern

Species that Metro monitors on selected sites are indicated with an asterisk

Metro Habitat of Concern habitat type[34]	Habitat description	Species associated with habitat	Conservation comments
Oregon white oak savannas and woodlands *"Oak Woodlands" in ODFW Conservation Strategy*	Oregon white oak is limited in geographic extent and only a fraction of historic oak remains in the Metro region. Less than 1 percent of historic Willamette Valley native oak and grassland habitats still exists. Savannas are areas with lower tree density than woodlands and often contain more native grassland compared to woodland.	white-breasted nuthatch,* Western bluebird,* house wren,* Western gray squirrel*	Oak tends to be found on dry, rocky south- or southwest-facing slopes. Historically, fire was an important factor in maintaining oak habitat and reducing encroaching conifers. Development, agriculture and cutting for firewood have threatened this habitat.
Native prairie grasslands *"Grasslands" in Conservation Strategy*	In the Metro region, grasslands are typically found in uplands and are often associated with native oak habitat and contain a variety of now-rare plant species. A fraction of one percent of historic native prairie grassland still exists in our area.	vesper sparrow,* savannah sparrow,* sharp-tailed snake, Northern and Southern alligator lizards	Native grasslands are one of the most imperiled habitats in the western U.S. Native grass-lands have been impacted by conversion to agriculture, development, invasive plant species, disruption of historical fire regimes and subsequent encroachment of shrubs and trees.
Wetlands *"Freshwater aquatic habitats" in Conservation Strategy*	Wetlands are areas with special "hydric" soils that retain water during the growing season or longer and support or could support hydrophytic vegetation (those plants requiring an abundance of water to grow). In the Willamette Valley, various sources document wetland losses between 40-57 percent of original, with continuing losses of more than 500 wetland acres per year.	great blue heron,* American bittern,* Western painted* and pond turtles, red-legged frog,* Pacific chorus frog*	Land use conversion to development and agriculture, as well as changes in the water cycle, threaten this habitat type. However, wetlands and other riparian habitat are currently the subject of much funding and restoration efforts.
Bottomland hardwood forests *"Freshwater aquatic habitats" in Conservation Strategy*	Bottomland hardwood forest occurs most often near rivers and larger streams and is associated with floodplains and wetlands. Over 70% of the region's bottomland hardwood forests have been lost. It often includes black cottonwood, ash and a complex native understory.	red-eyed vireo,* warbling vireo,* common yellowthroat,* American beaver	Habitat loss and water quality, quantity and invasive species pose threats to this habitat type.

[34] Metro's Habitat of Concern habitat type categories are identical to ODFW's Strategy Habitats. Chapter 4 in ODFW's *Oregon Conservation Strategy* provides detailed descriptions of Strategy Habitats' occurrence, conservation overview, and limiting factors, which are summarized in this table.

Indicator details

INDICATOR DETAILS

A description of each indicator, references to relevant graphs and figures and a discussion of each indicator's baseline conditions, target and potential means to reach each target are described below (see also Table 1 and Appendix 1).

It is important to note that other indicators such as wildlife population trends would be entirely relevant and could provide key habitat management information. Although certain species have been studied in selected areas for a season or two, there is no long-term wildlife data set available for the Metro region. The region's most commonly collected data relate to water quality. It may be useful to compile data, such as water quality or aquatic invertebrates, collected over time through a variety of sources to determine whether trend information could be extracted. Metro is compiling a map of long-term water quality monitoring sites and will assess and comment on the utility of the data set for the 2008 monitoring report.

Indicators 1-9

The *Introduction and background* section, Table 1 and Appendix 1 provided a description of Metro's Title 13 performance measures, targets and indicators. The indicator results are discussed at several spatial scales in subsequent sections. These indicators will be used to track watershed-based targets and monitor changes over time. This baseline report contains first-time measurements; future reports will compare conditions within and across watersheds over time.

Two sub-basins comprise more than 85 percent of the Metro region: the Lower Willamette and the Tualatin River sub-basins. Conditions in several large sub-watersheds falling primarily in the urban growth boundary strongly influence the region's total habitat and water quality conditions. Conversely, numerous other sub-watersheds contain relatively small proportions of the Metro region and are therefore less influential on the region's overall environmental conditions.

These factors should be considered when interpreting sub-watershed statistics offered in this report. For example, conditions in the 40-acre Molalla River sub-basin are offered in relationship to regional averages as for all sub-watersheds, but the comparison in that case is not really relevant due to the small sample size. However, tracking region-wide indicators and comparing conditions within each sub-watershed over time is relevant.

Table 6
Monitoring indicators used in this report and their ecological relevance

Indicators used within this report represent a subset of the "Example Indicators" in Appendix 1. The stream and wetland buffer distances and the landscape features within them were derived from a scientific literature review conducted for Metro's Title 13 - Nature in Neighborhoods.[35]

Performance objective and target	Indicator	Ecological relevance
Preserve and improve streamside, wetland and flood area habitat connectivity (sub-watershed scale). *2015 targets:* • *Increase forest and other vegetation within 50' of streams by 10%, and within 50-150 feet of streams and wetlands by 5%.* • *Protect at least 90% of undeveloped floodplain acres.*	*1.* % vegetation within 50 feet of streams and wetlands *2.* % forest within 50 feet of streams and wetlands *3.* % vegetation within 50-150 feet of streams and wetlands *4.* % forest within 50-150 feet of streams and wetlands *5.* Number of acres of Class I and II high value riparian habitat *6.* Number of acres of undeveloped floodplain	*1* and *2*. This area is vitally important for protecting water quality and providing shade to reduce water temperature. All vegetation is valuable, but trees provide the highest ecological benefit. *3* and *4*. This area, roughly the "site potential tree height" distance, is seen throughout the scientific literature as an area that strongly influences water quality. *5*. Measures gain or loss of the most intact riparian areas. *6*. Developing natural floodplains causes a wide variety of negative effects including altered hydrology,[36] introduction of toxics and increased flooding.
Preserve large areas of contiguous habitat and avoid fragmentation, (sub-watershed scale). *2015 targets:* • *Preserve 75% of Class A and B acres.* • *Preserve 80% of habitat interior acres.*	*7.* Number of acres of Class A and B high value upland habitat *8.* Number of acres of interior habitat	*7*. Metro's Regionally Significant Fish and Wildlife Habitat Inventory modeled wildlife habitat by measuring key characteristics: habitat patch size, shape, water resources and connectivity to other patches. Classes A and B are the highest value upland habitat classes. *8*. Habitat interior is ≥200 feet or more from the outside edge of a habitat patch. Many sensitive and declining wildlife species survive and thrive best away from "edge habitat," whereas habitat human disturbance is greater and non-native wildlife, invasive plant species and predators tend to thrive in urban edge habitats.
Preserve and improve wildlife connectivity between riparian corridors and upland habitat. *Objective 3 is not being measured in this report.*	Wildlife corridors were not explicitly accounted for in the Regionally Significant Fish and Wildlife Habitat Inventory and are excluded in the monitoring report. Several issues complicate corridor identification and delineation: • Different species have different corridor requirements.	Metro has developed a draft set of major wildlife corridors based on anchor habitats, connectivity between these anchors and connectivity to key wildlife areas outside the region. Anchor habitats include exceptionally large (for a given area) and/or ecologically important areas. For example, certain smaller areas containing known sensitive species breeding populations may be included. Corridors between anchors were identified using numerous sources including:

[35] See Exhibit F – Ordinance No. 05-1077C, Attachment 2: Metro's Technical Report for Fish and Wildlife Habitat. See Table 7 (p. 81), "Range of functional riparian area widths for fish and wildlife habitat" and Table 11 (p. 113), "Planning guidelines for upland wildlife habitat."

[36] "Altered hydrology" refers to changes in the water cycle, particularly changes in the amount and speed with which rainwater is delivered to the region's streams. Vegetation loss and increased levels of impervious surfaces interrupt the hydrologic cycle, alter stream structure, and degrade the chemical profile of the water that flows through streams. These changes to water storage and delivery harm the environment in a variety of ways, and are cumulative within watersheds.

Performance objective and target	Indicator	Ecological relevance
	• Corridor function is scale dependent. A key corridor in a small area may not be very significant on a regional scale and vice versa. Similarly, it is important to connect corridors within the region to important habitat areas outside the region. • Corridors are hard to quantify. How wide are they? Where is the centerline? This inhibits numeric comparison over time and is not easily quantifiable. • Field studies may be necessary to determine species use. Wildlife corridors are crucial and Metro is taking other measures to address them (see next column).	• recent aerial photographs, including those extending well beyond the Metro region • parks and natural areas information • Habitats of Concern and Metro's Regionally Significant Fish and Wildlife Habitat inventory • critical habitat area designations from other organizations including ODFW and The Nature Conservancy • the City of Portland • planning efforts in Pleasant Valley, Happy Valley and Damascus areas The map is being used to inform planning activities (e.g., transportation planning, natural area acquisition targets and the New Look at 2040), monitor corridor features and coordinate with other agencies and organizations such as ODFW, Oregon Department of Transportation and local jurisdictions.
Preserve and improve special habitats of concern (sub-watershed scale). *2015 target: preserve 90% of known Habitats of Concern.*	*9.* Number of acres and categorical types of special or at-risk habitats.	Metro's Regionally Significant Fish and Wildlife Habitat Inventory identified and mapped native oak, riparian bottomland hardwood, wetlands, river islands and deltas, as well as habitats with specific key functions (such as a key connector). This indicator tracks these habitat areas.
Additional measures (not part of Title 13 indicator list). *No targets. These measures were added to incorporate field data, add site-specific information and add confidence to GIS-based measures.*	*10.* Breeding Bird Survey data analysis	When tracking habitat conditions using remote sensing such as GIS, it is desirable to include real wildlife data to validate findings and draw inferences between habitat and wildlife trends. This field-based measure tracks many of the region's bird species' trends over time. The long-term (35+ years) data set is provided by USGS/Patuxent Wildlife Center; bird surveys are conducted each spring along a route extending from Tualatin to Milwaukie.
	11. Pilot stream reach model	Ideally, water quality response to vegetation changes near streams related to indicators 1-4 would be measured incrementally along streams by stream reach, using water quality data collected in the field. However, complete and consistently collected field data are not available and would be prohibitively expensive to collect. To address this issue Metro developed a pilot GIS water quality model based on selected field data sets and high quality land use information available for the Damascus area in Clackamas County. GIS data for the entire region, of sufficient quality to extend the model region-wide, is anticipated in time to develop a region-wide stream reach water quality model for the 2008 monitoring report.

The following pages provide baseline conditions and a more detailed discussion of each indicator.

Indicators 1 and 2
(Table 7 and Figure 2)

Forest and other vegetation within 50 feet of streams and wetlands

Objective	Preserve and improve streamside, wetland and flood area habitat and connectivity.
2004 baseline condition	
Indicator 1	Forest within 50 feet: Regional average 38.7 percent
Indicator 2	All vegetation within 50 feet: Regional average 63.3 percent
2015 Target	10 percent increase in vegetated acres (1,407 acres) for a total of 15,472 vegetated acres in 2015.

On average, 63 percent of the area within 50 feet of the region's streams and wetlands are vegetated. About 39 percent is riparian forest (patches of trees) with the remaining 24 percent in shrub, herbs, lawns, etc. Water quality degradation in many of the region's streams and significant declines of sensitive wildlife species make it clear that current levels are not sufficient to protect water quality or provide optimal wildlife habitat. Subsequent State of the Watersheds reports will analyze change over time and provide valuable information to the Metro Council and the region about where and how to best focus funding and restoration efforts.

Forest and other vegetation closest to streams and wetlands are among the region's highest value habitat and is the last defense against pollution and poor water quality. These areas also provide the strongest connection between habitat areas and more terrestrial wildlife species use riparian habitat than any other habitat type. If only two indicators could be used, indicators 1 and 2 would be the first choices because without these, streams and wetlands will continue to degrade. However, healthy riparian habitat within 50 feet of streams and wetlands is not sufficient to fully protect water quality or provide for the needs of many wildlife species (see figures 1a and 1b).

Local jurisdictions provide some regulatory protection to these areas through existing implementation of Title 3 (floodplain and water quality protection) and jurisdictions are required to implement Title 13, which will increase the extent of certain protected areas, by January 2009. However, these regulations do not prohibit development or vegetation clearing in these areas. The effectiveness of regulatory protection and voluntary measures, including nature-friendly development practices to preserve habitat where possible and mitigation to offset impacts where not possible, will be of primary importance to meeting this target.

Trees are a vital resource near streams, providing a wide variety of ecological functions, including:

- microclimate and shade to moderate air, soil and water temperature
- bank stabilization and sediment control
- pollution reduction
- storm water and stream flow moderation
- organic matter input key to the in-stream food web
- large woody debris important to salmon, channel complexity and trapping sediments

The DEQ considers restoration of streamside trees to be a key feature to reduce water temperature and toxics present in streams.

Note that Indicator 1 relates to trees and Indicator 2 relates to all vegetation, but the 10-year target accounts solely for vegetation for several reasons. Some of the "other vegetation" category actually consists of young trees, either naturally regenerated or planted through restoration efforts, but present GIS data does not distinguish between shrubs and young trees. In addition, shrubs can provide significant shade along smaller streams, helping reduce water temperatures. Native vegetation is a crucial habitat feature, but even grass can help slow storm water and trap sediments. Future reports will track both trees and vegetation near streams.

Metro developed the REIN online mapping tool to help identify restoration areas that have not yet grown into riparian shrub/forest. The tool, online at www.rein.org, was made public in January 2007. The REIN tool will help identify areas already restored and those most in need of tree and shrub plantings to best benefit the region's water quality and wildlife habitat. Any agency, organization, nonprofit or citizen group can enter their projects on the REIN tool.

A sub-watershed's contribution to the region's total vegetation is approximately proportional to its area within the Metro boundary. However, a few sub-watersheds stand out as either above or below average for these two indicators. The Willamette River/Columbia River sub-watershed provides the highest amount of forest near streams and wetlands in the region; 69.5 percent of the area within 50 feet of streams and wetlands is forested, contribution nearly 13 percent of the region's total. Many other sub-watersheds also provide key contributions to the region's total, including Beaverton Creek, Fanno Creek, Willamette River/Oswego Creek and Upper Johnson Creek.

On the other hand, some sub-watersheds' area within 50 feet of streams and wetlands has a high proportion of forest cover, but does not contribute much to the region's total. This may be because only a small portion of the sub-watershed falls within the Metro region, or because it does not contain much riparian habitat. For example, the Gilbert River sub-watershed's area closest to streams and wetlands is more than 70 percent forested, but it contributes less than one percent to the region's total because only 700 total acres fall within the Metro boundary. Chicken Creek comprises just 0.6 percent of the entire region's overall acreage, but contributes 1.7 percent of the forested area near streams and wetlands because it contains substantial riparian areas that are relatively well forested.

Stream- and wetland-side habitat preservation, restoration and careful development practices will be key to reaching the regional target. Local and regional bond measure funds are helping acquire important natural areas, with emphasis on functional riparian areas. For example, under a 1995 voter-approved bond measure Metro acquired more than 8,000 acres of ecologically valuable natural areas throughout the region and a second 2006 bond measure should enable acquisition of at least 3,500 more acres.

Local watershed groups, nonprofits and jurisdictions are actively working to restore many degraded riparian areas. These groups are making good progress, but more work is needed. Title 13 requires local jurisdictions to review their development code for barriers to nature-friendly development practices and remove such barriers. Some jurisdictions have completed this task; the remainder will need to do so in order to comply with Title 13. Reducing riparian impacts from new development will help protect the current "baseline," slow habitat loss and provide some replacement over time due to mitigation requirements, but increasing voluntary restoration efforts will likely be necessary to reach regional targets and offset impacts from existing and new development.

Indicators 3 and 4
(Table 8 and Figure 3)

Forest and other vegetation within 50-150 feet of streams and wetlands

Objective	Preserve and improve streamside, wetland and flood area habitat and connectivity.
2004 baseline condition	
Indicator 3	Forest within 50-150 feet: Regional average 33.9 percent
Indicator 4	All vegetation within 50-150 feet: Regional average 55.1 percent
2015 Target	5 percent increase in vegetated acres (982 acres) for a total of 20,614 (60.1 percent) vegetated acres in 2015

Local studies show a relationship between tree cover and stream health and also riparian bird communities, at many spatial scales.[37] Nationally, many studies and agency recommendations suggest a width of about 150 feet on each side of streams and wetlands will provide for many of the most important riparian functions. For example, several studies suggest this width in order to supply large woody debris (a key structural component in streams) and maintain cool water temperature and streambank stability. Some wildlife species require even wider riparian corridors. Thus, though trees and vegetation within 50 feet of streams and wetlands are necessary for stream health, this area alone is not sufficient for fully functioning waterways, particularly in urban areas where high levels of stormwater, pollutants and sediments may enter the water.

The total acres, percent cover and percent contribution to the region for this indicator are provided in Table 8 and displayed graphically in Figure 3. The regional average for vegetation within 50-150 feet of streams and wetlands is 55 percent, with 34 percent of that in tree cover. Comparing these figures with the area within 50 feet, these numbers are lower. Current levels within 50 feet are too low and the numbers within 50-150 feet are even lower. However, this comparison demonstrates a certain amount of regional commitment to protecting water quality, because the area closest to streams and wetlands is more vegetated and less developed than other areas. Some of the region's most critical riparian areas are being protected.

The target for indicators 3 and 4 (5 percent increase over 10 years) is lower than that for indicators 1 and 2 (10 percent increase over 10 years). The target closest to streams and wetlands is highest because while it is very important to protect water quality, it is also important to maintain a compact urban form. The Metro Council and local governments are working together to protect outlying areas from urban encroachment.

As in indicators 1 and 2, the Willamette River/Columbia River sub-watershed provides the highest amount of forest near streams and wetlands in the region at 11 percent of the region's total. Many other sub-watersheds also provide key contributions, including Beaverton Creek, Columbia Slough and Upper Johnson Creek. These sub-watersheds also contribute a substantial amount of land to the Metro region. Other watersheds contribute less overall land, but contain substantially higher proportions of vegetation

[37] Original field study citations: Frady, C., Gerth, B., Li, J. and Hennings, L. 2003. Portland Metro benthic invertebrate analysis. Prepared for Metro Regional Services, Portland, Oregon. Hennings, L.A. and W.D. Edge. 2003. Riparian bird community structure in Portland, Oregon: habitat, urbanization, and spatial scale patterns. The Condor 105:288-302. Cole, M.B. and Hennings, L.A. 2006. Baseline assessment of stream habitat and macroinvertebrate communities in and adjacent to the Damascus area urban growth boundary expansion, Oregon.

within 50-150 feet of streams and wetlands compared to other regional sub-watersheds. These include sub-watersheds such as Abernethy Creek, Saum Creek/Lower Tualatin River and Beaver Creek (Abernethy Creek watershed).

The activities needed to help reach the target for these criteria are similar to those discussed for indicators 1 and 2. However, because the area within 50-150 feet of streams is less subject to regulatory protection it will be important to emphasize nature-friendly development practices and acquisition, along with ongoing restoration efforts.

Indicator 5
(Table 9 and Figure 4)

Class I and II riparian habitat

Objective	Preserve and improve streamside, wetland and flood area habitat and connectivity.
2004 baseline condition	
Indicator 5	Regional average of Class I and II habitat is 17.8 percent
2015 Target	No specific target set for this indicator because it is based on existing (not new) Title 13 - Nature in Neighborhoods riparian habitat. Closely related to targets for indicators 1-4.

Metro's Regionally Significant Fish and Wildlife Habitat inventory, part of Title 13, designated three riparian (adjacent to streams and wetlands) and three upland habitat classes. Riparian habitat includes Classes I, II and III and upland habitat includes Classes A, B and C. Indicator 5 addresses Targets 1a and 1b by accounting for Class I and II riparian habitat.

The science-based riparian habitat inventory was conducted using on-the-ground features that contribute to riparian function and water quality such as floodplain, steep slopes, trees and other vegetation.[38] Class I and II are the highest quality, most important remaining riparian habitat and are afforded a basic level of protection or mitigation from development under Title 13. Local jurisdictions are working to implement Title 13 and can achieve regulatory compliance in several different ways, but the ordinance does not preclude development in these areas.

Indicator 5 overlaps spatially somewhat with indicators 1-4. However, Indicator 5 can extend beyond 150 feet in areas with extensive floodplains or steep slopes, or may only reach 50 feet from streams and wetlands if the area is developed. Classes I and II identify riparian habitat quality by specifically accounting for features that contribute to ecological functions such as microclimate and shade, water storage, protection from excess sediments and toxics and in-stream structure and food resources such as large woody debris and organic matter.

In general, older developed areas have more streams piped underground. This is evident in certain parts of the City of Portland, where some of the oldest developed areas in the region have no surface streams at all. Recent development techniques are often more careful to preserve stream corridors and wetlands and find ways to develop around them, although often with very narrow vegetated corridors. In some areas mitigation is required to offset the negative impacts of development on streams and wetlands.

[38] Metro. 2005. Metro's technical report for fish and wildlife habitat. Available online at www.metro-region.org/library_docs/nature/092305-10_ord_05-1077c_ex_f_attch_2_techn_rept.pdf.

The regional average for the proportion of Class I and II riparian habitat is 18 percent. Different sub-watersheds naturally have varying amounts of streams; however, region-wide it is estimated that over 25 percent of all surface streams have been lost through piping and other means (Appendix 8), thus current conditions are significantly altered from historical conditions.

The Columbia River Islands sub-watershed contributes more than 18 percent of the region's Class I and II riparian habitat. In fact, Columbia River Islands is composed of 96 percent Class I and II habitat. The islands are relatively longer than wide and are surrounded by river water, thus most of the land base is near water. These are some of the most valuable wildlife habitat areas in the region and are also called out in Indicator 9, Special Habitats of Concern.

Columbia Slough and the Willamette River/Columbia River sub-watersheds also contribute regionally important habitat quantities, each at 11 percent contribution to the region's total Class I and II habitat. Beaver Creek (Abernethy Creek watershed) contributes another 7 percent. Other smaller sub-watersheds stand out by contributing more Class I and II than their size would indicate. Latourell Creek contains 1,307 acres of Class I habitat, comprising 64 percent of the sub-watershed's area in the Metro region. Beaver Creek in the Tualatin Basin holds 3,297 acres of Class I habitat (26 percent of its area), unlike Beaver Creek in the Tualatin Basin, which contains only 52 acres of Class I and II, about 7 percent of its total area. Lower Johnson Creek and Kellogg Creek also contain relatively low percentages of high value riparian habitat.

The activities needed to help meet the regional target for Class I and II riparian habitat are similar to previous measures. As with the first two indicators, the effectiveness of regulatory protection and voluntary measures, including nature-friendly development practices to preserve habitat where possible and mitigation to offset impacts where not possible, will be of primary importance to meeting this target. Class II areas that are closest to streams and wetlands tend to lack sufficient shrub and forest cover (otherwise they would be Class I). While classified differently, some of these areas support native grass and herbaceous plant communities that can also be important habitats. Habitat restoration and enhancement in these areas can elevate the region's overall riparian habitat quality.

Indicator 6
(Table 10 and Figure 5)

Undeveloped floodplain

Objective	Preserve and improve streamside, wetland and flood area habitat and connectivity.
2004 baseline condition	
Indicator 6	Regional average 90.1 percent undeveloped, 9.9 percent developed floodplain area
2015 Target	No more than 10 percent increase in developed floodplain acres (3,133 acres) for a total of at least 28,196 undeveloped floodplain acres in 2015.

Floodplains used in this report include Federal Emergency Management Administration 100-year floodplains plus the 1996 flood area of inundation.

Floodplains, the flat areas near streams and rivers that are naturally subject to periodic inundation, are particularly important to maintaining healthy watersheds. Unfortunately, because they are flat they provide attractive development opportunities for industry and housing. Developing floodplains causes many expensive problems in urban areas, some direct and some indirect. Direct effects include increased storm water volumes, increased flooding and stream channel damage due to loss of the natural sponge effect of soils and vegetation. Damaged stream channels have reduced habitat complexity and lose their

vegetation and erode easily, sending unwanted sediments into the water. Polluted urban and suburban runoff impairs water quality in streams, wetlands and everything downstream.

Less obvious, but equally important, is the loss of ground water recharge through infiltration. Without this recharge many streams go dry during summer. This impacts vegetation, fish and most other wildlife species. These groundwater-stream interaction zones also provide key salmon habitat because they provide clean, cold water. Local studies show that migrating salmonids linger near such habitat.[39]

The total acres, percent cover and percent contribution to the region for this indicator are provided in Table 10 and displayed graphically in Figure 5. There are 34,777 floodplain acres in the region, averaging 90 percent undeveloped and 10 percent developed. Columbia River Islands sub-watershed is 99 percent floodplain, contributing 28 percent to the region's total and 31 percent of the region's undeveloped floodplain. Only 1 percent is developed. Columbia Slough and Willamette River/Columbia River sub-watersheds contribute another 14 and 13 percent of the region's undeveloped floodplain, respectively; together, these three sub-watersheds comprise about 57 percent of all undeveloped floodplain acres. Columbia Slough also contains the most developed floodplain (18 percent), followed by Willamette River/Columbia River and Lower Johnson Creek. The latter provides an example of the expense and damage that occurs when floodplains are developed.

Ecologically and economically, it is best not to build in the floodplain. In 1998 the Metro Council adopted Title 3 to meet standards for statewide planning goals that deal with water quality (Goal 6) and flood management (Goal 7). Unfortunately, floodplain development continues, altered hydrology has expanded flood-prone areas along numerous urban streams and it is uncertain whether the balanced cut and fill scheme completely mitigates the impacts of development on the floodplain.

The regional target for Indicator 6, calling for a loss of no more than 10 percent over the next decade, reflects the reality of urbanization and "buildable" lands. Although to protect water quality, ideally no additional acres of this key resource should be developed, it is likely that some acres will be developed, therefore the goal is to minimize floodplain development as much as possible. Otherwise, the region will see increasing flood and stream channel damage over time.

Major flood issues in Lower Johnson Creek resulted in a program to buy and remove houses in the developed floodplain, a high-cost restoration necessity that could have been avoided by prohibiting development in flood-prone areas. Avoiding development altogether in these areas is best. If development must occur, care should be taken to minimize hard surfaces and mitigate loss of the high flow capacity and "sponge" effect that natural floodplains provide. Metro and other jurisdictions also work to purchase floodplain areas to prevent future development and protect critical habitat.

Indicator 7
(Table 11 and Figure 4)

Class A and B upland habitat

Objective	Preserve large areas of contiguous habitat to avoid fragmentation.
2004 baseline condition	
Indicator 7	Regional average 10.1 percent Class A and B wildlife habitat
2015 Target	Preserve 75 percent (no more than 7,482 acres lost) for a total of at least 22,447 (7.6 percent Class A and B wildlife habitat acres in 2015.

[39] Brinckman, J. 2000. Research uncovers salmon spawning secret. The Oregonian, Friday, December 15, 2000.

The Title 13 target aims for no more than 25 percent decrease in Wildlife Class A and B acres (Indicator 7) in each sub-watershed, and in the region, by 2015. This acknowledges the importance of protecting riparian areas and the need for maintaining a compact urban form to prevent more widespread ecological damage to streams and uplands. By setting a maximum (no more than) loss target of important upland wildlife habitat, it also acknowledges the importance of this resource to the region's terrestrial wildlife species. The most sensitive or declining upland habitats such as white oak will be tracked more specifically under Indicator 9.

Metro's Regionally Significant Fish and Wildlife Habitat inventory categorizes upland areas into three upland habitat classes, Classes A, B and C. The region contains substantially more wildlife habitat than that identified in Metro's inventory, but these are considered the most regionally significant. However, small habitat areas provide both habitat and connectivity to larger habitat areas.

Indicator 7 addresses Target 2a by accounting for Class A and B upland habitat. Metro conducted a science-based wildlife habitat inventory using the principles of spatial ecology, which considers the arrangement of habitat across the landscape. A review of the scientific literature indicated that the features important to wildlife habitat patches include size, shape (see Indicator 8), water resources and proximity to other wildlife habitat areas. Field studies confirmed that these features influence habitat and wildlife communities in the Metro region. Compared to other habitat areas in the region, Class A and B habitat is characterized by certain desirable wildlife habitat characteristics:

- more snags, downed wood and logs
- more wildlife food
- fewer non-native trees, shrubs and herbs
- increased structural diversity and more wildlife cover, nesting and foraging areas
- less human disturbance
- increased wildlife diversity and abundance
- more year-round availability of water and more types of water resources

In general, large, well-connected habitat patches with good water resources are most valuable to wildlife. Special Habitats of Concern are an exception and are discussed under Indicator 9. Class A and B are the highest quality, most important remaining upland wildlife habitat areas but are not protected from development under Title 13. Class A and B habitat increasingly attracts developers as the region's population grows and finding large parcels for a variety of development types becomes more difficult.

The total acres, percent cover and percent contribution to the region for this indicator are provided in Table 11 and displayed graphically in Figure 4. On average, sub-watersheds in the region contain about 10 percent Class A and B habitat, but this ranges from 0 to 23 percent, depending on sub-watershed characteristics. Gilbert River contains 63 percent Class A and B but little of the sub-watershed lies within the Metro region, so it is not necessarily representative of the entire sub-watershed. Upper Johnson Creek and Clackamas River/Rock Creek contain 22 and 17 percent Class A and B, respectively. Upper Johnson Creek is also one of the top two contributors to the region's total Class A and B habitat area, adding 11 percent to the regional total. Willamette River/Columbia River contains most of Forest Park and tops the list with 5,626 acres, comprising 19 percent of the region's total high value upland wildlife habitat.

The target for Indicator 7 is to preserve at least 75 percent of Class A and B habitat over the next decade. Wildlife and urban development needs compete for the remaining large upland areas. Some of the areas cannot be heavily developed due to steep slopes and landslide hazards, but others are considered available for development.

These upland areas are particularly at risk of development; therefore, preservation and careful planning are keys to meeting Indicator 7's target. Field studies show that Class A and B habitats contain diverse wildlife communities even when the habitat patch contains low density residential development. Reducing development intensity, acquiring greenspaces, conservation easements, setting aside natural areas in open space tracts, clustering development and minimizing roads are some methods to reduce fragmenting large habitat areas.

Indicator 8
(Table 12 and Figure 6)

Large habitat patches (interior habitat)

Objective	Preserve large areas of contiguous habitat to avoid fragmentation.
2004 baseline condition	
Indicator 8	Regional average 5.7 percent interior habitat
2015 Target	Preserve 80 percent of interior habitat (no more than 3,380 acres lost) for a total of 13,522 acres (4.6 percent) interior.

Baseline conditions for interior habitat are documented in Table 12 and illustrated in Figure 6. This target has been revised as described below. The new target aims for no more than 20 percent decrease in interior habitat acres (Indicator 8) in each sub-watershed, and in the region, by 2015.

Habitat interior is a criterion used in the Metro Regionally Significant Fish and Wildlife Habitat inventory to rate the value of habitat patches to wildlife. Based on edge effects (birds and plants) documented in a 1999 study[40] adverse edge effects are markedly reduced, although not absent, at 200 feet to the interior of a habitat patch. The habitat measure was derived by using GIS to draw a 200-foot buffer to the inside of each habitat patch and measuring the "interior" remaining area of the patch.

Habitat interior represents a change from the original Title 13 target and indicator. Target 2b was originally intended to measure larger habitat patches (30 acres or more) and aimed for no more than 20 percent decrease in the number of such patches over the next ten years (by 2015). The 30-acre size was selected based on two local studies conducted by Metro and Dr. Michael Murphy at Portland State University, which were largely in agreement[41] In the Metro region about 30 acres is the size at which certain species that either need a larger territory or avoid edge habitat are present or increase in numbers.[42] Examples include ermine and neotropical migratory songbirds. Habitat on the interior of these patches is also better in terms of 3-dimensional structure and native plant composition.

The Habitat Interior indicator better measures habitat fragmentation than counting large patches because it combines habitat patch size and shape. More rounded or rectangular patches have less edge habitat than long, narrow strips. Habitat Interior does not show a false improvement in connectivity that simply counting habitat patches would; the overall number of patches would increase if patches are divided and fragmented. An appropriate indicator should show a decrease in number (acres or patches) if fragmentation increases, as measuring Habitat Interior would. Satisfactory performance will be no more than 20 percent loss of interior habitat acres by 2015.

[40] Hennings, L.A. and W.D. Edge. 2003. Riparian bird community structure in Portland, Oregon: habitat, urbanization, and spatial scale patterns. The Condor 105:288-302

[41] Murphy, M. 2005. Personal communication. Department of Vertebrate Biology, Portland State University, Portland, OR.

[42] Hennings, Lori. 2003. Moving towards adaptive management: Validating Metro's GIS models. Final report, USFWS Cooperative Agreement #1448-13420-01-j141, Metro Regional Government, Portland, OR.

Species richness is typically higher in edge habitats but the number of habitat specialists, or species requiring a particular type of habitat for survival, tends to decrease. One of the main reasons interior forest dwelling species do not survive successfully in narrow forests is because of increased edge habitat. Some wildlife species require large, relatively undisturbed habitats or need space away from edge habitat. Noise frequently impacts the ability of wildlife to carry on their natural functions within the urban landscape. Urbanization typically increases habitat fragmentation, providing more edge habitat and reducing the amount of original habitat available to wildlife.

The region's average sub-watershed contains 5.7 percent interior habitat. The large Willamette River/Columbia River sub-watershed contributes by far the highest amount of interior habitat, at 33 percent. Much of this is in Forest Park. Upper Johnson Creek contributes another 10 percent and Columbia Slough contributes 9 percent. The Columbia River Islands, so rich with riparian and undeveloped floodplain resources, contributes only 3 percent of the region's total due to the elongated nature of the river islands.

The target for Indicator 8 aims for conserving at least 80 percent of interior habitat. Adding trees to the outside of a habitat patch can increase interior habitat. As with Indicator 7, greenspace acquisition, conservation easements, reducing development intensity, setting aside open space tracts, clustering development and minimizing roads are some methods to reduce interior habitat loss.

Indicator 9
(Table 13 and Figure 7; Appendix 9)

Special Habitats of Concern

Objective	Preserve and improve special Habitats of Concern.
2004 baseline condition	
Indicator 9	Regional average 9.1 percent special Habitats of Concern
2015 Target	Preserve 95 percent (no more than 1,343 acres lost) special Habitats of Concern for a total of 25,515 acres (8.6 percent).

Baseline conditions for Habitats of Concern are documented in Table 13. The Title 13 target aims to preserve 95 percent of Habitat of Concern acres (Indicator 9) in each sub-watershed, and in the region, by 2015.

Habitats of Concern are identified based on site-specific information provided by local wildlife or habitat experts. Habitats of Concern can be smaller than 2 acres and are included in the inventory if falling into one or more of the following categories:

- Any patch specifically identified as a Priority Conservation Habitat by ODFW, U.S. Fish and Wildlife Service, or other agencies or local wildlife experts. Priority conservation habitats in the Metro region include Oregon white oak savannas and woodlands, native prairie grasslands, wetlands and bottomland hardwood forests. Table 5 provides a more detailed description of specific habitat types in Metro's Habitats of Concern designation and compares Metro's Habitats of Concern with ODFW's Conservation Opportunity Areas.
- Any patch of natural land cover identified by ODFW, U.S. Fish and Wildlife Service or other agencies or local wildlife experts as a river island or delta important to wildlife.
- Specifically delineated habitat areas that provide life-history requirements of sensitive, threatened or endangered wildlife species or Great Blue Heron rookeries (for example, nesting habitat for an existing population of native turtles); habitats that support at-risk plants; or habitats that provide unusually important wildlife functions, such as major wildlife crossings/pathways or a key migratory

pathway, such as an elk migratory corridor. Threatened or endangered salmonid species were not included because the inventory's focus was terrestrial wildlife.

The total acres, percent cover and percent contribution to the region for this indicator are provided in Table 13. Columbia River Islands, Willamette River/Columbia River and Columbia Slough together contribute more than 50 percent of the region's Habitats of Concern, primarily in wetlands and bottomland hardwood forest. However, every Habitat of Concern documented represents a scarce resource important to the region's wildlife and because Habitats of Concern are based on local knowledge, some remain undocumented. In some cases scarcity within a sub-watershed can mean a Habitat of Concern is even more important than in watersheds with abundant resources. Thus beyond quantity, Habitat of Concern type (such as oak) and placement are important. The Title 13 Habitats of Concern map, as well as regional and USGS quad maps of habitat areas, may be viewed on Metro's ftp site.[43]

Habitats of Concern are most typically designated as such to protect declining habitats. It is not surprising that many wildlife species depending on these habitats are also declining. Protecting declining habitat remnants will help these species' survival in the Metro region.

Indicator 10 – Breeding Bird Survey data

The Breeding Bird Survey is a cooperative effort between the U.S. Geological Survey's Patuxent Wildlife Research Center and the Canadian Wildlife Service's National Wildlife Research Centre to monitor the status and trends of North American bird populations. Following a rigorous protocol, thousands of dedicated volunteers collect Breeding Bird Survey data along thousands of randomly established roadside routes throughout North America. Professional Breeding Bird Survey coordinators and data managers work closely with researchers and statisticians to compile and deliver these population data and population trend analyses on more than 400 bird species, for use by conservation managers, scientists and the general public. The data are available for free on the Breeding Bird Survey web site.[44]

The Tualatin Route (Figure 8) provides a representative sample of the Metro region's breeding bird communities. Data for the Tualatin route (Breeding Bird Survey route no. 69001) has been collected since 1966, providing a 40-year comparison of bird counts from year to year. Long-term monitoring data sets are quite rare. These data provide a useful means of estimating bird species' trends over the long term.

Birds provide excellent indicators of biological conditions because they are responsive to changes in habitat conditions and the wide variety of species reflect the variety, quantity and quality of existing habitat. Breeding Bird Survey data provide on-the-ground information about species' trends that can be linked to environmental change over time. Because biological organisms integrate the effects of various stressors, they reflect current conditions, as well as changes over time and cumulative effects.

Different bird species or groups of species respond to habitat changes in different ways. For example, if one species is missing or overabundant and the species is associated with a particular plant community, biologists can infer that that plant community has declined and provide management recommendations to increase or improve that habitat. In this way, biological indicators can show problems otherwise missed or underestimated. Breeding Bird Survey data can also provide biological indicators for progress toward regional environmental targets such as interior habitat (Indicator 8) and Habitats of Concern (Indicator 9).

[43] Habitats of Concern map available at ftp.metro-region.org/dist/gm/fish+wildlife/maps/.

[44] Breeding Bird Survey web site: www.pwrc.usgs.gov/BBS/.

Urbanization changes bird communities. Non-native invasive bird species such as European starlings are associated with urban areas and can out-compete native species or outright kill eggs, young and adults. Starlings are routinely the most abundant species detected on the Tualatin Route, followed by American robins. American robins are habitat generalists. Generalists are those species that can live in a wide variety of conditions and also tend to thrive in urban areas. However, starlings appear to have stabilized in the Metro region, whereas robins are declining.

Conversely, long-distance Neotropical migrants are negatively associated with urbanization and are vulnerable to disturbance, starlings and predators. As a group, Neotropical migrants are declining although there are a few exceptions, typically cavity-nesting species such as Vaux's swifts and violet-green swallows.

Metro analyzed the Breeding Bird Survey data to identify statistically significant changes in species' trends over the 40-year period. Two comparisons are provided. The first analysis provides a sample of bird species with significant changes, negative or positive, for the Tualatin route (Figure 9).

The second analysis compares the Tualatin route with all routes statewide (137 routes; Figure 10). By identifying significant differences between the Metro region route and a composite of all routes statewide we can identify those Metro region species whose survey trends are substantially different from statewide trends. The Metro urban region is by far the largest urban area in the state and contains nearly half of the state's population; it is assumed that urbanization, land use and habitat changes in the Metro region are significant contributors to these trend differences. Identification of these species can help determine habitat management strategies or restoration priorities.

Indicator 11 – Stream reach conditions

Indicators 1-9 provide watershed-based information for 31 sub-watersheds in the regions; this medium scale watershed information can be aggregated to larger scales, including region-wide. However, it may be useful to study conditions at a smaller scale. Indicator 11 takes a closer look at streams on a more local level. Based on 1,500-meter stream reaches, Indicator 11 can help characterize conditions for a particular stream area, or reach. In future reports the information will help detect where environmental change has occurred, the rate of change and specific areas where restoration would have high potential for improving water quality and other habitat features. As with the Breeding Bird Survey data, this information provides field-based survey information that is supplementary to the Title 13 indicators.

The small-scale stream reach analysis is a pilot project based on several sub-watersheds in Clackamas County. The model was initially developed in partnership with Clackamas County Water Environment Services, based on GIS information and field data collected by Metro in 2003. That pilot model was refined and statistically analyzed in more detail for this report (Appendix 2).

The pilot could not be extrapolated to the entire region because Clackamas County purchased a high-quality set of imagery (LiDAR) that was not available region-wide. However, by mid-2008 Metro will have an improved set of aerial photo interpretation with more accurate statistics on trees, other natural features and developed areas. Unlike LiDAR, these data will be repeatable every two years. The stream reach model will be further refined for the next report and expanded to stream reaches throughout the region. Based on the new data, the 2008 monitoring report will include stream reach-level data comparisons of 2006 and 2008 and provide a color-coded map indicating each stream reach's health based on the model. The data and map will be updated every two years.

The results of the pilot model indicate that water quality in the study area, as measured by benthic

invertebrates or specific conductance, can be predicted based on the amounts of urban land cover, high quality habitat (Class I riparian plus Class A upland), percent impervious cover and percent forest cover. These and other variables, such as agricultural land cover, will be evaluated for the regional stream reach model and incorporated as appropriate.

Region-wide indictor results

REGION-WIDE INDICATOR RESULTS

The *Sub-watershed indicator results* section will describe existing fish and wildlife habitat conditions at the sub-watershed scale. This section aggregates those data to produce a regional analysis consisting of tabular and graphical comparisons for each ecological indicator. In addition, this section analyzes the national Breeding Bird Survey data, a long-term field data series collected each spring.

Results

Table 14 summarizes baseline conditions and targets for Title 13 Indicators 1-9. For each indicator the table provides the regional average, the range of values observed across the region's 31 sub-watersheds, the median and the standard deviation.

The regional average represents an indicator's total number of acres divided by all acres in the region, converted to percent cover. The range measures the spread or the dispersion of the observations for all sub-watersheds, from the smallest to the largest observed value. The median is the value halfway through the sub-watershed data set, below and above which fall an equal number of data (sub-watershed indicator) values. Unlike the average, or mean, the median does not account for the relative acres contributed by each sub-watershed. This helps represent the data set without the influence of outliers, such as a small sub-watershed with very high or low values or a large sub-watershed, which may disproportionately influence the regional average. Standard deviation is a measure of the spread or dispersion of the sub-watershed indicator values. More widespread values show a larger standard deviation.

The indicator statistics vary widely by sub-watershed, as shown by the range and standard deviation, and reflect the broad variety of watershed conditions within the region. The 2015 target conditions will be tracked by region, sub-watershed and jurisdiction.

The amount of change will vary depending on each sub-watershed's baseline conditions. For example, in Clackamas County a large, relatively undeveloped and natural resource-rich area was added to the urban growth boundary. Over the next few decades the area will urbanize and it is likely that some of the natural resources will be lost, particularly in the uplands, which are less likely to receive extensive regulatory protection. On the other hand, highly developed areas with few natural resources are less likely to change over time, although positive environmental opportunities do arise through land use changes and nature-friendly redevelopment – for example, stream daylighting, or bringing piped streams back above ground. Redevelopment offers opportunities to widen stream buffers and reduce impervious surfaces and most developed sites have existing opportunities to more effectively deal with stormwater.

Figures 9 and 10 and Appendix 10 show Breeding Bird Survey data results for selected species. Figure 9 shows species' long-term trends along the Metro region route and Figure 10 compares Metro region species' trends to the same species' trends statewide.

The extent and effectiveness of natural resource protection depends on each jurisdiction's regulatory and non-regulatory programs. Factors including comprehensive planning, zoning, code and code enforcement play key roles in the regulatory arena. Environmental education, restoration, natural area acquisition and easements play important non-regulatory roles in environmental conditions.

Title 13 encourages both regulatory and non-regulatory tools to maintain or improve environmental conditions over time. The ecosystem monitoring initiated in this report will help inform the Metro Council, local governments, watershed councils and other interested parties about whether and how effectively these efforts succeed in protecting the region's environment.

Table 7
Indicators 1 and 2 – Stream/wetland profile up to 50 feet

Riparian habitat condition, 0-50 feet - baseline conditions for Target 1a of Metro's Title 13 Performance Objective 1, "Preserve and improve streamside, wetland and flood area habitat and connectivity." Target 1a aims for a 10 percent increase in forest and other vegetated acres (tracked separately) within 50 feet surrounding streams and wetlands in each sub-watershed over the next 10 years (by 2015).

Sub-watershed	Acres with no vegetation	Forest acres	Open acres	Shrub acres	Total acres within 50'	% vegetated acres within 50' (Indicator 1)	% forested acres within 50' (Indicator 2)	Contribution to region's vegetated acres (Indicator 1)	Contribution to region's forest acres (Indicator 2)
Christensen Cr./Tualatin R.	7	10	6	0	23	70.0%	42.8%	0.1%	0.1%
Deep Cr./N. Fork Deep Cr.	65	109	179	16	369	82.5%	29.5%	2.2%	1.3%
Latourell Creek	238	57	77	25	398	40.3%	14.4%	1.1%	0.7%
Coffee Lake Creek	215	227	248	2	692	68.9%	32.8%	3.4%	2.7%
Columbia River Islands	722	303	54	25	1,105	34.6%	27.5%	2.7%	3.5%
Willamette R./Columbia R.	420	1,079	49	4	1,552	73.0%	69.5%	8.1%	12.6%
Columbia Slough	2,580	569	772	44	3,966	34.9%	14.4%	9.8%	6.6%
Kellogg Creek	231	205	113	6	556	58.4%	36.9%	2.3%	2.4%
Lower Johnson Creek	133	250	96	3	482	72.4%	51.9%	2.5%	2.9%
Upper Johnson Creek	154	615	276	31	1,076	85.7%	57.2%	6.6%	7.2%
Willamette R./Oswego Cr.	344	636	56	2	1,038	66.8%	61.3%	4.9%	7.4%
Gilbert River	25	67	1	0	92	73.0%	72.3%	0.5%	0.8%
Abernethy Creek	26	140	19	5	190	86.3%	73.8%	1.2%	1.6%
Beaver Cr.	227	444	204	35	910	75.0%	48.8%	4.9%	5.2%
Clackamas R./Rock Cr.	157	361	269	29	816	80.8%	44.2%	4.7%	4.2%
Corral Creek	3	5	0	0	9	60.6%	60.6%	0.0%	0.1%
Tanner Creek	138	108	50	12	308	55.2%	35.1%	1.2%	1.3%
Molalla R./Willamette R.	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%
Lower Dairy Creek	59	70	141	2	273	78.3%	25.8%	1.5%	0.8%
Lower McKay Creek	62	104	142	2	311	79.9%	33.4%	1.8%	1.2%
Lower W. Fork Dairy Cr.	2	0	2	0	4	57.9%	0.0%	0.0%	0.0%
Lower Gales Creek	22	35	22	0	79	72.2%	44.0%	0.4%	0.4%
Tualatin River	114	7	27	0	148	23.0%	4.5%	0.2%	0.1%
Beaverton Creek	499	784	561	56	1,899	73.7%	41.3%	10.0%	9.2%
Fanno Creek	495	715	424	32	1,665	70.3%	42.9%	8.3%	8.4%
Rock Cr./Lower Tualatin R.	203	149	139	4	495	59.1%	30.1%	2.1%	1.7%
Saum Cr./Lower Tualatin R.	199	505	338	16	1,058	81.2%	47.7%	6.1%	5.9%
Beaver Cr./Willamette R.	34	36	40	5	114	70.2%	31.2%	0.6%	0.4%
Chicken Creek	52	144	63	2	261	79.9%	55.2%	1.5%	1.7%
Lower Rock Cr./Tualatin R.	507	464	508	17	1,496	66.1%	31.0%	7.0%	5.4%
Upper Rock Cr./Tualatin R.	113	363	229	22	728	84.5%	49.9%	4.4%	4.2%
GRAND TOTALS	**8,046**	**8,561**	**5,107**	**397**	**22,111**	**Avg. 63.3%**	**Avg. 38.7%**	**100.0%**	**100.0%**

Table 8
Indicators 3 and 4 – Stream/wetland profile within 50-150 feet

Riparian habitat condition within 50-150 feet - baseline conditions for Target 1b of Metro's Title 13 Performance Objective 1, "Preserve and improve streamside, wetland and flood area habitat and connectivity." Target 1b aims for a 5 percent increase in forest and other vegetated acres (tracked separately) within 50-150 of streams and wetlands in each sub-watershed over the next 10 years (by 2015).

Sub-watershed	Acres with no vegetation	Forest acres	Open acres	Shrub acres	Total acres within 50-150'	% vegetated acres within 50-150' (indicator 3)	% forested acres within 50-150' (indicator 4)	Contribution to region's vegetated acres (indicator 3)	Contribution to region's forested acres (indicator 4)
Christenson Cr./Tualatin R.	20	20	12	1	54	62.1%	36.8%	0.2%	0.2%
Deep Cr./N. Fork Deep Cr.	151	155	301	24	630	76.0%	24.5%	2.4%	1.3%
Latourell Creek	360	91	105	24	580	38.0%	15.7%	1.1%	0.8%
Coffee Lake Creek	404	331	308	4	1,047	61.4%	31.6%	3.3%	2.7%
Columbia River Islands	876	560	100	25	1,561	43.9%	35.9%	3.5%	4.6%
Willamette R./Columbia R.	814	2,038	126	7	2,985	72.7%	68.3%	11.1%	16.9%
Columbia Slough	3,831	597	1,046	47	5,521	30.6%	10.8%	8.6%	4.9%
Kellogg Creek	566	257	180	6	1,009	43.9%	25.5%	2.3%	2.1%
Lower Johnson Creek	395	367	141	4	907	56.4%	40.4%	2.6%	3.0%
Upper Johnson Creek	504	843	569	41	1,956	74.3%	43.1%	7.4%	7.0%
Willamette R./Oswego Cr.	891	1,018	119	3	2,032	56.1%	50.1%	5.8%	8.4%
Gilbert River	19	104	1	0	123	84.9%	84.3%	0.5%	0.9%
Abernethy Creek	74	219	26	3	322	77.0%	68.0%	1.3%	1.8%
Beaver Cr.	422	691	441	44	1,598	73.6%	43.2%	6.0%	5.7%
Clackamas R./Rock Cr.	369	517	499	45	1,430	74.2%	36.2%	5.4%	4.3%
Corral Creek	10	10	0	0	20	51.5%	51.3%	0.1%	0.1%
Tanner Creek	261	195	88	23	568	53.9%	34.4%	1.6%	1.6%
Molalla R./Willamette R.	0	0	0	0	0	0.0%	0.0%	0.0%	0.0%
Lower Dairy Creek	161	78	172	6	418	61.4%	18.7%	1.3%	0.6%
Lower McKay Creek	122	62	137	1	322	62.0%	19.3%	1.0%	0.5%
Lower W. Fork Dairy Cr.	4	0	5	0	9	55.6%	0.0%	0.0%	0.0%
Lower Gales Creek	45	29	51	0	125	63.8%	23.1%	0.4%	0.2%
Tualatin River	142	7	33	0	181	21.7%	3.6%	0.2%	0.1%
Beaverton Creek	1,562	1,041	608	46	3,257	52.0%	32.0%	8.6%	8.6%
Fanno Creek	1,485	802	417	22	2,726	45.5%	29.4%	6.3%	6.6%
Rock Cr./Lower Tualatin R.	403	197	171	8	779	48.2%	25.2%	1.9%	1.6%
Saum Cr./Lower Tualatin R.	492	771	504	19	1,786	72.5%	43.2%	6.6%	6.4%
Beaver Cr./Willamette R.	95	63	64	5	227	58.3%	27.7%	0.7%	0.5%
Chicken Creek	169	135	66	1	371	54.4%	36.2%	1.0%	1.1%
Lower Rock Cr./Tualatin R.	980	424	489	11	1,904	48.6%	22.3%	4.7%	3.5%
Upper Rock Cr./Tualatin R.	339	447	334	33	1,153	0.71	0.39	0.04	0.04
GRAND TOTALS	**15,968**	**12,066**	**7,112**	**454**	**35,600**	**Avg. 55.1%**	**Avg. 33.9%**	**100.0%**	**100.0%**

Table 9
Indicator 5 – Riparian habitat condition (overall gain or loss of high quality habitat)

Riparian habitat condition, Class I and II - baseline conditions for Metro's Title 13 Performance Objective 1, "Preserve and improve streamside, wetland and flood area habitat and connectivity." Indicator 5 addresses Targets 1a, 1b and 1c by accounting for existing high quality riparian/floodplain habitat.

Sub-watershed	Riparian Class I acres	Riparian Class II acres	Class I plus Class II acres (indicator 5)	% Class I plus Class II acres	Contribution to region's Class I and Class II acres
Christensen Cr./Tualatin R.	42	10	52	7.1%	0.1%
Deep Cr./N. Fork Deep Cr.	281	340	621	13.9%	1.2%
Latourell Creek	1,307	8	1,315	63.6%	2.5%
Coffee Lake Creek	837	305	1,142	15.5%	2.2%
Columbia River Islands	9,550	91	9,641	95.5%	18.3%
Willamette R./Columbia R.	5,362	435	5,797	14.4%	11.0%
Columbia Slough	4,477	1,313	5,790	15.6%	11.0%
Kellogg Creek	585	268	853	7.7%	1.6%
Lower Johnson Creek	919	283	1,202	7.6%	2.3%
Upper Johnson Creek	1,641	677	2,318	15.3%	4.4%
Willamette R./Oswego Cr.	1,748	1,062	2,810	17.1%	5.3%
Gilbert River	232	5	237	33.9%	0.4%
Abernethy Creek	377	179	556	17.3%	1.1%
Beaver Cr.	3,297	375	3,672	26.2%	7.0%
Clackamas R./Rock Cr.	1,361	810	2,171	16.4%	4.1%
Corral Creek	11	0	11	8.6%	0.0%
Tanner Creek	726	250	976	16.7%	1.8%
Molalla R./Willamette R.	0	1	1	2.5%	0.0%
Lower Dairy Creek	312	258	570	16.8%	1.1%
Lower McKay Creek	342	99	441	13.1%	0.8%
Lower W. Fork Dairy Cr.	1	5	6	12.0%	0.0%
Lower Gales Creek	156	79	235	32.1%	0.4%
Tualatin River	163	34	197	9.8%	0.4%
Beaverton Creek	2,168	741	2,909	12.0%	5.5%
Fanno Creek	1,712	634	2,346	11.6%	4.4%
Rock Cr./Lower Tualatin R.	677	255	932	17.1%	1.8%
Saum Cr./Lower Tualatin R.	1,674	678	2,352	16.0%	4.5%
Beaver Cr./Willamette R.	82	115	197	7.2%	0.4%
Chicken Creek	294	76	370	19.4%	0.7%
Lower Rock Cr./Tualatin R.	1,308	426	1,734	13.9%	3.3%
Upper Rock Cr./Tualatin R.	1,020	325	1,345	18.3%	2.5%
GRAND TOTALS	**42,662**	**10,137**	**52,799**	**Avg. 17.8%**	**100.0%**

Table 10
Indicator 6 – Floodplain condition

Floodplain condition - baseline conditions for Target 1c of Metro's Title 13 Performance Objective 1, "Preserve and improve streamside, wetland and flood area habitat and connectivity." Target 1c aims for no more than a 10 percent increase in developed floodplain in each sub-watershed over the next 10 years (by 2015).

Sub-watershed	Acres in Metro's jurisdiction	Undeveloped floodplain acres	Developed floodplain acres	Total floodplain acres	% undeveloped floodplain	% developed floodplain (Indicator 6)	Contribution to region's total floodplain acres	Contribution to region's undeveloped. floodplain acres	Contribution to region's dev. floodplain acres
Christensen Cr./Tualatin R.*	734	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%
Deep Cr./N. Fork Deep Cr.*	4,476	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%
Latourell Creek	2,069	1,207	7	1,213	99.4%	0.6%	3.5%	3.9%	0.2%
Coffee Lake Creek	7,365	377	31	408	92.4%	7.6%	1.2%	1.2%	0.9%
Columbia River Islands	10,095	9,584	133	9,716	98.6%	1.4%	27.9%	30.6%	3.8%
Willamette R./Columbia R.	40,182	3,944	586	4,530	87.1%	12.9%	13.0%	12.6%	17.0%
Columbia Slough	37,060	4,266	632	4,898	87.1%	12.9%	14.1%	13.6%	18.3%
Kellogg Creek	11,067	242	55	296	81.6%	18.4%	0.9%	0.8%	1.6%
Lower Johnson Creek	15,859	485	459	944	51.4%	48.6%	2.7%	1.5%	13.3%
Upper Johnson Creek	15,116	361	13	374	96.6%	3.4%	1.1%	1.2%	0.4%
Willamette R./Oswego Cr.	16,389	1,507	293	1,800	83.7%	16.3%	5.2%	4.8%	8.5%
Gilbert River	700	43	0	43	100.0%	0.0%	0.1%	0.1%	0.0%
Abernethy Creek	3,212	72	50	121	59.2%	40.8%	0.3%	0.2%	1.4%
Beaver Cr.	13,997	2,461	77	2,538	97.0%	3.0%	7.3%	7.9%	2.2%
Clackamas R./Rock Cr.	13,227	723	117	840	86.1%	13.9%	2.4%	2.3%	3.4%
Corral Creek	128	3	0	3	94.9%	5.1%	0.0%	0.0%	0.0%
Tanner Creek	5,839	850	158	1,007	84.3%	15.7%	2.9%	2.7%	4.6%
Molalla R./Willamette R.*	40	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%
Lower Dairy Creek	3,383	384	15	400	96.2%	3.8%	1.1%	1.2%	0.4%
Lower McKay Creek	3,368	255	31	286	89.0%	11.0%	0.8%	0.8%	0.9%
Lower W. Fork Dairy Cr.	50	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%
Lower Gales Creek	733	196	6	202	97.1%	2.9%	0.6%	0.6%	0.2%
Tualatin River	2,009	167	8	175	95.5%	4.5%	0.5%	0.5%	0.2%
Beaverton Creek	24,212	802	314	1,116	71.8%	28.2%	3.2%	2.6%	9.1%
Fanno Creek	20,156	719	175	894	80.4%	19.6%	2.6%	2.3%	5.1%
Rock Cr./Lower Tualatin R.	5,435	571	50	621	91.9%	8.1%	1.8%	1.8%	1.5%
Saum Cr./Lower Tualatin R.	14,696	873	217	1,090	80.1%	19.9%	3.1%	2.8%	6.3%
Beaver Cr./Willamette R.*	2,725	0	0	0	0.0%	0.0%	0.0%	0.0%	0.0%
Chicken Creek	1,906	136	0	136	100.0%	0.0%	0.4%	0.4%	0.0%
Lower Rock Cr./Tualatin R.	12,461	913	21	934	97.8%	2.2%	2.7%	2.9%	0.6%
Upper Rock Cr./Tualatin R.	7,339	189	1	190	99.3%	0.7%	0.5%	0.6%	0.0%
GRAND TOTALS	**296,028**	**31,329**	**3,448**	**34,777**	**Avg. 90.1%**	**Avg. 9.9%**	**100.0%**	**100.0%**	**100.0%**

*These sub-watersheds are either within constrained canyons or contain limited acres with no Federal Emergency Management Agency floodplain area within the Metro boundary.

Table 11
Indicator 7 – Upland wildlife habitat quality

Upland wildlife habitat, Class A and B - baseline conditions for Target 2A of Metro's Title 13 Performance Objective 2, "Preserve large areas of contiguous habitat to avoid fragmentation." Target 2a aims for no more than 15 percent decrease in Wildlife Class A and B acres in each sub-watershed over the next ten years (by 2015).

Sub-watershed	Wildlife Class A acres	Wildlife Class B acres	Class A plus Class B acres	% Class A plus Class B acres (indicator 7)	Contribution to region's Class A and B acres
Christensen Cr./Tualatin R.	171	0	171	23.3%	0.6%
Deep Cr./N. Fork Deep Cr.	93	563	656	14.7%	2.2%
Latourell Creek	293	109	402	19.4%	1.3%
Coffee Lake Creek	172	460	632	8.6%	2.1%
Columbia River Islands	20	0	20	0.2%	0.1%
Willamette R./Columbia R.	5,436	190	5,626	14.0%	18.8%
Columbia Slough	291	427	718	1.9%	2.4%
Kellogg Creek	386	518	904	8.2%	3.0%
Lower Johnson Creek	908	284	1,192	7.5%	4.0%
Upper Johnson Creek	1,414	1,958	3,372	22.3%	11.3%
Willamette R./Oswego Cr.	1,039	1,170	2,209	13.5%	7.4%
Gilbert River	438	0	438	62.6%	1.5%
Abernethy Creek	203	500	703	21.9%	2.3%
Beaver Cr.	976	369	1,345	9.6%	4.5%
Clackamas R./Rock Cr.	1,207	1,026	2,233	16.9%	7.5%
Corral Creek	25	0	25	19.5%	0.1%
Tanner Creek	567	388	955	16.4%	3.2%
Molalla R./Willamette R.	0	0	0	0.0%	0.0%
Lower Dairy Creek	16	75	91	2.7%	0.3%
Lower McKay Creek	5	39	44	1.3%	0.1%
Lower W. Fork Dairy Cr.	0	1	1	2.0%	0.0%
Lower Gales Creek	1	17	18	2.5%	0.1%
Tualatin River	2	0	2	0.1%	0.0%
Beaverton Creek	1,146	802	1,948	8.0%	6.5%
Fanno Creek	357	1,152	1,509	7.5%	5.0%
Rock Cr./Lower Tualatin R.	327	258	585	10.8%	2.0%
Saum Cr./Lower Tualatin R.	788	1,690	2,478	16.9%	8.3%
Beaver Cr./Willamette R.	15	178	193	7.1%	0.6%
Chicken Creek	69	34	103	5.4%	0.3%
Lower Rock Cr./Tualatin R.	69	243	312	2.5%	1.0%
Upper Rock Cr./Tualatin R.	618	428	1,046	14.3%	3.5%
GRAND TOTAL	**17,051**	**12,878**	**29,929**	**Avg. 10.1%**	**100.0%**

Table 12
Indicator 8 – Wildlife interior habitat

Habitat interior – baseline conditions for Target 2b of Metro's Title 13 Performance Objective 2, "Preserve large areas of contiguous habitat to avoid fragmentation." Target 2b aims for no more than 20 percent decrease in Habitat Interior acres in each sub-watershed over the next 10 years (by 2015). The Habitat Interior indicator provides a measure of fragmentation by accounting for habitat patch size and shape and deducting edge areas from acres counted.

Sub-watershed	Sub-watershed acres in Metro	Habitat interior acres (Indicator 8)	% interior habitat within sub-watershed (Indicator 8)	Contribution to region's total interior habitat
Christensen Cr./Tualatin R.	734	16	2.2%	0.1%
Deep Cr./N. Fork Deep Cr.	4,476	176	3.9%	1.0%
Latourell Creek	2,069	240	11.6%	1.4%
Coffee Lake Creek	7,365	271	3.7%	1.6%
Columbia River Islands	10,095	576	5.7%	3.4%
Willamette R./Columbia R.	40,182	5,602	13.9%	33.1%
Columbia Slough	37,060	1,561	4.2%	9.2%
Kellogg Creek	11,067	304	2.7%	1.8%
Lower Johnson Creek	15,859	538	3.4%	3.2%
Upper Johnson Creek	15,116	1,628	10.8%	9.6%
Willamette R./Oswego Cr.	16,389	970	5.9%	5.7%
Gilbert River	700	406	58.0%	2.4%
Abernethy Creek	3,212	320	10.0%	1.9%
Beaver Creek	13,997	48	0.3%	0.3%
Clackamas R./Rock Cr.	13,227	694	5.2%	4.1%
Corral Creek	128	5	3.9%	0.0%
Tanner Creek	5,839	411	7.0%	2.4%
Molalla R./Willamette R.	40	0	0.0%	0.0%
Lower Dairy Creek	3,383	10	0.3%	0.1%
Lower McKay Creek	3,368	8	0.2%	0.0%
Lower W. Fork Dairy Cr.	50	1	2.0%	0.0%
Lower Gales Creek	733	0	0.0%	0.0%
Tualatin River	2,009	39	1.9%	0.2%
Beaverton Creek	24,212	589	2.4%	3.5%
Fanno Creek	20,156	201	1.0%	1.2%
Rock Cr./Lower Tualatin R.	5,435	114	2.1%	0.7%
Saum Cr./Lower Tualatin R.	14,696	833	5.7%	4.9%
Beaver Cr./Willamette R.	2,725	573	21.0%	3.4%
Chicken Creek	1,906	35	1.8%	0.2%
Lower Rock Cr./Tualatin R.	12,461	422	3.4%	2.5%
Upper Rock Cr./Tualatin R.	7,339	313	4.3%	1.9%
TOTALS	**296,028**	**16,902**	**Avg. 5.7%**	**100%**

Table 13
Indicator 9 – Special Habitats of Concern

Baseline conditions for Target 4a of Metro's Title 13 Performance Objective 4, "Preserve and improve special Habitats of Concern." Target 4a aims to preserve 95 percent of Habitat of Concern acres in each sub-watershed over the next 10 years (by 2015).

Sub-watershed	Sub-watershed acres in Metro	Habitat of Concern acres (Indicator 9)	% Habitat of Concern within sub-watershed (Indicator 9)	Contribution to region's total Habitats of Concern
Christensen Cr./Tualatin R.	734	183	24.9%	0.7%
Deep Cr./N. Fork Deep Cr.	4,476	141	3.2%	0.5%
Latourell Creek	2,069	878	42.4%	3.3%
Coffee Lake Creek	7,365	433	5.9%	1.6%
Columbia River Islands	10,095	3,252	32.2%	12.1%
Willamette R./Columbia R.	40,182	6,926	17.2%	25.8%
Columbia Slough	37,060	3,293	8.9%	12.3%
Kellogg Creek	11,067	532	4.8%	2.0%
Lower Johnson Creek	15,859	798	5.0%	3.0%
Upper Johnson Creek	15,116	621	4.1%	2.3%
Willamette R./Oswego Cr.	16,389	976	6.0%	3.6%
Gilbert River	700	531	75.9%	2.0%
Abernethy Creek	3,212	0	0.0%	0.0%
Beaver Creek	13,997	2,659	19.0%	9.9%
Clackamas R./Rock Cr.	13,227	1,081	8.2%	4.0%
Corral Creek	128	0	0.0%	0.0%
Tanner Creek	5,839	759	13.0%	2.8%
Molalla R./Willamette R.	40	0	0.0%	0.0%
Lower Dairy Creek	3,383	144	4.3%	0.5%
Lower McKay Creek	3,368	79	2.3%	0.3%
Lower W. Fork Dairy Cr.	50	0	0.0%	0.0%
Lower Gales Creek	733	37	5.0%	0.1%
Tualatin River	2,009	121	6.0%	0.5%
Beaverton Creek	24,212	555	2.3%	2.1%
Fanno Creek	20,156	474	2.4%	1.8%
Rock Cr./Lower Tualatin R.	5,435	515	9.5%	1.9%
Saum Cr./Lower Tualatin R.	14,696	933	6.3%	3.5%
Beaver Cr./Willamette R.	2,725	23	0.8%	0.1%
Chicken Creek	1,906	264	13.9%	1.0%
Lower Rock Cr./Tualatin R.	12,461	414	3.3%	1.5%
Upper Rock Cr./Tualatin R.	7,339	236	3.2%	0.9%
TOTALS	**296,028**	**26,858**	**Avg. 9.1%**	**100.0%**

Table 14

Regional summary of baseline conditions and targets for Indicators 1-9

Indicator	Baseline conditions (acres)	Baseline conditions (regional average)	Target condition (acres) by 2015	Target condition (%) by 2015
1 and 2 Percent vegetated within 50 feet of streams and wetlands	14,065	**63.3% vegetated** *Range: 0.0 – 86.3%* *Median: 70.0%* *Standard deviation: 19.9%* **38.7% forest** *Range: 0.0 – 73.8%* *Median: 41.3%* *Standard deviation: 19.6%*	• 10% vegetation increase • 1,407 acres added • 15,472 acres total vegetated	73.3%
3 and 4 Percent vegetated within 50-150 feet of streams and wetlands	19,632	**55.1% vegetated** *Range: 0.0 – 84.9%* *Median: 56.4%* *Standard deviation: 17.8%* **33.9% forest** *Range: 0.0 – 84.3%* *Median: 32.0%* *Standard deviation: 19.0%*	• 5% vegetation increase • 982 acres added • 20,614 acres total vegetated	60.1%
5 Class I and II riparian habitat	52,799	**17.8% Class I and II** *Range: 2.5 = 95.5%* *Median: 15.5%* *Standard deviation: 17.9%*	• 5% increase, Class I and II • 2,640 acres added • 55,439 acres Class I and II	22.8%
6 Undeveloped floodplain	31,329	**90.1% undeveloped** *Range: 0.0 – 100.0%* *Median: 87.1%* *Standard deviation: 34.9%*	• No more than 10% increase in developed floodplain • No more than 3,133 acres more floodplain developed • 28,196 acres undeveloped	80.1% undeveloped
7 Upland Class A and B wildlife habitat	29,929	**10.1% Class A and B** *Range: 0.0 – 62.6%* *Median: 8.6%* *Standard deviation: 11.9%*	• Preserve 75 percent • No more than 7,482 acres lost • 22,447 acres total Class A and B	7.6%
8 Large habitat patches (interior habitat)	16,902	**5.7% habitat interior** *Range: 0.0 – 58.0%* *Median: 3.7%* *Standard deviation: 10.3%*	• Preserve 80 percent • No more than 3,380 acres lost • 13,522 acres interior habitat	4.6%
9 Special Habitats of Concern	26,858	**9.1% Habitats of Concern** *Range: 0.0 – 75.9%* *Median: 5.0%* *Standard deviation: 15.6%*	• Preserve 95% • No more than 1,343 acres lost • 25,515 acres Habitats of Concern	8.6%

Figure 2

Comparison of vegetation and forest acres within 50 feet of streams and wetlands for sub-watersheds in the Metro region (Indicators 1 and 2)

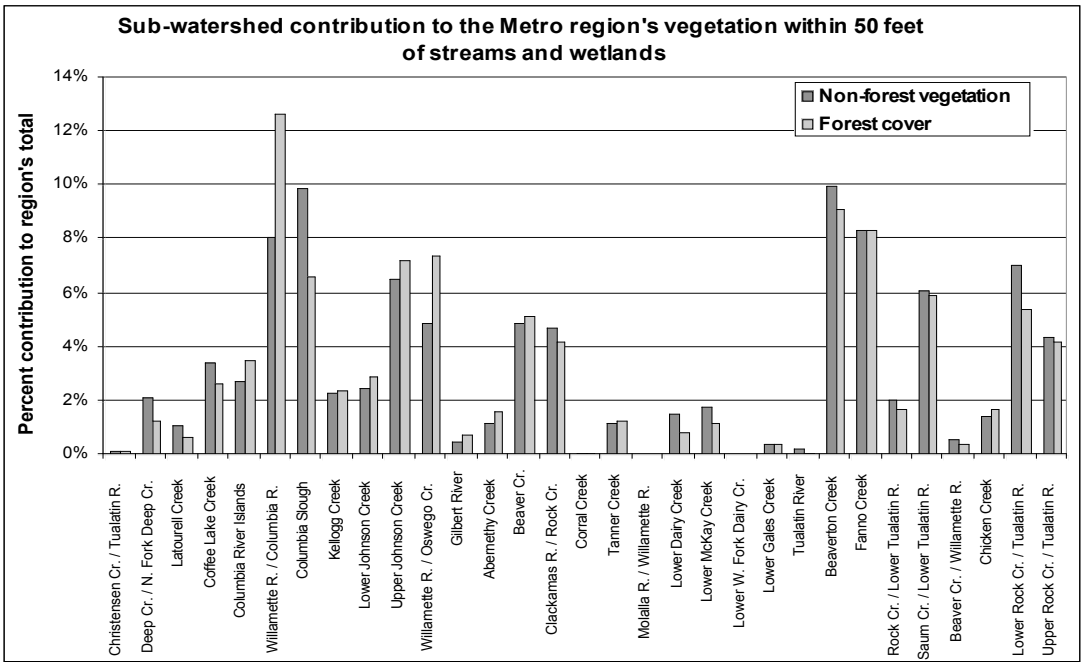


Figure 3

Comparison of vegetation and forest acres within 50-150 feet of streams and wetlands for sub-watersheds in the Metro region (Indicators 3 and 4)

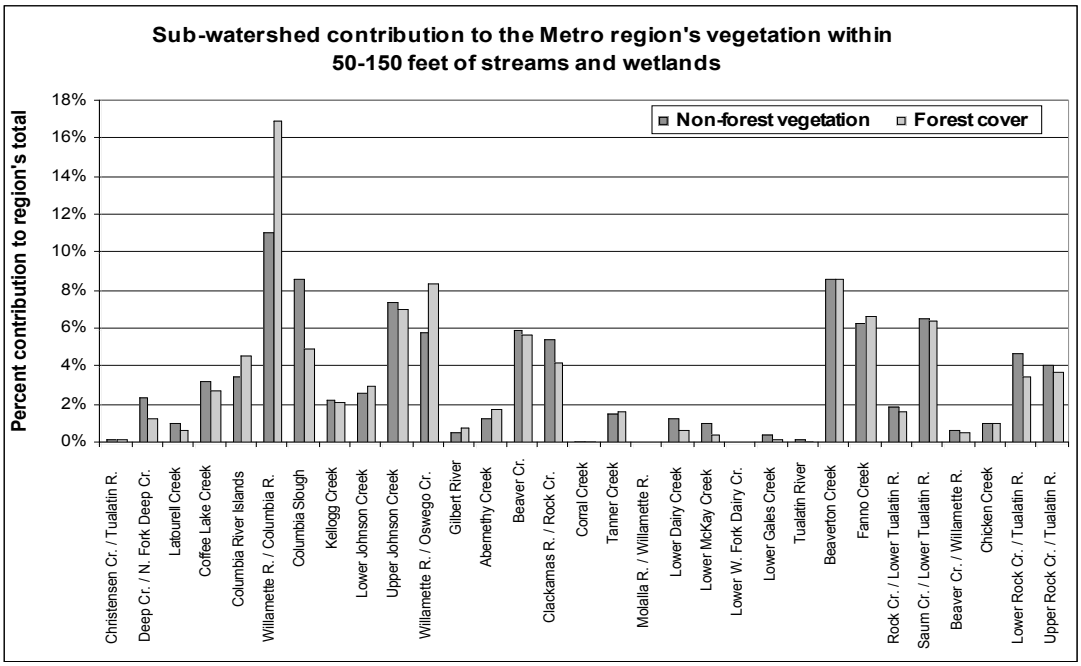


Figure 4

Comparison of the highest value riparian (fish) and upland (wildlife) habitat for sub-watersheds in the Metro region (Indicators 5 and 7)

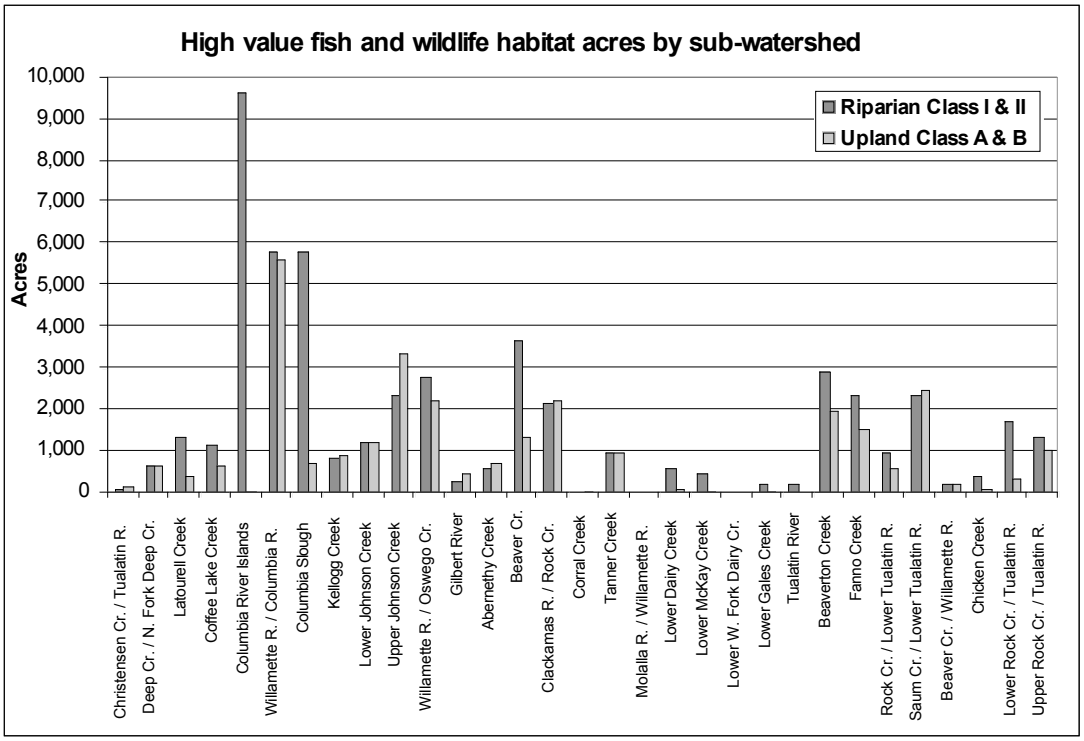


Figure 5

Comparison of developed and undeveloped floodplain acres for sub-watersheds in the Metro region (Indicator 6)

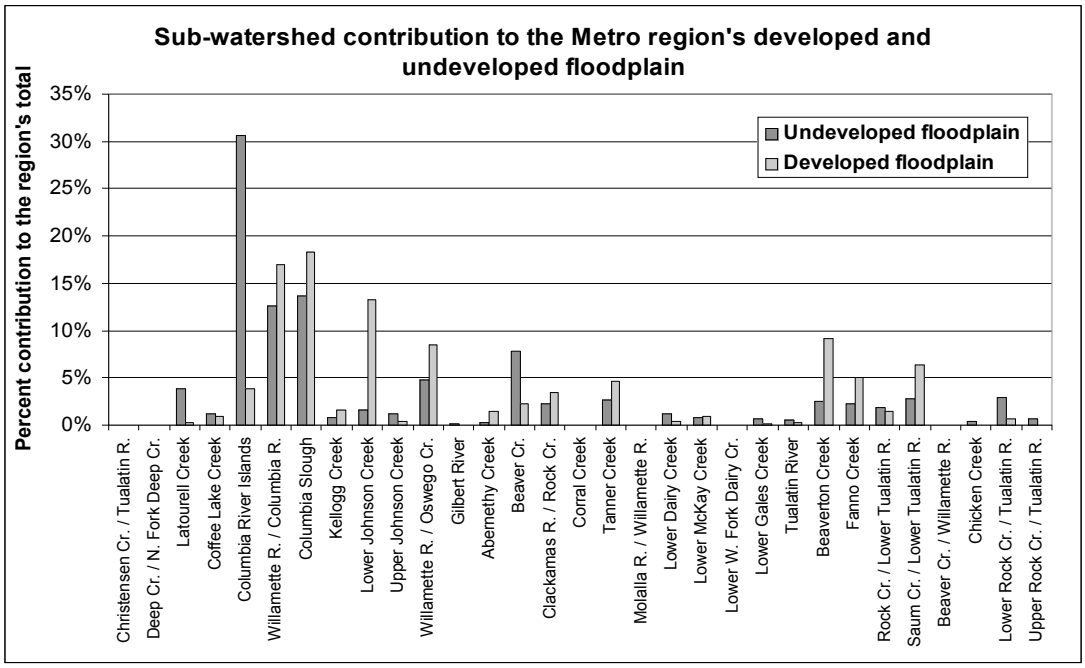


Figure 6

Comparison of interior habitat acres for sub-watersheds in the Metro region (Indicator 8)

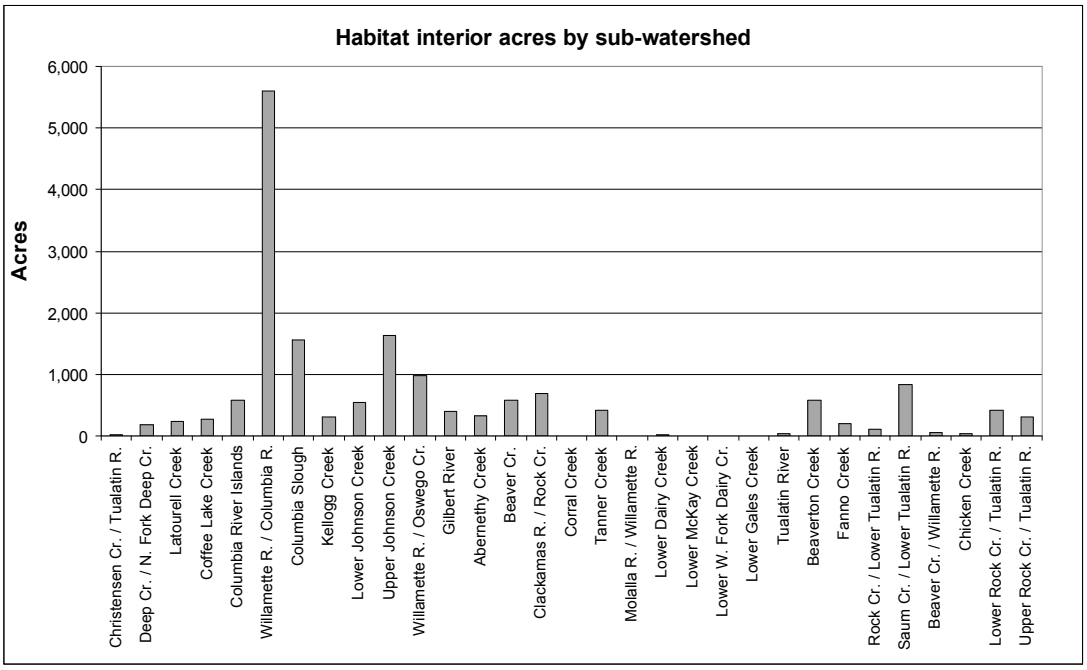


Figure 7

Comparison of the number of acres of special Habitats of Concern in the Metro region (Indicator 9)

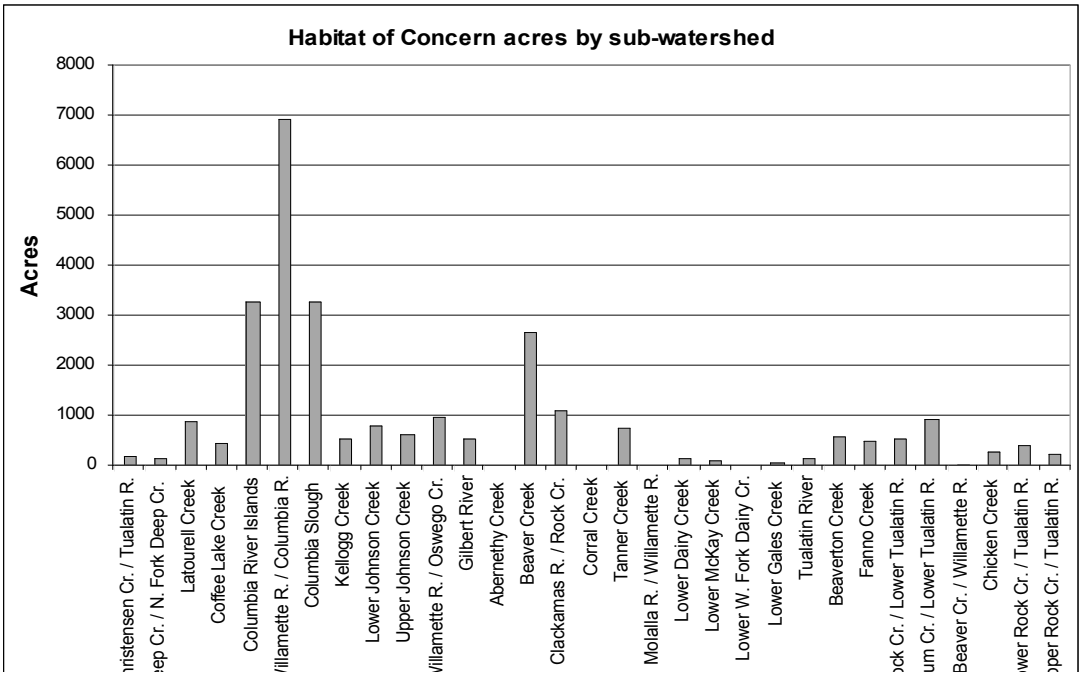


Figure 8
Breeding Bird Survey Tualatin route map (Breeding Bird Survey route #69001)

The Tualatin Route provides a representative sample of the Metro region's breeding bird communities. Data has been collected since 1966 providing a long-term comparison of bird counts from year to year, affording a useful means of estimating bird species' trends over a long period.

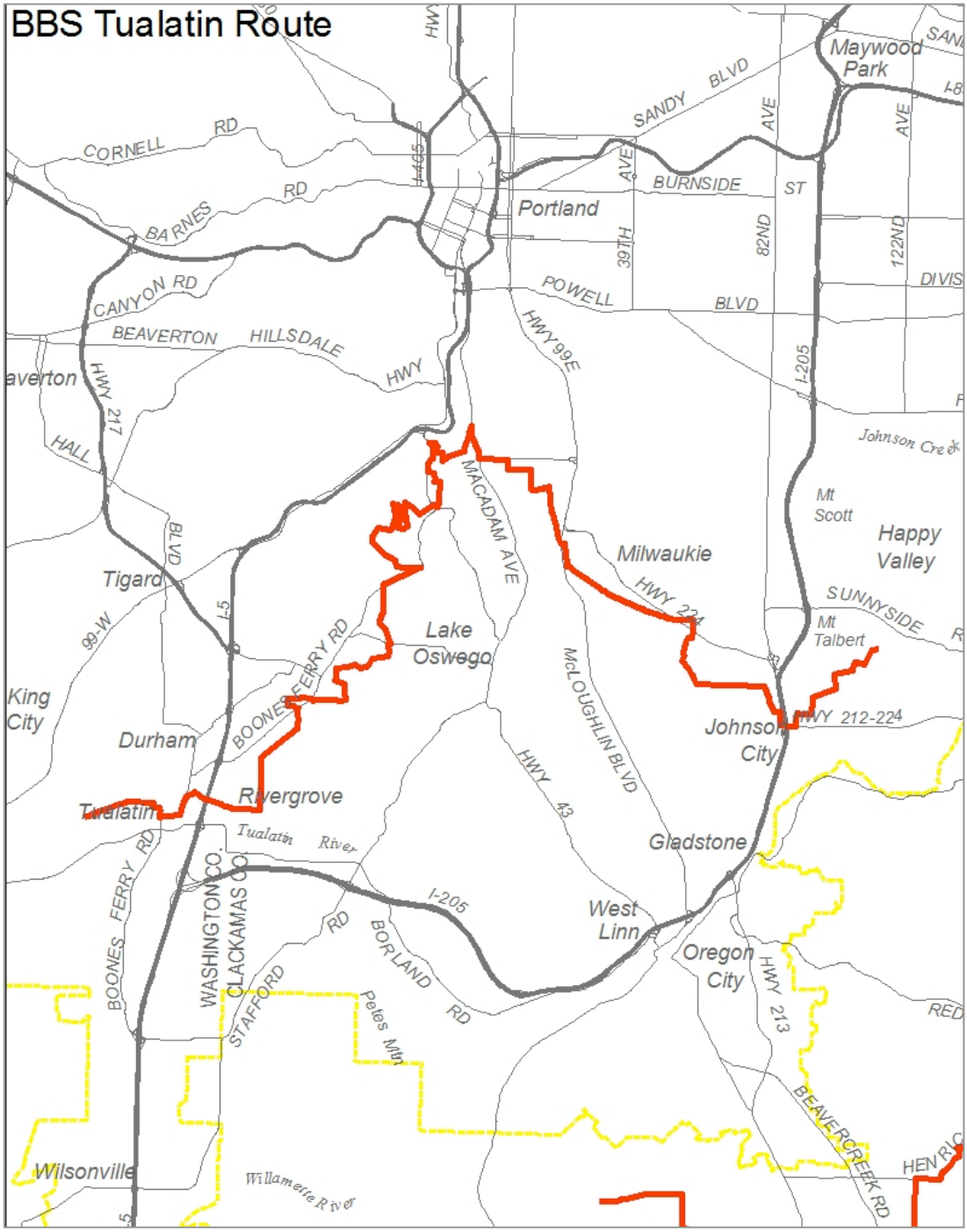


Figure 9

Breeding Bird Survey trends, 1966-2005: Average percent change per year for Portland species with significant changes

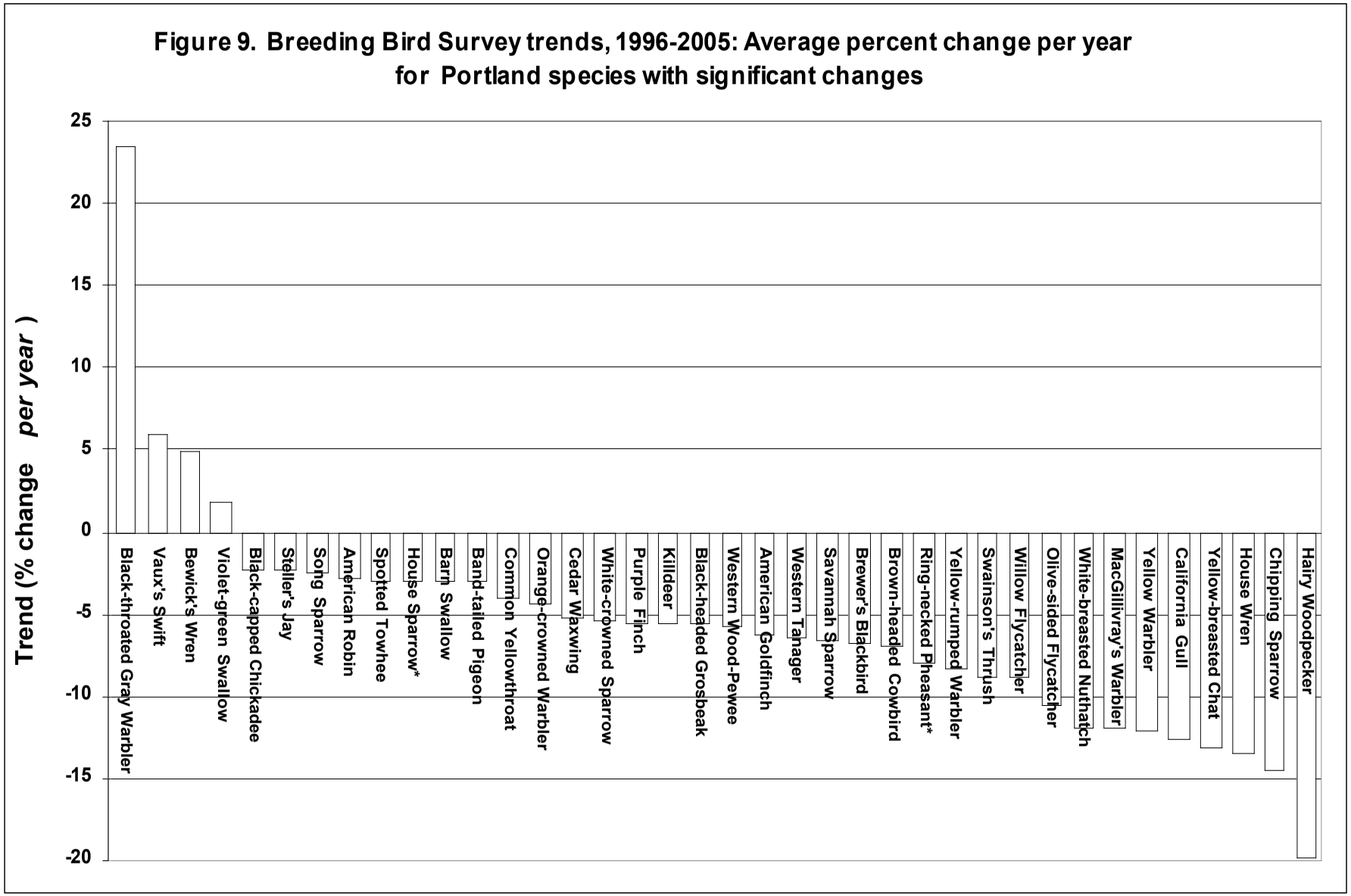
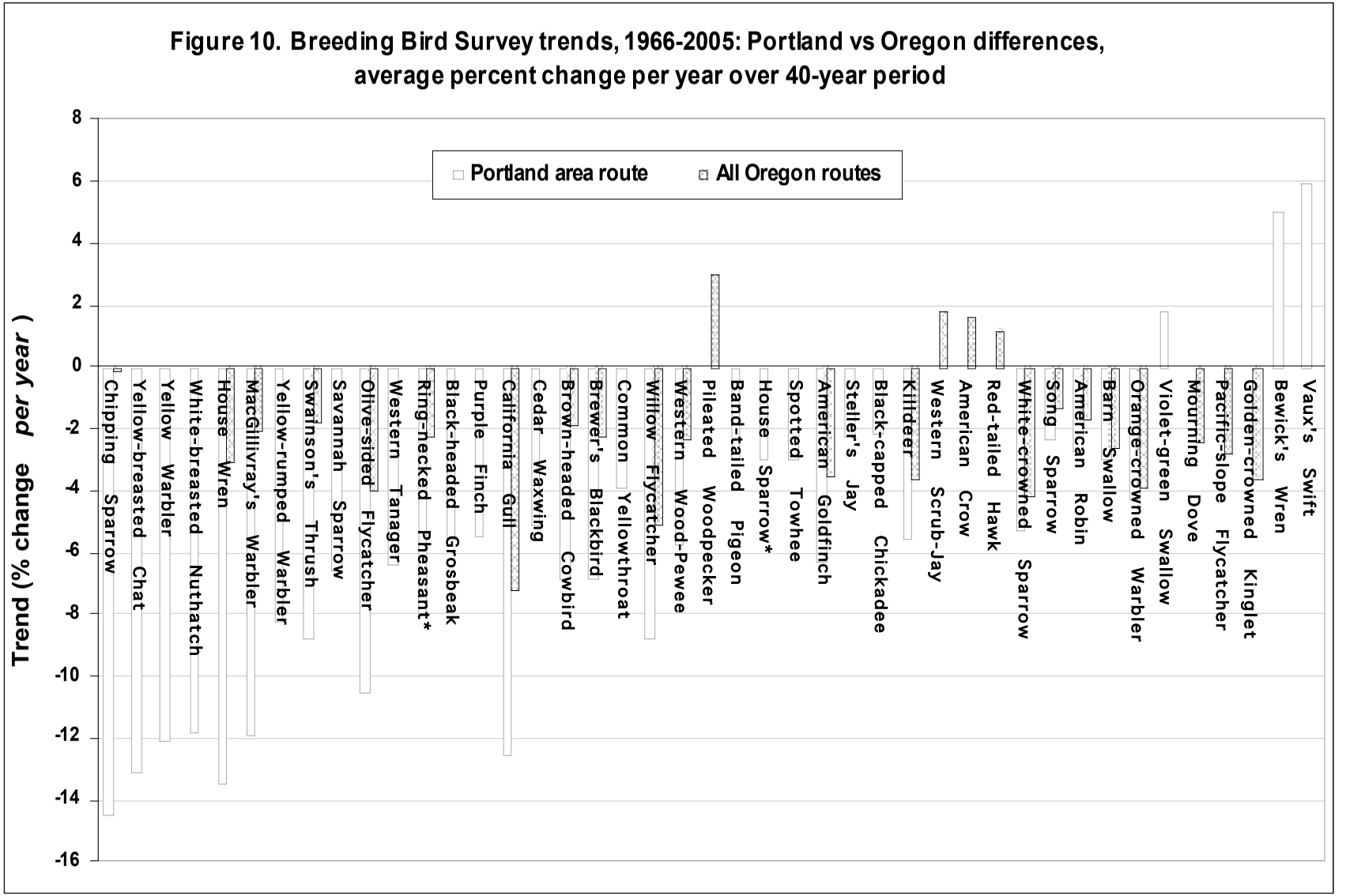


Figure 10

Breeding Bird Survey trends, 1966-2005: Portland vs. Oregon differences, average percent change per year over 40-year period



Discussion

The *Introduction and background* section introduced Title 13 and spoke to urban ecosystems, spatial scale and ecological targets. The *Water, habitats and species at risk* section discussed watersheds, water quality, fish and wildlife and the Metro region's connections with ODFW's Conservation Strategy. The subsequent section provided details about the nine Title 13 indicators and the use of Breeding Bird Survey Data (Indicator 10) and a stream reach land use/water quality model (Indicator 11) to help gauge the region's ecological health.

The data presented in this section paint a picture of conditions as they were in 2005, when the aerial photographs were flown. Conditions in 2005 are the starting point – the baseline, in this case – for measuring watershed health and progress toward Title 13 objectives and targets using the variables described, over at least a 10-year period. Table 14 summarizes the regional baseline for each of the nine Title 13 variables. Every two years until 2015, monitoring reports will measure progress towards these targets. In 2015 the Metro Council will assess whether each target has been reached and determine whether adjustments to Title 13 policy should be made or any further action taken.

The existing condition for vegetation closest to streams and wetlands is estimated to be over 63 percent. Of that, approximately 38 percent is forested. Vegetation, especially trees, near water is very important to water quality and fish, provides key wildlife habitat and represents the best remaining wildlife corridors in the region. If only one variable could be measured, Indicator 1 would be the likely selection. That is why Council chose a relatively high target of a 10 percent increase over 10 years. This is the area most likely to receive some regulatory protection, although development is not prohibited there. The target may be met by avoiding development altogether, utilizing nature-friendly development practices and mitigating for habitat that is damaged and restoring vegetation.

However, Indicators 1 and 2 do not accurately describe overall watershed health. For example, the variable does not address invasive species although emerging GIS technology may improve the ability to measure invasives such as Himalayan blackberries and reed-canarygrass in the future. In addition, trees and other vegetation in the uplands provide more overall habitat, including habitats critical to declining species such as oak specialists, and also serve to protect water quality. Floodplains soak up water during storms, protecting stream and wetland hydrology and reducing the likelihood of economically damaging floods.

Conditions within 50-150 feet of water (Indicators 3 and 4) comprise a mixture of upland and riparian habitats, depending on local features such as soils and slope. This area is often a transition zone between two types of habitat, or an ecotone, containing features of each adjacent habitat type. Ecotones tend to harbor high biological diversity because species depending on both habitats occur there. Baseline vegetation in this zone is estimated at just over 55 percent, with about 34 percent in forest, with a target of five percent increase by 2015. This area receives relatively less regulatory protection compared to the area within 50 feet of water; therefore, voluntary measures will be important to meet the target.

Indicators 1-4 represent existing conditions and help identify restoration potential for vegetation within 150 feet of water. These indicators measure vegetation in generalized buffer distances in areas where the scientific literature indicates that many key ecological functions occur, if appropriate features are present. In contrast, Indicator 5 (Class I and II habitat) explicitly incorporates landscape features to estimate existing ecological functions, providing a more accurate assessment of watershed health than Indicators 1-4. However, Indicator 5 not provide as direct a means of identifying restoration potential because degraded areas near streams are downgraded or omitted from the inventory. Together, these two sets of measures provide a relatively accurate depiction of what is, and could be, on the ground.

Class I and II riparian is currently estimated to cover approximately 18 percent of the region. Title 13 sets a target for 5 percent increase by 2015. The Title 13 inventory was mapped and the map was included in the ordinance as a snapshot in time; it is the "official" inventory, based on a complex computer modeling process and the map will not change without Council action. For this reason, interim reports will measure change in the mapped Class I and II riparian areas; any detected change will show a habitat loss in interim 2-year monitoring reports. This is intended to track the inventory to which Title 13 regulatory protection may apply. The inventory will be updated for the 2015 report. Better data will result in a different modeling process; therefore, it is likely that the 2015 riparian habitat model will also be retroactively applied to earlier aerial photos to provide a more direct comparison of actual gain or loss over the 10-year period.

Vegetation is not the only feature providing ecological functions in riparian areas. Natural floodplains bestow a critical "sponge" effect for storm water, provide key wildlife habitat and house complex chemical and biological processes that contribute to healthy watersheds. About 10 percent of the region's floodplains are currently covered with buildings, pavement and other developed features. The best circumstance would be to see restoration of developed floodplain, or at least a zero percent increase in developed floodplain area. However, socioeconomic factors also played a role in Council selection of the undeveloped floodplain target of no more than 10 percent loss over 10 years, and Council did not make these decisions alone; cities, counties, key economic players and others contributed to target decisions. Restoration opportunities during redevelopment could help offset any losses over the 10-year period.

Class A and B upland habitat (Indicator 7) is essential to the region's current biological diversity. These habitat areas are either known Habitats of Concern or are large, well-connected patches with good water resources. Many of these habitat patches lie on the region's volcanic buttes or in the areas on the edge of the urban growth boundary, where existing habitat connects to larger habitats outside the boundary. Some are protected as natural area parks, but others are vulnerable to fragmentation or complete loss. Elk, deer and many other species still use these habitats. Class A and B can be considered anchor habitats, often connected through riparian corridors, and provide the foundation of the region's wildlife habitat system. As of 2005, about 10 percent of the region is covered by Class A and B upland wildlife habitat. They are not typically protected through regulation and provide some of the most significant remaining development opportunities. The 2015 target for Class A and B is to preserve at least 75 percent of existing habitat. Acquisition and restoration will be key tools to minimize fragmentation and loss of these important habitat areas.

Because they are large, Class A and B habitat patches usually contain significant interior habitat (Indicator 8), used by species with large home ranges or those that are sensitive to disturbance. A habitat patch's shape influences its amount of interior habitat; round or rectangular patches contain relatively more interior than long or convoluted patches. Interior habitat typically contains better structural conditions and reduced invasive species compared to edge habitats. The region contains a baseline amount of 5.7 percent interior habitat, with a target of preserving at least 80 percent of existing habitat over 10 years. Note this target is more rigorous than that for Class A and B. If some portions of Class A and B are removed, it is possible to minimize loss of interior habitat by keeping the habitat patch shape as rounded as possible. In other words, it is better to develop little parts of the patch that extrude than to intrude deeply into the patch (unless the extrusion is part of an important corridor). As with Class A and B, acquisition and restoration provide particularly important means of meeting this target.

Habitats of Concern (Indicator 9) are declining habitat types or critically important habitat areas. Declining habitats such as native oak, prairie, wetlands and butte tops are closely linked with declining wildlife species. Some of these habitats are particularly vulnerable to invasive species infestation because they are not closed-canopy forest, which reduces sunlight from the forest floor and suppresses sun-loving invasives such as Himalayan blackberry and reed-canarygrass. This is also why interior habitat contains

fewer invasives, in addition to reduced seed sources from disturbed edge areas. Thus for Habitats of Concern, acquisition and restoration provide equally important tools for meeting the 2015 target specifying 95 percent preservation of these areas.

Aside from the nine Title 13 indicators discussed above, two other indicators provide information about the region's ecological health: the Breeding Bird Survey data tracks species' trends over time at a generalized regional scale, whereas the 1,500-meter stream reach pilot model can help identify restoration priorities.

The Breeding Bird Survey, although it does not assess conditions in each of the region's watersheds, provides valuable information about bird species' trends over a long time period and insights to habitat management that could help declining species.

Long-term wildlife data sets are extremely rare. Nothing speaks to the success of a habitat system like living animals, which reflect the myriad of ecological features and processes that are simply too complex to measure. For example, scientists can measure any number of water quality parameters and find no problems, but if all of the invertebrates in the stream are dead, they obviously missed something. Similarly, declining or increasing bird species can help pinpoint problems in the region's habitat system as a whole. For instance, the Breeding Bird Survey data currently shows declines in bird species with open nests, particularly species nesting close to the ground, which suggests a possible over-abundance of small mammalian nest predators such as non-native squirrels and cats. This data set also shows declines in bird species relying on Habitats of Concern; hypothetically, careful conservation and restoration of these habitats over time may be accompanied by increases in these species' numbers. The Breeding Bird Survey data can also link wildlife trends in the Metro region to conditions elsewhere – such as loss of over-wintering or stopover habitat for migratory songbirds.

Appendix 10 lists species that appear to be declining, or declining faster, in the Metro region compared to statewide, as well as species that are increasing in numbers. The information reveals some interesting trends and these trends are largely backed by local research. A few common factors seem to prevail among declining species:

- Riparian, grassland, agriculture, native oak, native shrub or conifer specialist (implies habitat loss or in the latter, conversion to deciduous).
- Species that build open cup-shaped nests, which are vulnerable to predators (urban areas have more small predators, such as small mammals and jays and crows, that eat eggs and nestlings).
- Nesting on or near the ground. Previous analysis indicates a trend in which the lower a species nests, the more negative the population trend.
- Neotropical migrants, or those species that breed here and winter south of the U.S./Mexico border. Locally and across the country, Neotropical migrants seem to be adverse to urban habitats, often prefer large habitat areas and are typically open cup nesters.
- A number of declining species need larger snags.

These analyses, combined with knowledge gained from local research[45], tell us how we can help: plant native trees and shrubs. Preserve and increase Habitats of Concern such as native oak, riparian and key hilltop habitat important to migratory songbirds. Preserve large habitat patches. Increase the width of

[45] Original local field study citations: Hennings, L.A. and W.D. Edge. 2003. Riparian bird community structure in Portland, Oregon: habitat, urbanization, and spatial scale patterns. The Condor 105:288-302. Hennings, L. 2006. Bird communities in and adjacent to the Damascus area urban growth boundary expansion, Oregon. Final grant report submitted to U.S. Fish and Wildlife Service.

vegetated stream corridors. Plant backyard and street trees for habitat connectivity. Such activities will help native wildlife species, increase habitat for sensitive species and reduce non-native starlings.

The stream reach model (Indicator 11) is a work in progress and was successfully developed for certain watersheds in Clackamas County. Statistically, relationships were relatively strong in these rather rural watersheds, but it is anticipated that cumulative effects in more urbanized areas may mask some of the relationships between land features and water quality. The new GIS data being collected for the 2008 monitoring report will help determine whether this is a useful model for the entire region. If so, it can help identify stream areas most in need of restoration to help water quality, fish and wildlife.

The indicator data show that more forest cover and vegetation is needed near streams to help water quality and wildlife. Re-vegetating and conserving floodplain resources will also help the region's environment. Conserving and restoring the region's dominant native habitats such as coniferous and mixed forests, as well as declining habitats, including bottomland hardwood forest, native oak and native grassland/prairie habitat, is likely to halt or reverse negative population trends of the region's native species.

Scaling down to the watershed level provides the next step in evaluating environmental conditions. Spatial patterns emerge that reflect factors such as age and intensity of development, topography and proximity to the urban core or rural edge. The next section takes a more detailed look at each watershed and sub-watershed within the Metro region.

Sub-watershed indictor results

SUB-WATERSHED INDICATOR RESULTS

There are six sub-basins, 12 watersheds and 31 sub-watersheds partially or wholly within Metro's jurisdictional boundary (Table 3).

The large-scale comparisons include aggregated data tables for all watersheds to summarize regional conditions for each indicator and allow for comparison among sub-watersheds. This section explores each watershed and sub-watershed in more detail.

Large-scale conditions provide information about land use effects and environmental conditions across the landscape and over the long term. Influences at medium spatial scales can show environmental change in more site-specific areas and over shorter periods of time compared to large-scale influences and begin to identify areas that have stabilized or are experiencing rapid change. The 2008 report will provide the first region-wide, watershed-based comparison of how conditions are changing over time. This can provide important information to planners and watershed groups for strategic natural resource and land use planning.

Clackamas Sub-Basin

Table 15
Watersheds and sub-watersheds within the Clackamas River sub-basin

Sub-Basin	Watershed	Sub-Watershed	Acres in Metro	Sub-Total
Clackamas (5,210 acres in Metro)	Lower Clackamas River	Christensen Creek/Tualatin River (see Table 16)	734	5,210
		Deep Creek/North Fork Deep Creek (see Table 17)	4,476	

About the Clackamas Sub-Basin

The Clackamas sub-basin includes portions of two sub-watersheds, Christensen Creek/Tualatin River and Deep Creek/North Fork Deep Creek, which together comprise 1.8 percent of the Metro region's total area.

Water quality issues. Clackamas sub-basin TMDLs are in place as part of the Willamette Basin TMDL. Known water quality issues include *E. coli* and other bacteria, temperature and mercury. Pesticides are also a growing water quality concern in the Lower Clackamas. Residue from home and yard products and other applications are consistently found in water quality samples.

A key water quality standard violated in the river is summer stream water temperature. Water consistently over 64 degrees can foster algal blooms that degrade water quality and impart an unpleasant taste to drinking water. Salmon and steelhead require water colder than 55 degrees for spawning, egg incubation and fry emergence.

Sub-basin description. The Clackamas River flows from its headwaters on Ollalie Butte, just south of Mt. Hood, west into the Willamette River near Oregon City.[46] The watershed drains nearly 1,000 square miles, ranging from Cascade forests and mountain meadows to farmland and suburban neighborhoods.

[46] Full TMDL report available online at www.deq.state.or.us/wq/tmdls/willamette.htm.

The Clackamas River supplies high-quality drinking water to over 200,000 people including residents of Lake Oswego, Milwaukie, Oregon City and West Linn. The river generates hydroelectric power, hosts many productive farms and nurseries, offers a wealth of recreational opportunities and is home to a wide variety of plant and animal life. The Clackamas is well known for its steelhead fishing and whitewater recreation.

The Clackamas River Basin Council collaborates with willing landowners and citizens to monitor water temperatures and works with volunteer landowners to plant trees along river and streamside areas in order to shade and cool the water and protect water quality. The watershed council recruits volunteers for restoration and monitoring and provides free native trees to property owners for stream habitat restoration. Clackamas River Basin Council's web site includes ample information about this sub-basin, available at www.clackamasriver.org.

Habitats of Concern. The Lower Clackamas River sub-basin's two sub-watersheds contain 324 acres of known Habitats of Concern, comprising 1.2 percent of the region's total known Habitats of Concern acres. See Tables 16 and 17 for details.

Selected watershed assessments and technical resources:

Beatty, Christopher, D. and Streeter, Karen L. 1999. Assessment of habitat conditions and invertebrate assemblages in the streams of the lower Tualatin River basin, September 1999. Water Environment Services of Clackamas County, Clackamas, OR.

Carpenter Kurt D. 2004. Pesticides in the lower Clackamas River basin, OR 2000-2001, Water Resources Investigations Report 03-4145. U.S. Department of the Interior & U.S. Geological Survey, Portland, OR.

Clackamas River Basin Council and Ecotrust. 2000. Rock and Richardson Creek watershed assessment. Clackamas River Basin Council, Damascus, OR and Ecotrust, Portland, OR, www.clackamasriver.org/basins/rockrichardson/rr.html.

Cole, Michael B. 2003. Assessment of macroinvertebrate communities in streams of north Clackamas County, OR, 2002. ABR Inc., Forest Grove, OR.

Friesen, Thomas, A. and Zimmerman, Mark P. Distribution of fish and crayfish and measurement of available habitat in streams of the north Clackamas County – Final Report 1997-1999. Columbia River Investigations, Oregon Department of Fish and Wildlife, Clackamas, OR.

Meross, S. 2000. Salmon restoration in an urban watershed: Johnson Creek, Oregon. Conditions, programs and challenges. Prepared for the Multnomah Progress Board, Portland, OR.

Metro. 1995. Clackamas River watershed atlas. Metro, Portland, OR.

Metro. 2000. Rock and Richardson Creek landscape and natural resource assessment. Metro, Portland, OR.

Oregon Department of Environmental Quality. 2006. Willamette Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon Department of Fish and Wildlife and Water Environment Services of Clackamas County. 1998. Distribution of fish and crayfish and measurement of available habitat in streams of the north Clackamas urban area – 1997-98 annual report. Oregon Department of Fish and Wildlife, Portland, OR and Clackamas County Water Environment Services, Clackamas, OR.

Oregon State University Institute for Water and Watersheds. The IWW is the state water resources research institute for Oregon and contains a library of watershed publications (www.water.oregonstate.edu). Oregon State University, Corvallis, OR.

Portland State University and Metropolitan Regional Government, 1995. Rock Creek watershed atlas: Planning with an awareness of natural boundaries. Portland State University and Metro, Portland, OR.

State of Oregon, Oregon Watershed Enhancement Board (OWEB), 2006. The Oregon Plan for salmon and watersheds – Biennial Report, 2005-2007. OWEB, Salem, OR, www.oregon-plan.org/OPSW.

Swanson, Andrew J. 2004. 2003-2004 water quality and flow monitoring report for municipal separate storm sewer system Permit #101348. Water Environment Services of Clackamas County, Clackamas, OR.

Swanson, Andrew J. 2004. The Surface Water Management Agency of Clackamas County's surface water monitoring report for July 2003 to June 2004. Water Environment Services of Clackamas County, Clackamas, OR.

Swanson, Andrew, J. 2001. Surface water and storm water monitoring plan for CCSD#1 and SWMACC. Water Environment Services of Clackamas County, Clackamas, OR.

Swanson, Andrew, J. 2003. Surface water and storm water monitoring plan for SWMACC. Water Environment Services of Clackamas County, Clackamas, OR.

Tanner, Dwight Q. and Lee, Karl K. 2004. Organochlorine pesticides in the Johnson Creek basin, OR, 1988-2002, Scientific Investigations Report 2004-5061. U.S. Geological Survey, U.S. Department of the Interior, Portland, OR; City of Portland, OR; City of Gresham, OR; City of Milwaukie, OR; Clackamas County, OR; and Multnomah County, OR.

Watershed councils and related groups:

Clackamas County Soil and Water Conservation District, 256 Warner Milne Road, Room 2, Oregon City, OR 97045

Clackamas River Basin Council, PO Box 1869, Clackamas, 97015-1869, 503-650-1256

Clackamas River, Friends of, 9205 SE Clackamas, #142, Clackamas 97015, 503-492-1593

Clackamas River Water, 16770 SE 82nd Drive, Clackamas 97015

Rock Creek Environmental Center, 503-690-540

Table 16
Sub-watershed 1: Christensen Creek/Tualatin River

Summary statistics for the Christensen Creek/Tualatin River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Christensen Creek/Tualatin River *Lower Clackamas River watershed* *Clackamas sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	734 acres	0.2%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**70.0%**	0.1%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	43.0%	0.1%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**62.1%**	0.2%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	36.8%	0.2%	33.9%	
% Class I + Class II riparian habitat	*7.1%*	0.1%	17.8%	≥22.8%
% undeveloped floodplain	0.0%	0.0%	90.1%	≥80.1% undev
% developed floodplain	0.0%	0.0%	9.9%	
% Class A + Class B wildlife habitat	**23.3%**	0.6%	10.1%	≥7.6%
% interior habitat	2.2%	0.1%	5.7%	≥4.6%
Habitats of Concern	**24.9%**	0.7%	9.1%	≥8.6%

Only 734 acres of the Christensen Creek/Tualatin River sub-watershed fall within the Metro region, comprising just 0.2 percent of the region. Table 16 includes a very small sample of the watershed and is not necessarily representative of the watershed as a whole. However, the portion within the region includes some important fish and wildlife habitat.

Although there is not a large quantity of riparian habitat, what is there tends to be slightly more forested than the regional average within both 50 and 150 feet of streams and wetlands. Similarly, the percent of these buffers in total vegetation is higher than the regional average. No floodplain falls within this area of the watershed.

In the area within the Metro region, this watershed contains more than twice the regional average Class A and B upland habitat. The four highest value fish and wildlife habitat classes together slightly exceed the regional average. The interior habitat is lower than the regional average.

Table 17
Sub-watershed 2: Deep Creek/North Fork Deep Creek

Summary statistics for the Deep Creek/North Fork Deep Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Deep Creek/North Fork Deep Creek *Lower Clackamas River watershed* *Clackamas sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	4,476 acres	1.5%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**82.5%**	2.2%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*29.5%*	1.3%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**76.0%**	2.4%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*24.5%*	1.3%	33.9%	
% Class I + Class II riparian habitat	13.9%	1.2%	17.8%	≥22.8%
% undeveloped floodplain	0.0%	0.0%	90.1%	≥80.1% undev
% developed floodplain	0.0%	0.0%	9.9%	
% Class A + Class B wildlife habitat	14.7%	2.2%	10.1%	≥7.6%
% interior habitat	3.9%	1.0%	5.7%	≥4.6%
Habitats of Concern	*3.2%*	0.5%	9.1%	≥8.6%

The Deep Creek/North Fork Deep Creek sub-watershed contributes 1.5 percent of the Metro region's area. Most of the sub-watershed falls within the Metro boundary and contain substantial agriculture with some forestry uses.

This and certain other sub-watersheds in the Lower Clackamas River sub-basin, due to their volcanic butte/Missoula flood geologic history, have the unusual circumstance of headwaters in lowlands, with streams cutting wider and deeper canyons as they flow toward the Clackamas River.

The sub-watershed's proportion of high-value Class I and II riparian habitat falls somewhat below average. The proportion of vegetated acres within 150 of streams and wetlands is substantially higher than the regional average, but percent forested area is lower. This reflects the drainage's strong agriculture component and its geology, with substantial agriculture near streams in the flatland headwaters. There is essentially no floodplain in this sub-watershed.

The Deep Creek/North Fork Deep Creek sub-watershed contains proportionately more high-value upland habitat than riparian and the four habitat classes together average proportionately somewhat higher than region-wide. However, the drainage contains a relatively small proportion of interior habitat compared to many other sub-watersheds in the region. In general, the highest value upland Class A and B are classed as such due to large habitat patch size, good water resources, proximity to other habitats and interior habitat. Habitat interior in the Metro inventory is defined as the area of a habitat patch that is 200 feet or more from the edge of the patch. Thus the drainage contains generally large, well-connected patches with good water resources, but shape is not optimal for minimizing habitat edge.

LOWER COLUMBIA – SANDY RIVER SUB-BASIN

Table 18
Watersheds and sub-watersheds within the Lower Columbia – Sandy River sub-basin

Sub-Basin	Watershed	Sub-Watershed	Acres in Metro
Lower Columbia – Sandy (2,069 acres in Metro)	Columbia Gorge Tributary	Latourell Creek	2,069

About the Lower Columbia – Sandy River sub-basin

The Lower Columbia – Sandy sub-basin includes a single sub-watershed within the Metro region, Latourell Creek, which comprises 0.7 percent of the land within Metro's boundary.

Water quality issues. Lower Columbia – Sandy sub-basin TMDLs are in place as part of the Sandy River Basin TMDL rule[47] (Appendix 4). Known water quality issues in and near the Metro area include temperature and dissolved oxygen.

However, based on data collected by DEQ and summarized using the Oregon Water Quality Index, the Sandy River (measured at the Troutdale Bridge) exhibits excellent water quality throughout the year. A detailed description and methodology review of the Oregon Water Quality Index can be found on the DEQ web site.[48]

Sub-basin description. The Sandy River originates from glaciers on the western slopes of Mt. Hood and travels 56 miles before flowing into the Columbia River near Troutdale. The Sandy is the only major glacial river draining the western Cascades in Oregon and glacially derived fine particles known as "glacial flour" give the Sandy its distinctive summertime milky-gray color.

Outside of the Metro area, major tributaries to the Sandy River include the Zigzag, Salmon and Bull Run rivers. The Little Sandy River is the largest tributary to the Lower Bull Run River. In the Metro area, political jurisdictions include portions of Multnomah and Clackamas counties as well as portions of the cities of Gresham and Troutdale.

In the entire sub-basin, approximately 70 percent of the area is owned and managed by the U.S. Forest Service in the Mt. Hood National Forest. Twenty-two percent is in private ownership. The Bureau of Land Management owns 4 percent; 2 percent is owned by the City of Portland and the remainder is owned by the state, local governments or Portland General Electric (PGE). Nearly 20 percent is designated as Wilderness. The portion of the sub-basin lying within the Metro region comprises less than 1 percent of the region's area, but contains very important high-value riparian resources.

The Sandy is home to 19 native and 14 introduced fish species. The following fish species are listed as threatened or endangered by NOAA Fisheries: Chinook salmon (Threatened), Steelhead trout (Threatened) and Coho salmon (Candidate species).

Three river segments within the basin were given various National Wild and Scenic River designations by

[47] Available online at www.deq.state.or.us/wq/tmdls/sandy.htm.

[48] DEQ's Oregon Water Quality Index available online at www.deq.state.or.us/lab/wqm/wqi/wqimain.htm.

Congress in 1988, including the Sandy River from Dodge Park (River Mile 18.5) to Dabney State Park (River Mile 6).[49]

The Bull Run watershed comprises approximately 25 percent of the Sandy Basin (90,000 acres). Much of it is in the Bull Run Reserve, created by presidential proclamation in 1892 to protect Portland's water supply. The Bull Run supply consists of two storage reservoirs and an outlet structure on Bull Run Lake, a natural water body near the headwaters. The unfiltered water serves over 800,000 people in and near the City of Portland. Electricity is generated at the dams and the Federal Energy Regulatory Commission license expires in 2029. PGE's Marmot Dam was removed in 2007.

The Sandy River Basin Watershed Council implements high priority projects based on the restoration strategy recently developed by the council and the Sandy River Basin Partners.[50] Tree planting and off-channel habitat projects help salmon. In 2005, 124 volunteers from local high schools distributed more than ten tons of salmon carcasses as part of their large-scale nutrient supplementation project.

Habitats of Concern. The Sandy River sub-basin's single sub-watershed contains 878 acres of known Habitats of Concern, comprising a significant 3.3 percent of the region's total known Habitats of Concern.

Selected watershed assessments and technical resources:

Oregon Department of Environmental Quality. 2005. Sandy River Basin Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon State University Institute for Water and Watersheds. The IWW is the state water resources research institute for Oregon and contains a library of watershed publications. Oregon State University, Corvallis, OR, www.water.oregonstate.edu.

The Nature Conservancy, Oregon Field Office. 2007. Sandy River Riparian Habitat Protection Project Report 2006. The Nature Conservancy, Portland, OR, www.nature.org/Oregon.

U.S. Environmental Protection Agency. 2007. Lower Columbia-Sandy Watershed Profile. U.S. Environmental Protection Agency, Seattle, WA, www.epa.gov

U.S. Geological Survey. 2006. Sandy River Sediment Transportation Data Collection, Oregon Water Resources Department – USGS Project Workplan, 2006. U.S. Geological Survey, Oregon Water Science Center, Portland, OR, www.usgs.gov.

U.S. Geological Survey. 2006. Sediment and Turbidity Date for Monitoring Stations in the Sandy River, Oregon. United States Geological Survey, Oregon Water Science Center, Portland, OR, www.usgs.gov.

Watershed councils and related groups:

Clackamas County SWCD, 256 Warner Milne Road, Oregon City, OR 97045, 503-656-3499, rick.gruen@or.nacdnet.net, www.cc-swcd.org

East Multnomah Soil and Water Conservation District, 5211 N. Williams Avenue, Portland, OR 97217

Sandy Basin Watershed Council, PO Box 868, Sandy, OR 97055, 503-630-2382

Sandy River, Friends of, 503-663-2672, Rob Galasso

Wetlands, Friends of, 503-253-6247, Alice Blatt

[49] River Mile refers to the distance from the mouth towards the upstream end of a stream or river.

[50] Available online at www.oregonwatersheds.org/oregoncouncils/sandyriver.

Table 19
Sub-watershed 3: Latourell Creek

Summary statistics for the Latourell Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Latourell Creek *Columbia Gorge Tributary watershed* *Lower Columbia - Sandy sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	2,069 acres	0.7%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	*40.3%*	1.1%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*14.4%*	0.7%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*38.0%*	1.1%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*15.7%*	0.8%	33.9%	
% Class I + Class II riparian habitat	**63.6%**	2.5%	17.8%	≥22.8%
% undeveloped floodplain	**99.4%**	3.9%	90.1%	≥80.1% undev
% developed floodplain	*0.6%*	0.2%	9.9%	
% Class A + Class B wildlife habitat	**19.4%**	1.3%	10.1%	≥7.6%
% interior habitat	**11.6%**	1.4%	5.7%	≥4.6%
Habitats of Concern	**42.4%**	3.3%	9.1%	≥8.6%

The Latourell Creek sub-watershed contributes about 1 percent of the region's area, much of it (83 percent) in high-value habitat. Given the sub-watershed's relatively small area within the Metro region, it contributes a substantial amount of the region's highest value fish and wildlife habitat.

While Latourell Creek's vegetation within 150 feet of streams and wetlands falls below average, the proportion of Class I and II riparian is much higher than average – 64 percent vs. the regional average of 18 percent. Most of the Class I and II habitat (1,207 acres) is undeveloped floodplain, a critical asset to fish, wildlife, groundwater recharge and maintaining flow during summer.

Class A and B upland is proportionately about double the region's average, contributing 1.3 percent of the regional total. The percent interior habitat in the sub-watershed is more than twice the regional average, suggesting large, well-shaped habitat patches that provide very valuable wildlife habitat, especially for the more sensitive wildlife species that rely on this feature.

LOWER WILLAMETTE SUB-BASIN

Table 20
Watersheds and sub-watersheds within the Lower Willamette sub-basin

Sub-Basin	Watershed	Sub-Watershed	Acres in Metro	Sub-Totals
Lower Willamette (153,833 acres in Metro)	Columbia River – Hayden Island	Coffee Lake Creek	7,365	
		Columbia River Islands	10,095	5,210
	Columbia Slough – Willamette River	Willamette River – Columbia River	40,182	
		Columbia Slough	37,060	77,242
	Johnson Creek	Kellogg Creek	11,067	
		Lower Johnson Creek	15,859	
		Upper Johnson Creek	15,116	
		Willamette River – Oswego Creek (includes Tryon Creek)	16,389	58,431
	Scappoose Creek	Gilbert River	700	700

About the Lower Willamette sub-basin

The Lower Willamette River sub-basin contains four watersheds and nine sub-watersheds that are partially or wholly located within Metro's boundary. Together the sub-basin's drainages comprise more than half (52 percent) of the land within Metro's boundary. Land contribution to Metro's jurisdictional boundary by watershed include: Columbia River – Hayden Island, 5.9 percent; Columbia Slough – Willamette River, 26.1 percent; Johnson Creek, 19.7 percent; and Scappoose Creek, 0.2 percent.

Because the sub-watershed includes more than half of the Metro region's area, selected sub-watersheds are described in more detail below.

Water quality issues. The Lower Willamette sub-basin TMDLs are in place as part of the Willamette TMDL rule (Appendix 4). Known water quality issues in and near the Metro area include *E. coli* bacteria and fecal coliform, DDT and dieldrin, temperature, pH and mercury. Sub-watershed specific water quality issues are discussed below.

Sub-basin description. The Lower Willamette Sub-basin is located in the northern-most portion of the Willamette Basin and is drained by the Willamette River, Multnomah Channel and tributaries.[51] The entire sub-basin's 408 square miles extend from the divides shared with the Sandy and Clackamas sub-basins in the Cascade foothills on the east, across the Willamette River to the Tualatin divide on the west, north to the town of St. Helens and south to Willamette Falls at River Mile 26.6. The southeastern portion of the sub-basin drains directly to the Willamette River and contains the majority of the Portland metropolitan area, while the northwestern portion generally drains rural and agricultural lands through tributaries that discharge to the Multnomah Channel.

Major tributaries include Johnson Creek, Tryon Creek, Kellogg Creek and the Columbia Slough in the Portland metropolitan area. Political jurisdictions within the Metro region include all or portions of the cities of Portland, Gresham, Fairview, Wood Village, Troutdale, Johnson City, Happy Valley, Gladstone, Lake Oswego, Maywood Park, Milwaukie and West Linn as well as portions of Multnomah, Clackamas and Washington counties. The sub-basin is almost entirely in private ownership. Land use in the Metro region is primarily urban.

[51] Further information available online at www.deq.state.or.us/wq/tmdls/willamette.htm.

Columbia River – Hayden Island. Hayden Island is an island in the Columbia River between the cities of Vancouver, WA and Portland. It is bordered on the north side by the main channel of the Columbia River and on the south side by a smaller channel of the Columbia, also known as North Portland Harbor. Even though separated by this channel from most of Portland, much of Hayden Island is part of Portland and forms one of its 95 neighborhoods, most of which is in Portland's North section, though the eastern end is in Northeast Portland.

Interstate 5 connects the island, via the northernmost Oregon exit, to the rest of North Portland and, with the Interstate Bridge, to Vancouver to the north. Jantzen Beach on the east end of the island has highly developed retail areas near the freeway, as well as hotels, offices and condominium complexes. Further east there are several houseboat moorages and marinas.

Hayden Island lies at the intersection of two major wildlife corridors and is utilized by wildlife moving north-south between Smith and Bybee Lakes and Ridgefield National Wildlife Refuge and east-west between Sauvie Island and the Sandy River.[52] The island includes at least 39 acres of protected wetlands, as well as one of the largest intact stands of cottonwood-ash bottomland forest remaining on the Lower Columbia. The Audubon Society states that at least 81 bird, 9 mammal and 4 amphibian species have been observed on the island including several sensitive species (Bald eagles, pileated woodpeckers, willow Flycatchers and Western painted turtles). Endangered Species Act-listed chinook, chum, sockeye salmon and steelhead use the river channels surrounding the island and are also known to use at least one of the island's wetlands. Today, the Port of Portland holds West Hayden Island in "Marine Strategic Reserve" with no immediate plans for development.

Columbia Slough/Willamette River. The Columbia Slough is a 19 mile-long complex of channels located on the floodplain of the Columbia River between Fairview Lake on the east and the Willamette River at Kelley Point Park on the west. The slough watershed drains approximately 51 square miles of land.

Over the years the slough system has been extensively dredged, diked, filled and channelized, principally by the U.S. Army Corps of Engineers, the City of Portland and the Port of Portland. Originally a series of wetlands and marshes created by annual flooding of the Columbia and Willamette rivers, the slough is now a highly managed water system with dikes and pumps to provide watershed drainage and flood control for the surrounding lowlands. The Multnomah County Drainage District No. 1 is a special purpose district whose primary responsibility is to provide flood control for the slough contained within levees. Due to the extensive modifications noted above, the area within the Multnomah County Drainage District No. 1's boundaries no longer drains naturally, but relies on two primary pump stations that lift water over the levee and into the Columbia River and/or lower Columbia Slough which drains to the Willamette River. The hydraulic management of the slough can have a significant impact on the water quality and uses supported by the slough.

The Columbia Slough is water quality limited for chlorophyll a, pH and phosphorus from spring through fall due to excessive algal growth. This algal growth affects the aesthetic quality of the slough and may affect such beneficial uses as fishing and boating. The dissolved oxygen criteria for cool water aquatic life are violated throughout the year. These dissolved oxygen criteria violations may prevent the Columbia Slough from supporting salmonid fish rearing as well as resident fish and aquatic life.

[52] Sallinger, B. 2005. West Hayden Island: Portland's forgotten greenspace. Audubon Society of Portland, The Warbler, Volume 69 No. 10, October 2005, page 1.

The slough is water quality limited for dieldrin, DDE, DDT, PCBs and dioxin due to elevated levels found in fish tissue, impairing the use of the slough for fishing. The State of Oregon Health Division and the City of Portland have issued recommendations against eating fish from the slough due to PCBs, DDE and DDT.[53] Elevated bacteria and lead concentrations have also been documented in the slough.

To address these water quality problems, DEQ developed ten TMDLs that specify pollutant loading limits and require pollution reduction programs for pollutant sources. In December 1998, the U.S. Environmental Protection Agency approved the TMDLs for the Columbia Slough. The 1998 TMDL established for the Columbia Slough remains in effect for the following constituents: pH, dissolved oxygen, phosphorus, chlorophyll-a, bacteria, lead, DDE/DDT, PCBs, dieldrin and 2,3,7,8-TCDD.[54]

Water quality in the slough is generally thought to have begun improving in the late 1940s after the catastrophic Vanport Flood. According the the Columbia Slough Watershed Council, the 2000 elimination of Combined Sewer Overflows and watershed-wide efforts to revegetate the slough with native plants have made the slough cleaner than it has been for the past 100 years. However, the slough's water quality is ranked near the bottom of a statewide list of waterbodies monitored by DEQ.[55] Efforts to improve water quality in the slough, especially the permitting of point source discharges and the removal of combined sewer overflows, have resulted in a significant improvement in water quality over the last ten years.

Many kinds of land use are found within the sub-watershed including heavy and light industries, residential areas, vegetable farming and the Portland International Airport (PDX), which occupies approximately 3,200 acres near the center of the watershed. The Columbia Slough also serves as one of the City of Portland's largest open space and wildlife habitat areas.

Johnson Creek. Johnson Creek flows 25 miles from its headwaters in the Cascade foothills to its confluence with the Willamette River near the city of Milwaukie. The sub-watershed drains approximately 54 square miles and includes portions of the cities of Gresham, Happy Valley, Portland and Milwaukie as well as portions of Clackamas and Multnomah counties. Significant tributaries to Johnson Creek include Crystal Springs, Kelley, Butler, Hogan, Sunshine and Badger creeks. Land uses in Johnson Creek include commercial, industrial, residential and various types of agriculture.

The Johnson Creek sub-watershed has been the subject of several water quality investigations over the last few years. For example, the U.S. Geological Survey has published a number of reports on Johnson Creek's hydrology and water quality, many which can be found on the USGS web site at www.oregon.usgs.gov.

Johnson Creek's water quality parameters included in the Oregon Water Quality Index are temperature, dissolved oxygen, biochemical oxygen demand, pH, total solids, ammonia and nitrate nitrogen, total phosphorous and fecal coliform. Average Oregon Water Quality Index scores for Johnson Creek are very poor throughout the year. Although water quality in Johnson Creek has not significantly deteriorated since 1990, neither has it improved.

[53] Further information available online at www.ohd.hr.state.or.us/esc/docs/lowcolum.htm.

[54] Columbia Slough Watershed Council. 2007. State of the Slough. Available online at www.columbiaslough.org/ourwatershed/sos.htm.

[55] Department of Environmental Quality. 2007. Oregon Water Quality Index. Available online at www.deq.state.or.us/lab/wqm/wqimain.htm.

Johnson Creek and its tributaries have experienced development-related impacts to its natural hydrology that may influence stream temperatures. Of these, altered channel morphology, water withdrawals and reduction of summertime base flows due to increases in impervious surface area probably have the most impact on stream temperatures. Bacteria and toxics water quality problems are exacerbated by changes in hydrology. In the case of bacteria, the paths and time in which it takes bacteria to go from "source" to "stream" are often greatly reduced by modern stormwater conveyance systems and land use practices. The current water quality violations for DDT and dieldrin may also be exacerbated by human-related factors that impact hydrology. In the past DDT and dieldrin were used extensively throughout the watershed and typically find their way to Johnson Creek attached to sediment particles transported during rain.

The Willamette River/Oswego Creek sub-watershed falls within the Johnson Creek watershed and includes Tryon Creek, a seven mile-long stream located in southwest Multnomah County and northwest Clackamas County, within the city boundaries of Portland and Lake Oswego. It originates in the West Hills of Portland and flows in a southeasterly direction from Multnomah Village, through Tryon Creek State Park, to its confluence with the Willamette River in Lake Oswego. The creek is one of the major remaining free flowing tributaries that descend Portland's West Hills.

Major tributaries to Tryon Creek include Falling and Arnold creeks. Tryon Creek has large human-induced seasonal fluctuations in water flow and carries large amounts of stormwater runoff during the winter. The stream also carries water from underground aquifers that surface through springs and seeps during the summer months.

Tryon Creek Canyon was logged in the 1880s by the Oregon Iron Co. to provide fuel for an iron smelter in Lake Oswego. The forest has naturally re-grown into a mixed stand of red alder, Douglas fir, bigleaf maple and western red cedar. Tryon Creek State Park is a 641-acre natural day-use area located within the city of Portland. This park provides the stream with key water quality protection, although the beneficial effects of the forest buffer are reduced due to stormwater piping to the stream from development in the uplands above the park.

Political jurisdictions include the cities of Portland and Lake Oswego, portions of unincorporated Multnomah and Clackamas counties and Tryon Creek State Park. Aside from parks and open spaces, land use is almost exclusively residential.

The Tryon Creek watershed has experienced development-related impacts to its natural hydrology that may influence stream temperatures. Of these, altered channel morphology and reduction of summertime base flows due to increases in impervious surfaces in the watershed probably have the most impact on stream temperatures.

Scappoose Creek. A relatively small portion of the Scappoose Creek watershed, comprised of 700 acres within the Gilbert River sub-watershed, falls within the Metro region. That area is, however, rich with riparian and upland habitat as well as Habitats of Concern. This area is described in more detail under the sub-watershed description.

Habitats of Concern. The Lower Willamette sub-basin's nine sub-watersheds contain 17,362 of the region's acres of known Habitats of Concern, comprising nearly two-thirds (64.7 percent) of the region's total known Habitats of Concern acres.

Selected watershed assessments and technical resources:

Adams, Jeff. 2006. A bug's life in the Columbia Slough: Handbook of aquatic invertebrates and

macroinvertebrate monitoring in the Columbia Slough watershed. Xerces Society, Portland, OR and The Columbia Slough Watershed Council, Portland, OR.

Storer, Bob and McGuire, Tom. No date. Johnson Creek Watershed Action Plan. Available online at: www.jcwc.org/actionPlan/WAP10.30.03.pdf.

City of Portland. 2001. Johnson Creek Restoration Plan. City of Portland, OR.

Columbia Slough Watershed Council. 2003. Columbia Slough Watershed Action Plan.

Cude, C. 2001. Oregon water quality index report for Johnson Creek watershed. Report to the Oregon Department of Environmental Laboratory Division, Water Quality Monitoring Section, Portland, OR.

Johnson Creek Watershed Council. 2006. Johnson Creek watershed: A decade of change - Annual report 2006. Johnson Creek Watershed Council, Milwaukie, OR, www.jcwc.org.

Johnson Creek Watershed Council. 2007. Links and regional watershed information. Johnson Creek Watershed Council, Milwaukie, OR, www.jcwc.org.

Meross, S. 2000. Salmon restoration in an urban watershed: Johnson Creek, Oregon. Conditions, programs and challenges. Prepared for the Multnomah Progress Board, Portland, OR.

Multnomah County, Oregon. 2007. Fish Passage Culverts. Multnomah County, Portland, OR 97204, 503-823-4000.

Oregon Department of Environmental Quality. 1998. Columbia Slough Total Maximum Daily Loads (TMDLs) for chlorophyll *a*, dissolved oxygen, pH, phosphorus, bacteria, DDE/DDT, PCBs, Pb, dieldrin and 2,3,7,8 TCDD. Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon Department of Environmental Quality. 2006. Willamette Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon State University Institute for Water and Watersheds. The IWW is the state water resources research institute for Oregon and contains a library of watershed publications, www.water.oregonstate.edu. Oregon State University, Corvallis, OR.

Storer, Bob and McGuire, Tom. No date. Johnson Creek Watershed Action Plan. Available online at: www.jcwc.org/actionPlan/WAP10.30.03.pdf.

Tanner, Dwight, Q., Bragg, Heather, M. and Johnston, Matthew, W. U.S. Geological Survey with the U.S. Army Corps of Engineers. 2006. Total dissolved gas and water temperature in the lower Columbia River, Oregon and Washington, 2006. U.S. Geological Survey, Portland, OR.

U.S. Environmental Protection Agency. 2007. Lower Willamette watershed profile. U.S. Environmental Protection Agency, Seattle, WA.

Woodward-Clyde Consultants. 1995. Johnson Creek Resources Management Plan. Prepared for the Johnson Creek Corridor committee.

Watershed councils and related groups:

Columbia Slough Watershed Council, 7040 NE 47th Ave., Portland, OR 97218-1212, www.columbiaslough.org

East Multnomah SWCD, 2701 NW Vaughn Street, Suite 450, Portland, OR 97210, 503-222-SOIL

Johnson Creek Watershed Council, 1900 SE Milport Road; Milwaukie, OR 97222, www.jcwc.org

Lower Columbia Watershed Council, Margaret Magruder, 12589 Hwy 30, Clatskanie OR 97016, 503-728-9015, 503-728-9015 (fax), magruder@clatskanie.com

Scappoose Bay Watershed Council, 57420-2 Old Portland Road, Warren, OR 97053, Janelle St. Pierre, sbwc@opusnet.com

Tryon Creek Watershed Council/Friends of Tryon Creek State Park, www.tcwc.tryonfriends.org

Willamette Riverkeepers, 1515 SE Water Ave #102, Portland, Oregon 97214

Table 21
Sub-watershed 4: Coffee Lake Creek

Summary statistics for the Coffee Lake Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Coffee Lake Creek *Columbia River – Hayden Island watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	7,365 acres	2.5%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**68.9%**	3.4%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*32.8%*	2.7%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**61.4%**	3.3%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	31.6%	2.7%	33.9%	
% Class I + Class II riparian habitat	15.5%	2.2%	17.8%	≥22.8%
% undeveloped floodplain	92.4%	1.2%	90.1%	≥80.1% undev
% developed floodplain	7.6%	0.9%	9.9%	
% Class A + Class B wildlife habitat	8.6%	2.1%	10.1%	≥7.6%
% interior habitat	3.7%	1.6%	5.7%	≥4.6%
Habitats of Concern	5.9%	1.6%	9.1%	≥8.6%

The Coffee Lake Creek sub-watershed contributes about 3 percent of the region's total area. About 300 acres of the drainage lie outside the Metro boundary.

The percent cover of the four high-value habitat classes is slightly below the regional average, but close to proportional. The percent vegetation within 50 feet of streams is 5 percent higher than the regional average, while percent forest in that area is 5 percent lower than regional average. Vegetation and forest patterns in the 50-150 foot band near streams and wetlands are similar. Floodplain area in this drainage is fairly proportional to the drainage area and is less developed than regional trends.

Coffee Lake Creek sub-watershed contributes proportionately less high-value upland wildlife habitat and less interior habitat compared to regional average, suggesting more habitat fragmentation here than in many other sub-watersheds.

Table 22
Sub-watershed 5: Columbia River Islands

Summary statistics for the Columbia River Islands sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Columbia River Islands *Columbia River – Hayden Island watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	10,095 acres	3.4%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	*34.6%*	2.7%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*27.5%*	3.5%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*43.9%*	3.5%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	35.9%	4.6%	33.9%	
% Class I + Class II riparian habitat	**95.5%**	18.3%	17.8%	≥22.8%
% undeveloped floodplain	**98.6%**	30.6%	90.1%	≥80.1% undev
% developed floodplain	*1.4%*	3.8%	9.9%	
% Class A + Class B wildlife habitat	*0.2%*	0.1%	10.1%	≥7.6%
% interior habitat	5.7%	3.4%	5.7%	≥4.6%
Habitats of Concern	**32.2%**	12.1%	9.1%	≥8.6%

The Columbia River Islands sub-watershed, consisting of large river surface and islands, provides some of the most valuable habitat in the region. Undeveloped river islands are a Habitat of Concern because they are protected from predators, contain rich fish and wildlife food resources and are a unique type of habitat. The river and islands are 100 percent floodplain, most of it undeveloped.

River islands and deltas provide unique habitat for migrating and nesting shorebirds, waterfowl, nesting terns and gulls and other wildlife through enriched food resources, sand and mudflats and protection from predators and disturbance. Macroinvertebrate communities are denser and more diverse around river islands and deltas. Bald eagles winter, breed and forage on islands in the Metro region and elsewhere in the Pacific Northwest.

Channel complexity and large wood, which are linked to island formation, have been substantially reduced from historic levels. Protecting river islands is vital to maintaining healthy ecosystems and the species that depend upon them.

The Columbia River Islands sub-watershed is primarily high-value riparian habitat and although the watershed comprises just over 3 percent of the region's area, it contains more than 18 percent of the region's highest-value riparian habitat. The amount of vegetation and forest within 50 feet of streams and wetlands is skewed (appears low) because much of this band falls in the river, which extends beyond 50 feet. Vegetation is mapped on both sides of streams but in this case, the sub-watershed only extends from the islands to the waterline of the river's shores and the river is so wide that the GIS model maps only water on the river side of the islands. This is also true for vegetation in the 50-150 foot band, but note that the percent forest in this area is slightly higher than the regional average. In reality, after accounting for the river, the percent forested area is much higher than the regional average.

The proportion of interior habitat in this sub-watershed is exactly equal to the regional average but the special protected nature of islands must be noted. Edge effects such as predators and disturbance are greatly reduced here, increasing habitat value.

Table 23

Sub-watershed 6: Willamette River – Columbia River

Summary statistics for the Willamette River – Columbia River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Willamette River – Columbia River *Columbia Slough – Willamette River watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	40,182 acres	13.6%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**73.0%**	8.1%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**69.5%**	12.6%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**72.7%**	11.1%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**68.3%**	16.9%	33.9%	
% Class I + Class II riparian habitat	14.4%	11.0%	17.8%	≥22.8%
% undeveloped floodplain	87.1%	12.6%	90.1%	≥80.1% undev
% developed floodplain	12.9%	17.0%	9.9%	
% Class A + Class B wildlife habitat	14.0%	18.8%	10.1%	≥7.6%
% interior habitat	**13.9%**	33.1%	5.7%	≥4.6%
Habitats of Concern	**17.2%**	25.8%	9.1%	≥8.6%

The large Willamette River – Columbia River sub-watershed comprises a substantial 14 percent of the region's area and falls entirely within the Metro boundary. The regional average for a sub-watershed area within the region is about 9,500 acres, compared to this drainage at more than 40,000 acres. Smith and Bybee Lakes, a regionally significant Habitat of Concern critical to numerous at-risk species, falls within this sub-watershed.

The Willamette River – Columbia River sub-watershed contains proportionately less riparian habitat than many other watersheds, but the area within 50 feet of streams and wetlands is well protected with 73 percent vegetation, most of it (nearly 70 percent) forest. This compares to regional averages of 63 percent overall vegetation and 39 percent forest, thus streams and rivers in this drainage tend to be well protected. The area within 50-150 feet of streams and wetlands shows substantially higher amounts of vegetation and tree coverage compared to the region's average.

The sub-watershed contains a proportional amount of floodplain relative to the region; however, it contributes a disproportionately high amount of developed floodplain, comprising a total of 17 percent of the region's developed floodplain.

This sub-watershed also contains a disproportionately high amount of high-value Class A and B upland habitat, covering nearly 19 percent of the sub-watershed area compared to about 10 percent regionally. The drainage contributes one-third of the region's interior habitat, suggesting an extraordinarily high importance to regional wildlife, particularly species needing reduced edge effects such as disturbance and nest predation, as well as those species requiring large habitat patches.

Table 24
Sub-watershed 7: Columbia Slough

Summary statistics for the Columbia Slough sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Columbia Slough *Columbia Slough – Willamette River watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	37,060 acres	12.5%	9,549 acres	
% Class I + Class II riparian habitat	15.6%	11.0%	17.8%	≥73.3% total
% Class A + Class B wildlife habitat	*1.9%*	2.4%	10.1%	
% vegetated acres within 50' of streams and wetlands	*34.9%*	9.8%	63.3%	≥60.1% total
% forested acres within 50' of streams and wetlands	*14.4%*	6.6%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*30.6%*	8.6%	55.1%	≥22.8%
% forested acres within 50-150' of streams and wetlands	*10.8%*	4.9%	33.9%	≥80.1% undev.
% undeveloped floodplain	87.1%	13.6%	90.1%	≥7.6%
% developed floodplain	12.9%	18.3%	9.9%	
% interior habitat	4.2%	9.2%	5.7%	≥4.6%
Habitats of Concern	8.9%	12.3%	9.1%	≥8.6%

This large sub-watershed comprises nearly 13 percent of the region's area and is wholly contained within the Metro boundary. It contains proportionately less high-value riparian habitat than many other watersheds, but contributes a critical 11 percent of the region's total Class I and II riparian.

The percent vegetation and forest within 150 feet of streams and wetlands is substantially lower than the regional average. However, strong support for riparian restoration and enhancement in this sub-watershed means that many acres of important fish and wildlife habitat are in the process of being restored or enhanced.

The slough contains nearly 5,000 acres of floodplain. The floodplain area in this watershed is more than 18 percent developed, almost double the regional average and comprising nearly a fifth of the region's developed floodplain. However, more than 4,200 acres of floodplain are undeveloped, contributing a critically important 13.6 percent of the region's total undeveloped floodplain.

The relative lack of upland habitat reflects development patterns of this highly urbanized watershed. This sub-watershed contains relatively low proportions of high-value upland habitat (just under 2 percent compared to the region's 10 percent average), but does a bit better in interior habitat, reaching over 4 percent compared to about 6 percent average regionally. The slough contributes more than 9 percent of the region's total interior habitat, proportionately less than the region but a key piece of the total.

Table 25
Sub-Watershed 8: Kellogg Creek

Summary statistics for the Kellogg Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Kellogg Creek *Johnson Creek watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	11,067 acres	3.7%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	*58.4%*	2.3%	63.3%	
% forested acres within 50' of streams and wetlands	36.9%	2.4%	38.7%	≥73.3% total
% vegetated acres within 50-150' of streams and wetlands	*43.9%*	2.3%	55.1%	
% forested acres within 50-150' of streams and wetlands	*25.5%*	2.1%	33.9%	≥60.1% total
% Class I + Class II riparian habitat	*7.7%*	1.6%	17.8%	≥22.8%
% undeveloped floodplain	*81.6%*	0.8%	90.1%	
% developed floodplain	**18.4%**	1.6%	9.9%	≥80.1% undev
% Class A + Class B wildlife habitat	**8.2%**	3.0%	10.1%	≥7.6%
% interior habitat	2.7%	1.8%	5.7%	≥4.6%
Habitats of Concern	4.8%	2.0%	9.1%	≥8.6%

The Kellogg Creek sub-watershed comprises about 4 percent of the region, falling entirely within the Metro boundary.

The sub-watershed contains relatively low proportions of high value riparian and upland habitat compared to the region. This indicates, in part, that there are fewer surface streams and wetlands here relative to the region as a whole. Within 50 feet of streams the area is about 5 percent less vegetated than regionally, but is close to average in forest canopy, reflecting in part the important restoration activities of several groups in the drainage.

Within 50-150 feet of streams and wetlands the sub-watershed falls substantially below (11 percent) average for vegetation and about 9 percent below average for forest canopy. The Kellogg Creek sub-watershed contributes a small amount of the region's floodplain (2.4 percent). Nearly 20 percent of the floodplain is developed.

The Kellogg Creek sub-watershed contributes less than 2 percent of the region's interior habitat, about half the region's average for this criterion. It contributes 3 percent of the region's total Class A and B upland wildlife habitat.

Table 26

Sub-watershed 9: Lower Johnson Creek

Summary statistics for the Lower Johnson Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Lower Johnson Creek *Johnson Creek watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	15,859 acres	5.4%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**72.4%**	2.5%	63.3%	
% forested acres within 50' of streams and wetlands	**51.9%**	2.9%	38.7%	≥73.3% total
% vegetated acres within 50-150' of streams and wetlands	56.4%	2.6%	55.1%	
% forested acres within 50-150' of streams and wetlands	**40.4%**	3.0%	33.9%	≥60.1% total
% Class I + Class II riparian habitat	*7.6%*	2.3%	17.8%	≥22.8%
% undeveloped floodplain	*51.4%*	1.5%	90.1%	
% developed floodplain	**48.6%**	13.3%	9.9%	≥80.1% undev
% Class A + Class B wildlife habitat	7.5%	4.0%	10.1%	≥7.6%
% interior habitat	3.4%	3.2%	5.7%	≥4.6%
Habitats of Concern	5.0%	3.0%	9.1%	≥8.6%

The Lower Johnson Creek sub-watershed contributes nearly 5.5 percent of the region's area. The entire drainage lies within the Metro region.

The sub-watershed contains substantially less percent cover high-value riparian and upland habitat compared to the region, but does contribute over 6 percent of such habitat to the region's total. The relatively high proportions of vegetation and forest within 150 feet of streams and wetlands reflects, in part, intense watershed restoration and protection efforts conducted by the Johnson Creek Watershed Council and other active groups.

Johnson Creek's urban flooding issues are well recognized. The watershed contributes 5 percent of the region's area, but more than 13 percent of the region's developed floodplain. It contributes about 2 percent of the region's undeveloped floodplain. Several floodplain restoration efforts are underway in the sub-watershed. For example, the Portland Bureau of Environmental Services has purchased over 160 acres of frequently flooded property through a willing seller program, to be restored for water storage and fish and wildlife habitat. Four completed projects (Brookside Wetland, Kelley Creek Confluence and Tideman Johnson Park and East Powell butte floodplain restoration projects) will add about 110 acre-feet (an acre at the depth of one foot) of flood storage. Over the next 5-15 years, the Bureau of Environmental Services will work to acquire and restore an additional 140 acres of frequently flooded property. This work is anticipated to reduce the extent and severity of damage in the most frequently flooded urban properties along Johnson Creek.

Johnson Creek contributes proportionately less interior habitat compared to the region, reflecting past and current development patterns and intensity. However, it does contribute 4 percent of the region's highest value upland wildlife habitat.

Table 27
Sub-watershed 10: Upper Johnson Creek

Summary statistics for the Upper Johnson Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Upper Johnson Creek *Johnson Creek watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	15,116 acres	5.1%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**85.7%**	6.6%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**57.2%**	7.2%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**74.3%**	7.4%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**43.1%**	7.0%	33.9%	
% Class I + Class II riparian habitat	15.3%	4.4%	17.8%	≥22.8%
% undeveloped floodplain	**96.6%**	1.2%	90.1%	≥80.1% undev
% developed floodplain	*3.4%*	0.4%	9.9%	
% Class A + Class B wildlife habitat	**22.3%**	11.3%	10.1%	≥7.6%
% interior habitat	**10.8%**	9.6%	5.7%	≥4.6%
Habitats of Concern	*4.1%*	2.3%	9.1%	≥8.6%

This large sub-watershed comprises about 5 percent of the region's area, all of it within the Metro boundary.

Upper Johnson Creek contains 15 percent Class I and Class II riparian, compared to 18 percent region-wide average. It contributes 4.4 percent of the region's high-value riparian habitat, slightly less than the drainage's proportional area in the region. Upper Johnson Creek contains relatively little floodplain, but what is there is only 3 percent developed.

The area's streams and wetlands tend to be well vegetated and well forested, providing important water quality protection and key fish and wildlife habitat. The sub-watershed's area within 50 feet of streams and wetlands contains more vegetation and more forest cover than average, reflecting development patterns and restoration/protection efforts. The same pattern holds true for the area within 50-150 feet of streams and wetlands, where 74 percent of the area is vegetated compared to 55 percent regionally, and 43 percent is forested compared to 34 percent regionally.

High-value upland habitat makes this watershed stand out from others, with more than 22 percent Class A and B upland habitat compared to the region's 10 percent average. Despite only containing 5 percent of the area, it holds more than 11 percent of the region's high-value upland habitat. In addition, this sub-watershed contributes 10 percent of the region's interior habitat (twice its proportional area) compared to 6 percent average in all of the region's sub-watersheds. In keeping with this watershed's unusually high levels of key upland habitat, the proportion of interior habitat is nearly twice the average of the region and comprises nearly 10 percent of the region's total interior habitat acres. Such habitat areas are vital to the region's most sensitive wildlife species.

Table 28
Sub-watershed 11: Willamette River/Oswego Creek

Summary statistics for the Willamette River/Oswego Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Willamette River/Oswego Creek *Johnson Creek watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	16,389 acres	5.5%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	66.8%	4.9%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**61.3%**	7.4%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	56.1%	5.8%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**50.1%**	8.4%	33.9%	
% Class I + Class II riparian habitat	17.1%	5.3%	17.8%	≥22.8%
% undeveloped floodplain	83.7%	4.8%	90.1%	≥80.1% undev
% developed floodplain	**16.3%**	8.5%	9.9%	
% Class A + Class B wildlife habitat	13.5%	7.4%	10.1%	≥7.6%
% interior habitat	5.9%	5.7%	5.7%	≥4.6%
Habitats of Concern	6.0%	3.6%	9.1%	≥8.6%

The Willamette River/Oswego Creek sub-watershed, comprising about 6 percent of the region's area, includes Tryon Creek and Oswego Lake.

Lying wholly within the Metro region, the sub-watershed is average for proportion of high-value Class I and II riparian habitat. The drainage's streams and wetlands are well vegetated within 50 feet of streams, consisting of 67 percent vegetated corridors, 5 percent higher than the regional average. Most of that vegetation (61 percent) is forest and the watershed contributes more than 7 percent of the region's near-stream forest cover compared to 5.5 percent of the region's area.

The sub-watershed's proportion of vegetation within 50-150 feet of streams and wetlands is similar to the rest of the region for vegetation cover, but nearly half of that is forest – well above the region's average forest cover, contributing 8.4 to the region's total forested area.

This sub-watershed contains 1,800 acres of floodplain. More than 16 percent of that area is developed compared to a regional average of 10 percent, contributing about 9 percent of the region's developed floodplains.

The Willamette River/Oswego Creek sub-watershed falls slightly above average for high-value Class A and B upland habitat. Fourteen percent of the watershed's area within the Metro boundary is Class A and B habitat, compared to 10 percent regionally. It contributes about 7.5 percent of the region's high-value upland habitat compared to only 5.5 percent of the total area. The sub-watershed also contributes slightly more interior habitat to the region compared to its size.

Table 29
Sub-watershed 12: Gilbert River

Summary statistics for the Gilbert River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Gilbert River *Scappoose Creek watershed* *Lower Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	700 acres	0.2%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**73.0%**	0.5%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**72.3%**	0.8%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**84.9%**	0.5%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**84.3%**	0.9%	33.9%	
% Class I + Class II riparian habitat	**33.9%**	0.4%	17.8%	≥22.8%
% undeveloped floodplain	**100.0%**	0.1%	90.1%	≥80.1% undev.
% developed floodplain	*0.0%*	0.0%	9.9%	
% Class A + Class B wildlife habitat	**62.6%**	1.5%	10.1%	≥7.6%
% interior habitat	**58.0%**	2.4%	5.7%	≥4.6%
Habitats of Concern	**75.9%**	2.0%	9.1%	≥8.6%

Only a small portion of the Gilbert River sub-watershed falls within the Metro region, comprising just 0.2 percent of the region's area.

However, the 700 acres within the Metro region are rich with high value riparian and upland habitat, particularly the latter, as reflected in the high percent of Habitats of Concern acres.

The portion of the Gilbert River sub-watershed in the Metro region is more vegetated, and much more forested, within 50 feet of streams and wetlands than the region's average. With only 0.2 percent of the region's area, it contributes nearly a percent of the region's near-stream forest cover. The area within 50-150 feet of streams and wetlands falls far above average for vegetation and forest. The sub-watershed area contains a modest floodplain area, none of which is developed.

Sixty-three percent of the drainage's area within the Metro boundary is Class A and B habitat, compared to 10 percent regionally. In fact, it comprises 1.5 percent of the region's high-value upland habitat, an important contribution from such a relatively small area. A correspondingly high proportion of the area contains interior habitat (58 percent compared to 6 percent regional average) and contributes 2.4 percent towards the region's total.

MIDDLE WILLAMETTE SUB-BASIN

Table 30
Watersheds and sub-watersheds within the Middle Willamette sub-basin

Sub-Basin	Watershed	Sub-Watershed	Acres in Metro	Sub-Total
Middle Willamette (36,403 acres in Metro)	Abernethy Creek	Abernethy Creek	3,212	36,403
		Beaver Creek	13,997	
		Clackamas River – Rock Creek	13,227	
		Corral Creek	128	
		Tanner Creek	5,839	

About the Middle Willamette Sub-basin

The Middle Willamette sub-basin's 698 square miles are divided among four watersheds of which only one, Abernethy Creek, falls within the Metro region.[56] Abernethy Creek and its sub-watersheds comprise 12.3 percent of the Metro area. The Abernethy Creek watershed includes five sub-watersheds that are partially or wholly located within Metro's boundary. Major land uses in Abernethy Creek watershed include urban, rural, agriculture and forestry.

Water quality issues. The Middle Willamette sub-basin TMDLs are in place as part of the Willamette Basin TMDL rule (Appendix 4). Known water quality issues in and near the Metro area include bacteria, temperature and mercury.

Sub-basin description. The Middle Willamette sub-basin includes the Willamette River from Willamette Falls at River Mile 26.6 to River Mile 108 near the Santiam River. The sub-basin is located in the northwest portion of the Willamette Basin and drains parts of the Cascade foothills from the east and the Coast Range from the west.

Habitats of Concern. The Middle Willamette sub-basin's five sub-watersheds contain 4,499 acres of known Habitats of Concern, comprising 16.7 percent of the region's total known Habitats of Concern acres. See Appendix 9 for details.

Selected watershed assessments and technical resources:

Beatty, C.D. and Streeter, K.L. 1999. Assessment of Habitat Conditions and Invertebrate Assemblages in the Streams of the Lower Tualatin River Basin, September 1999. Water Environment Services of Clackamas County, Clackamas, OR.

Carpenter K.D. 2004. Pesticides in the Lower Clackamas River Basin, Oregon 2000-01, Water-Resources Investigations Report 03-4145. U.S.D.I. and U.S.G.S., Portland, OR.

Cole, M.B. 2003. Assessment of Macroinvertebrate Communities in Streams of North Clackamas County, Oregon, 2002. ABR Inc., Forest Grove, OR.

Friesen, T.A. and Zimmerman, M.P. 1999. Distribution of Fish and Crayfish and Measurement of Available Habitat in Streams of the North Clackamas County – Final Report 1997-1999. Oregon Department of Fish and Wildlife, Clackamas, OR.

[56] Further information available online at www.deq.state.or.us/wq/tmdls/willamette.htm.

Network of Oregon Watershed Councils. 2006. Willamette Watershed Council's accomplishments atlas. Network of Oregon Watershed Councils, Eugene, OR, www.oregonwatersheds.org.

Oregon Department of Environmental Quality. 2006. Willamette Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon Department of Fish and Wildlife (ODFW) and Water Environment Services of Clackamas County. 1998. Distribution of fish and crayfish and measurement of available habitat in streams of the North Clackamas urban area – 1997-98 Annual Report. ODFW and Clackamas County, Clackamas, OR.

Oregon State University Institute for Water and Watersheds, Corvallis, OR, 97331-2208, 541-737-9918, www.water.oregonstate.edu

Oregon State University Institute for Water and Watersheds. The IWW is the state water resources research institute for Oregon and contains a library of watershed publications. Oregon State University, Corvallis, OR, www.water.oregonstate.edu.

Oregon State University. No date. Willamette Basin Explorer web site. Oregon State University, Corvallis, OR, www.willametteexplorer.info.

Portland State University (PSU), Executive Leadership Institute, Watershed Management Professional Program, 503-725-8261, www.eli.pdx.edu/nre/wmpp/resource.htm

State of Oregon, Oregon Watershed Enhancement Board (OWEB), 2006. The Oregon Plan for Salmon and Watersheds – Biennial Report, 2005-2007, OWEB, Salem, OR, 503-986-0178, www.oregon-plan.org/OPSW

Swanson, Andrew J., Water Environment Services of Clackamas County. 2004. The Surface Water Management Agency of Clackamas County's Surface Water Monitoring Report for July 2003 to June 2004, Clackamas County, Clackamas, OR, 503-353-4567.

Swanson, Andrew, J., Water Environment Services of Clackamas County, 2004, 2003-2004 Water Quality and Flow Monitoring Report for Municipal Separate Storm Sewer System Permit #101348, Clackamas County, Clackamas, OR, 503-353-4567.

Swanson, Andrew, J., Water Environment Services of Clackamas County, 2001, Surface Water and Storm Water Monitoring Plan for CCSD#1 and SWMACC, Water Environment Services of Clackamas County, Clackamas, OR, 503-353-4567.

Swanson, Andrew, J., Water Environment Services of Clackamas County, 2003, Surface Water and Storm Water Monitoring Plan for SWMACC, Clackamas, OR, 97015, 503-353-4567.

Tanner, Dwight Q. and Lee, Karl K., 2004, U.S. Geological Survey (USGS), U.S. Department of the Interior, City of Portland, City of Gresham, City of Milwaukie, Clackamas County and Multnomah County, Organochlorine Pesticides in the Johnson Creek Basin, Oregon, 1988-2002, Scientific Investigations Report 2004-5061.

U.S. Environmental Protection Agency. 2007. Middle Willamette watershed profile. U.S. Environmental Protection Agency, Seattle, WA, 98101, 800-424-4EPA or 206-553-1200.

U.S. Geological Survey. 2007. National Water Information System: Web interface, real-time water data. U.S. Geological Survey, Portland, OR, www.waterdata.usgs.gov/us/nwis.

Water Environment Services of Clackamas County. 2007. Watershed Stewardship Assistance Program: Grant Information and Application. Water Environment Services, Clackamas, OR, www.co.clackamas.or.us/wes.

Watershed councils and related groups:

Clackamas County SWCD, 256 Warner Milne Road, Room 2, Oregon City, OR 97045, 503-656-3499, Fax: 503-650-2367, E-mail rick.gruen@or.nacdnet.net, web site www.cc-swcd.org

Middle Fork Willamette Council, Eve Montanaro, PO Box 27 Lowell OR 97452, (541) 937-9800, (541) 937-9811 (fax), mfwwc@efn.org

Clackamas River Basin Council, Cheryl McGinnis, PO Box 1869 Clackamas OR 97015-1869, 503-558-0550, 503-558-0992 (fax), info@clackamasriver.org

Willamette Riverkeepers, 1515 SE Water Ave #102, Portland, Oregon 97214

Table 31
Sub-watershed 13: Abernethy Creek

Summary statistics for the Abernethy Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Abernethy Creek *Abernethy Creek watershed* *Middle Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	3,212 acres	1.1%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**86.3%**	1.2%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**73.8%**	1.6%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**77.0%**	1.3%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**68.0%**	1.8%	33.9%	
% Class I + Class II riparian habitat	17.3%	1.1%	17.8%	≥22.8%
% undeveloped floodplain	*59.2%*	0.2%	90.1%	≥80.1% undev
% developed floodplain	**40.8%**	1.4%	9.9%	
% Class A + Class B wildlife habitat	**21.9%**	2.3%	10.1%	≥7.6%
% interior habitat	**10.0%**	1.9%	5.7%	≥4.6%
Habitats of Concern	0.0%	0.0%	9.1%	≥8.6%

The Abernethy Creek sub-watershed falls primarily within the Metro region, contributing about 1 percent of the region's total acres.

Abernethy Creek contains a proportionate amount of high-value riparian and about twice the regional average of Class A and B upland habitat. Most of the area within 50 feet of streams and wetlands is vegetated, much of it (74 percent) in forest. The forest provides key water quality and habitat attributes by providing shade, food and cover in the riparian areas; riparian habitat provides for more species than any other habitat type in the region. The area within 50-150 feet of streams and wetlands is similarly well vegetated, also consisting primarily of forest. The watershed's floodplains are much more developed than usual, contributing only 0.2 percent to the region's undeveloped floodplain but nearly 2 percent of the region's total developed floodplain, compared to only 1.1 percent of the region's total area.

Abernethy Creek contains important upland habitat covering 10 percent of the sub-watershed, contributing 2 percent to the region's total compared to 1 percent of the region's area. This habitat is critical to sensitive wildlife species, due in part to the relatively high proportion of interior habitat within these patches (10 percent compared to 5.7 percent region-wide).

Table 32
Sub-watershed 14: Beaver Creek

Summary statistics for the Beaver Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Beaver Creek *Abernethy Creek watershed* *Middle Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	13,997 acres	4.7%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**75.0%**	4.9%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**48.8%**	5.2%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**73.6%**	6.0%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**43.2%**	5.7%	33.9%	
% Class I + Class II riparian habitat	**26.2%**	7.0%	17.8%	≥22.8%
% undeveloped floodplain	**97.0%**	7.9%	90.1%	≥80.1% undev
% developed floodplain	*3.0%*	2.2%	9.9%	
% Class A + Class B wildlife habitat	9.6%	4.5%	10.1%	≥7.6%
% interior habitat	4.1%	3.4%	5.7%	≥4.6%
Habitats of Concern	**19.0%**	9.9%	9.1%	≥8.6%

The Beaver Creek watershed includes about 5 percent of the region's area, all lying within the Metro boundary.

Beaver Creek contains large amounts of high-value riparian and upland habitat covering more than a quarter of the watershed and contributing 7 percent of the region's Class I and II habitat, compared to less than 5 percent contribution to the region's total area. The importance of this sub-watershed's habitat value is reflected in the high percent of Habitats of Concern acres. The area within 50 of streams and wetlands is very well vegetated and forested compared to the region, with 75 percent overall vegetation and nearly 50 percent forest. The area within 50-150 feet of streams and wetlands also falls well above average, with 74 percent overall vegetation including 43 percent forest cover. Beaver Creek watershed contributes 8 percent of the region's undeveloped floodplain (compared to 4.7 percent of the region's total area) and only 3 percent developed floodplain.

Class A and B upland habitat is about on par with the rest of the region but interior habitat lies below average, suggesting more fragmented habitats than some other watersheds.

Table 33
Sub-watershed 15: Clackamas River/Rock Creek

Summary statistics for the Clackamas River/Rock Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Clackamas River/Rock Creek *Abernethy Creek watershed* *Middle Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	13,227 acres	4.5%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**80.8%**	4.7%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**44.2%**	4.2%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**74.2%**	5.4%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	36.2%	4.3%	33.9%	
% Class I + Class II riparian habitat	16.4%	4.1%	17.8%	≥22.8%
% undeveloped floodplain	86.1%	2.3%	90.1%	≥80.1% undev
% developed floodplain	13.9%	3.4%	9.9%	
% Class A + Class B wildlife habitat	**16.9%**	7.5%	10.1%	≥7.6%
% interior habitat	5.2%	4.1%	5.7%	≥4.6%
Habitats of Concern	8.2%	4.0%	9.1%	≥8.6%

The Clackamas River/Rock Creek watershed includes a mixture of urban and rural uses and comprises about 5 percent of the region's area. All but about 500 acres of this drainage lies within the Metro boundary.

The proportion of high-value riparian habitat, at 16.4 percent Class I and II, is close to the regional average. The area within 50 feet of streams and wetlands is well vegetated and well forested (81 percent and 44 percent respectively, compared to 63 percent and 39 percent regionally). The area within 50-150 feet of streams and wetlands is also very well vegetated. The forest cover in this area is slightly above the region's average. The sub-watershed includes less floodplain than many other watersheds and floodplains here are more developed than average, with about 14 percent compared to 9.9 percent developed floodplain regionally.

The Clackamas River/Rock Creek sub-watershed contains strong upland habitat resources. The sub-watershed includes 17 percent Class A and B upland habitat, more than 1.5 times the regional average, and contains about 8 percent of the region's total. Interior habitat within these habitat patches is close to the regional average.

Table 34
Sub-watershed 16: Corral Creek

Summary statistics for the Corral Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Corral Creek *Abernethy Creek watershed* *Middle Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	128 acres	0.0%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	60.6%	0.0%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**60.6%**	0.1%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	51.5%	0.1%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**51.3%**	0.1%	33.9%	
% Class I + Class II riparian habitat	*8.6%*	0.0%	17.8%	≥22.8%
% undeveloped floodplain	94.9%	0.0%	90.1%	≥80.1% undev
% developed floodplain	*5.1%*	0.0%	9.9%	
% Class A + Class B wildlife habitat	**19.5%**	0.1%	10.1%	≥7.6%
% interior habitat	3.9%	0.0%	5.7%	≥4.6%
Habitats of Concern	0.0%	0.0%	9.1%	≥8.6%

Only a small portion (128 acres) of the Corral Creek watershed falls within the Metro region, comprising well under 1 percent of the region's area.

The area within Metro is not a sufficient sample of the watershed to provide relevant watershed-based information, but numbers are provided in Table 34 for future comparison.

Table 35
Sub-watershed 17: Tanner Creek

Summary statistics for the Tanner Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Tanner Creek *Abernethy Creek watershed* *Middle Willamette sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	5,839 acres	2.0%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	*55.2%*	1.2%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	35.1%	1.3%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	53.9%	1.6%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	34.4%	1.6%	33.9%	
% Class I + Class II riparian habitat	16.7%	1.8%	17.8%	≥22.8%
% undeveloped floodplain	*84.3%*	2.7%	90.1%	≥80.1% undev
% developed floodplain	**15.7%**	4.6%	9.9%	
% Class A + Class B wildlife habitat	**16.4%**	3.2%	10.1%	≥7.6%
% interior habitat	7.0%	2.4%	5.7%	≥4.6%
Habitats of Concern	13.0%	2.8%	9.1%	≥8.6%

The Tanner Creek sub-watershed makes up about 2 percent of the area and lies entirely within the Metro region.

Tanner Creek's high-value Class I and II riparian resource cover is about average, although the vegetation and forest within 50 feet of streams and wetlands falls below average for the region. The area within 50-150 feet of streams and wetlands falls close to regional average for both percent forest and vegetation. Tanner Creek contains a substantial amount of floodplain, including 3 percent of the regional undeveloped floodplain acres. The floodplains are fairly developed and contribute about 5 percent of the region's developed floodplain, compared to 2 percent of the Metro region's total acres.

This sub-watershed contains a substantial amount of high-value Class A and B upland habitat and a correspondingly high percent cover of interior habitat, with more than 16 percent of the former and 17 percent interior habitat. Tanner Creek contributes more than 3 percent of the region's total interior habitat.

MOLALLA – PUDDING SUB-BASIN

Table 36
Watershed and sub-watershed within the Molalla – Pudding sub-basin

Sub-Basin	Watershed	Sub-Watershed	Acres In Metro
Molalla – Pudding	Lower Molalla River	Molalla River – Willamette River	40

About the Molalla – Pudding sub-basin

The portion of the Molalla – Pudding River sub-basin within Metro's boundary contains a small portion of only one sub-watershed, comprising just 0.01 percent of the region's area.

Water quality issues. DEQ has completed data collection in the sub-basin and is currently developing TMDLs for the Molalla – Pudding sub-basin. Portions of streams in the sub-basin do not meet state water quality standards for temperature, bacteria, nitrates and toxics.[57] Toxics include iron, manganese, arsenic and three legacy pesticides: dieldrin, chlordane and DDT (Appendix 4).

Sub-basin description. Within the entire Molalla – Pudding sub-basin, the Pudding River is 62 miles long and originates in the low elevation Waldo Hills located east of Salem.[58] The Molalla River is 49 miles long and originates on the west slope of the Cascade Range. The Pudding River flows in to the Molalla River 0.75 miles upstream from the point at which the Molalla River flows into the Willamette River.

This sub-basin includes some of the best agricultural soils in the country. At the south end of French Prairie, north of Salem and east of Keizer, is Lake Labish bottomlands, a one-time wetland left over from an old bed of the Willamette River. Lake Labish is about 10 miles long and one-half mile at its widest and includes 1,270 acres of peat created by decayed vegetation. The peat is four feet to eight feet deep.

This Molalla-Pudding-French Prairie-North Santiam Agricultural Water Quality Management Area Plan provides guidance for addressing agricultural water quality issues in the Molalla-Pudding-French Prairie-North Santiam Agricultural Water Quality Management Area. The purpose of this area plan is to identify strategies to reduce water pollution from agricultural lands through a combination of educational programs, suggested land treatments, management activities and monitoring.

Habitats of Concern. The Molalla-Pudding sub-basin does not contain any known Habitats of Concern.

Watershed assessments and plans:

Molalla-Pudding-French Prairie-North Santiam Subbasins Agricultural Water Quality Management Area Plan. Developed by The Molalla-Pudding-French Prairie-North Santiam Subbasins Local Advisory Committee with assistance from The Oregon Department of Agriculture and The Marion Soil and Water Conservation District, March 2004.

Oregon Department of Environmental Quality. 2006. Willamette Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon State University Institute for Water and Watersheds. The IWW is the state water resources

[57] Further information available online at www.deq.state.or.us/news/prDisplay.asp?docID=2147.

[58] Further information available online at www.deq.state.or.us/wq/TMDLs/willamette.htm#mp.

research institute for Oregon and contains a library of watershed publications. Oregon State University, Corvallis, OR, www.water.oregonstate.edu.

U.S. Environmental Protection Agency. 2007. Molalla-Pudding Watershed Profile. U.S. Environmental Protection Agency, Seattle, Washington, www.epa.gov.

U.S. Geological Survey. 2007. National Water Information System: Web Interface, Real-Time Water Data. U.S. Geological Survey, Oregon Water Science Center, Portland, OR, www.waterdata.usgs.gov/us/nwis.

Watershed councils and related groups:

Pudding River Watershed Council, Jamison Cavallaro, PO Box 242 Aurora OR 97002-0242, 503-422-2844, cavallaro@cascadiaplanners.com

Table 37

Sub-watershed 18: Molalla River/Willamette River

Summary statistics for the Molalla River/Willamette River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Molalla River/ Willamette River *Lower Molalla River watershed* *Molalla - Pudding sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	40 acres	0.0%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	0.0%	0.0%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	0.0%	0.0%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	0.0%	0.0%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	0.0%	0.0%	33.9%	
% Class I + Class II riparian habitat	2.5%	0.0%	17.8%	≥22.8%
% undeveloped floodplain	0.0%	0.0%	90.1%	≥80.1% undev
% developed floodplain	0.0%	0.0%	9.9%	
% Class A + Class B wildlife habitat	0.0%	0.0%	10.1%	≥7.6%
% interior habitat	0.0%	0.0%	5.7%	≥4.6%
Habitats of Concern	0.0%	0.0%	9.1%	≥8.6%

Only 40 acres of this watershed fall within the Metro region, too few acres to provide meaningful interpretation of the statistics in Table 37. However, a general description of the Molalla-Pudding sub-basin, including the Molalla River/Willamette River sub-watershed, is provided above for future comparisons.

TUALATIN SUB-BASIN

Table 38
Watersheds and sub-watersheds within the Tualatin sub-basin

Sub-Basin	Watershed	Sub-Watershed	Acres In Metro	Sub-Total
Tualatin (98,473 acres in Metro)	Dairy Creek	Lower Dairy Creek	3,383	6,801
		Lower McKay Creek	3,368	
		Lower West Fork Dairy Creek	50	
	Gales Creek	Lower Gales Creek	733	2,742
		Tualatin River	2,009	
	Lower Tualatin River	Beaverton Creek	24,212	64,499
		Fanno Creek	20,156	
		Rock Creek/Lower Tualatin River	5,435	
		Saum Creek/Lower Tualatin River	14,696	
	Rock Creek – Tualatin River	Beaver Creek/Willamette River	2,725	24,431
		Chicken Creek	1,906	
		Lower Rock Creek/Tualatin River	12,461	
		Upper Rock Creek/Tualatin River	7,339	

About the Tualatin Sub-basin

Data descriptions. Together the 13 sub-watersheds in the Tualatin sub-basin comprise one-third of the land within the Metro area. Land contribution to the Metro region include, by sub-watershed: Dairy Creek, 2.3 percent; Gales Creek, 0.9 percent; Lower Tualatin River, 21.8 percent; and Rock Creek – Tualatin River, 8.3 percent.

Water quality issues. The Tualatin sub-basin TMDLs are in place[59] (Appendix 4). Known water quality issues in and near the Metro area include temperature, bacteria, dissolved oxygen, chlorophyll a, toxics (arsenic, iron and manganese), biological criteria and low pH. TMDLs were established in 1988 for ammonia and phosphorus to address low dissolved oxygen, elevated pH and chlorophyll a in the mainstem. DEQ is proposing to revise the TMDLs for ammonia and phosphorus, which have been largely addressed and establish new TMDLs for temperature, bacteria and tributary dissolved oxygen.

The Tualatin River has experienced water quality problems over the years as human activity increased in the sub-basin. The sub-basin's wastewater treatment facilities were upgraded in the 1970s, resulting in improved water quality and quantity. Flow augmentation from Scoggins Dam (Hagg Lake) first occurred in June 1975.

Sub-basin description. The Tualatin River, a sub-basin of the Willamette River Basin, drains an area of 712 square miles.[60] The headwaters originate in the Coast Range and flow in a generally easterly direction to the confluence with the Willamette River. The sub-basin lies almost entirely within Washington County, but small portions are in Multnomah, Clackamas and Yamhill counties. Major land uses include agriculture, forestry and urban development.

[59] See TMDL rules at www.deq.state.or.us/wq/tmdls/willamette.htm#t.

[60] See TMDL rules at www.deq.state.or.us/wq/tmdls/willamette.htm#t.

The Tualatin River is approximately 83 miles in length and has a very flat gradient for most of its length. Summer flow is supplemented with releases of water from Scoggins Reservoir (Hagg Lake) on Scoggins Creek and from Barney Reservoir, located on the Trask River, which diverts water from an entirely different sub-basin into the upper Tualatin River. Flow is also diverted from the Tualatin River to Oswego Lake in the lower portion of the river near River Mile 6.7. The Tualatin mainstem enters the Willamette River at elevation of 49 feet above sea level just upstream of Oregon City (Willamette River Mile 28.5).

The Tualatin sub-basin supports a wide range of forest, agriculture and urban activities. The urban area is rapidly growing and in the Metro region includes the cities of Beaverton, Cornelius, Durham, Forest Grove, Hillsboro, King City, Lake Oswego, portions of Portland, North Plains, Sherwood, Tigard, Tualatin and West Linn.

The Tualatin River is home to Winter Steelhead, Coho Salmon and resident Cutthroat Trout. Winter Steelhead are currently listed as threatened by the National Marine Fisheries Service under the federal Endangered Species Act.

Habitats of Concern. The Tualatin sub-basin's 13 sub-watersheds contains 3,795 acres of known Habitats of Concern, comprising 14.2 percent of the region's total known Habitats of Concern acres. See Appendix 9 for details.

Dairy Creek. The Dairy Creek watershed is drained by the west and east forks of Dairy Creek and McKay Creek.[61] Water quality in the headwater streams is generally good although somewhat high in phosphorus, probably due to natural geology. However, water quality in the Tualatin Plain is impaired at various times of the year due to elevated temperatures and phosphorus and reduced dissolved oxygen.

The watershed's hydrology has been altered through wetland drainage, stream channelization, development and stream diversion for agriculture, with over 90 percent of water rights allocated for irrigation. Riparian corridors are generally narrow, particularly in West Fork Dairy Creek.

Dairy Creek and its tributaries provide habitat for several salmonid species including steelhead, cutthroat trout and coho. The east and west forks of Dairy Creek provide the primary cutthroat trout spawning and rearing habitat in the Tualatin Basin. The urbanized portions of this watershed contain relatively fewer trout than other areas, probably due to water quality, lack of pools and a reduction in stream habitat complexity. Lamprey, red-legged frogs and other sensitive amphibians use this sub-watershed. Northern Spotted Owls were formerly present but have not been seen since 1978 due to loss of old growth conifer habitat.

Gales Creek. Gales Creek drains about 80 miles in the western portion of the Tualatin basin.[62] The mainstem is 23.5 miles long and enters the Tualatin River about 1.5 miles south of Forest Grove. About two-thirds of the sub-watershed is privately owned for forestry, agricultural or urban uses, with 28 percent managed by Oregon Department of Forestry as the Tillamook State Forest.

Stream channels have been modified through draining wetlands for agriculture, logging and dredging for gravel, construction of culverts and bridges, removal of large woody debris and riparian vegetation, and water diversions and ditches. Water withdrawals for agriculture create low flow issues during the dry season.

[61] Bureau of Land Management. 1999. Dairy-McKay watershed analysis.

[62] Bruener, N. 1998. Gales Creek watershed assessment project. Prepared for the Tualatin River Watershed Council.

Natural conditions such as low gradient, low summer flows, and high summer temperatures in the lower mainstem exacerbate water quality issues. Heavy sedimentation, high temperatures, and low dissolved oxygen levels are primarily due to human activities such as removal of riparian vegetation and agricultural practices. High fecal coliform levels are also present, and can be dangerous to water contact recreation.

Lamprey, coho, steelhead and cutthroat trout are present in the system, but culverts and dams have created fish passage issues. Himalayan blackberries and other invasive species are common in riparian areas here, although these areas remain important for songbirds and other wildlife species.

Lower Tualatin River. This sub-watershed includes a portion of the mainstem Tualatin River as well as part of Beaverton, Fanno, Rock and Saum creeks.[63] Fanno Creek drains the Tualatin Mountains and the most urbanized portion of the watershed, although Rock Creek is also urbanized. The Lower Tualatin helps for the Tualatin Plain, an extensive landscape of floodplains and flat to rolling terrain. Stream gradients are low here and often slow-moving.

The water is too warm in this watershed due to reduced riparian canopy and slow velocity flows. Other water quality issues include bacteria associated with livestock, pets and septic tanks and low dissolved oxygen.

Water quality issues, lack of large wood and reduced stream channel complexity degrade cold-water fish habitat in this watershed. However, coho, cutthroat trout and steelhead are present, and winter steelhead spawn and rear in Fanno Creek. Invasive plant and animal species (e.g., bullfrog and nutria) reduce terrestrial habitat quality but many bird and wildlife species do make homes in the watershed.

Watershed assessments and plans:

Beatty, Christopher, D. and Streeter, Karen L. 1999. Assessment of Habitat Conditions and Invertebrate Assemblages in the Streams of the Lower Tualatin River Basin, September 1999. Water Environment Services of Clackamas County, Clackamas, OR.

Oregon Department of Environmental Quality. 2006. Willamette Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon Department of Environmental Quality. 2001. Tualatin Subbasin Total Maximum Daily Load (TMDL). Oregon DEQ, Portland, OR, www.deq.state.or.us.

Oregon State University Institute for Water and Watersheds. The IWW is the state water resources research institute for Oregon and contains a library of watershed publications. Oregon State University, Corvallis, OR, www/water.oregonstate.edu.

Tualatin River Watershed Council. 2001. Middle Tualatin – Rock Creek Watershed Analysis 2001. Tualatin River Watershed Council, Hillsboro, OR, www.trwc.org.

Tualatin River Watershed Council. 2007. Tualatin River Watershed Technical Supplement. Tualatin River Watershed Council, Hillsboro, OR, www.trwc.org.

Tualatin River Watershed Council. 2007. Tualatin River Watershed Council Projects. Tualatin River Watershed Council, Hillsboro, OR, www.trwc.org.

U.S. Environmental Protection Agency. 2007. Tualatin Watershed Profile. U.S. Environmental Protection Agency, Seattle, WA, www.epa.gov.

[63] Hawksworth, J.T. 2001. Lower Tualatin watershed analysis.

U.S. Geological Survey. 2007. National Water Information System: Web Interface, Real-Time Water Data. U.S. Geological Survey, Portland, OR, www.waterdata.usgs.gov/us/nwis.

Watershed councils and related groups:

Rock Creek Watershed Partners. PO Box 2152, Beaverton, Oregon, 97075, 503-629-6305, www.cedarmill.org/RCWP.

Tualatin River Watershed Council (TRWC), PO Box 338, Hillsboro, Oregon, 97123-0338, 503-846-4810, www.trwc.org

Tualatin Soil and Water Conservation District, 1080 SW Baseline, Suite B-2, Hillsboro, OR 97123

Clean Water Services, 2550 Southwest Hillsboro Highway, Hillsboro, Oregon 97123, 503-681-3600 , www.cleanwaterservices.org

Tualatin Riverkeepers, 12360 SW Main Street Suite 100, Tigard, OR 97223, 503-620-7507, www.tualatinriverkeepers.org/contact.html

Table 39
Sub-watershed 19: Lower Dairy Creek

Summary statistics for the Lower Dairy Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Lower Dairy Creek *Dairy Creek watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	3,383 acres	1.1%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**78.3%**	1.5%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*25.8%*	0.8%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**61.4%**	1.3%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*18.7%*	0.6%	33.9%	
% Class I + Class II riparian habitat	16.8%	1.1%	17.8%	≥22.8%
% undeveloped floodplain	**96.2%**	1.2%	90.1%	≥80.1% undev
% developed floodplain	*3.8%*	0.4%	9.9%	
% Class A + Class B wildlife habitat	*2.7%*	0.3%	10.1%	≥7.6%
% interior habitat	*0.3%*	0.1%	5.7%	≥4.6%
Habitats of Concern	4.3%	0.5%	9.1%	≥8.6%

Lower Dairy Creek comprises just over 1 percent of the region's area. A few hundred acres of the sub-watershed fall outside of the Metro boundary.

Lower Dairy Creek's percent cover of high value Class I and II riparian is close to the regional average, at about 17 percent vs. the region's 18 percent average. In the area within 50 feet of streams and wetlands, this sub-watershed contains 15 percent more vegetation than the regional average, although the tree cover within this area is well below the regional average, reflecting the drainage's strong agriculture component.

Vegetation and forest patterns within 50-150 feet of streams and wetlands is similar to the area within 50 feet, with overall vegetation well above regional average but tree cover substantially below the average.

The Lower Dairy Creek sub-watershed contains 400 acres of floodplain of which 96 percent is undeveloped, contributing 1.2 percent of the region's total undeveloped floodplain and only 0.4 percent of the region's developed floodplain.

Lower Dairy Creek contains relatively little high value upland habitat (2.7 percent) of which only 0.3 percent is interior habitat, contributing a small proportion of the region's upland and interior habitat.

Table 40
Sub-watershed 20: Lower McKay Creek

Summary statistics for the Lower McKay Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Lower McKay Creek *Dairy Creek watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	3,368 acres	1.1%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**79.9%**	1.8%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*33.4%*	1.2%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**62.0%**	1.0%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*19.3%*	0.5%	33.9%	
% Class I + Class II riparian habitat	13.1%	0.8%	17.8%	≥22.8%
% undeveloped floodplain	89.0%	0.8%	90.1%	≥80.1% undev
% developed floodplain	11.0%	0.9%	9.9%	
% Class A + Class B wildlife habitat	*1.3%*	0.1%	10.1%	≥7.6%
% interior habitat	*0.2%*	0.0%	5.7%	≥4.6%
Habitats of Concern	*2.3%*	0.3%	9.1%	≥8.6%

The Lower McKay Creek sub-watershed contains just over 1 percent of the region's area. About 500 acres of the drainage lie outside the Metro boundary.

Lower McKay Creek contains proportionately less high-value riparian and upland habitat compared to many other watersheds in the region. However, the area within 50 feet of streams and wetlands contains a substantially higher percentage of vegetation than the regional average (80 percent vs. 63 percent, respectively). The amount of forest within this area is about 5 percent lower than the regional average. This pattern reflects the strong agricultural component within the drainage.

Similar patterns are seen within the 150-foot buffer, where 62 percent is vegetated compared to the region's 55 percent average, but only 19 percent of that area is forested compared to the regional average of 40 percent.

The area contains relatively little floodplain and the undeveloped vs. developed portions hold close to the regional average of 90 percent and 10 percent, respectively.

In keeping with a low amount (1.3 percent) of high value Class A and B upland habitat, this sub-watershed contains very little interior habitat.

Table 41

Sub-watershed 21: Lower West Fork Dairy Creek

Summary statistics for the Lower West Fork Dairy Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Lower West Fork Dairy Creek *Dairy Creek watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	50 acres	0.0%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	*57.9%*	0.0%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*0.0%*	0.0%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	55.6%	0.0%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*0.0%*	0.0%	33.9%	
% Class I + Class II riparian habitat	*12.0%*	0.0%	17.8%	≥22.8%
% undeveloped floodplain	*0.0%*	0.0%	90.1%	≥80.1% undev
% developed floodplain	*0.0%*	0.0%	9.9%	
% Class A + Class B wildlife habitat	*2.0%*	0.0%	10.1%	≥7.6%
% interior habitat	2.0%	0.0%	5.7%	≥4.6%
Habitats of Concern	0.0%	0.0%	9.1%	≥8.6%

Only 50 acres of this watershed fall within the Metro region, too few acres to provide meaningful interpretation of the statistics in Table 41.

Table 42
Sub-watershed 22: Lower Gales Creek

Summary statistics for the Lower Gales Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Lower Gales Creek *Gales Creek watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	733 acres	0.2%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**72.2%**	0.4%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**44.0%**	0.4%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**63.8%**	0.4%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*23.1%*	0.2%	33.9%	
% Class I + Class II riparian habitat	**32.1%**	0.4%	17.8%	≥22.8%
% undeveloped floodplain	**97.1%**	0.6%	90.1%	≥80.1% undev
% developed floodplain	**2.9%**	0.2%	9.9%	
% Class A + Class B wildlife habitat	*2.5%*	0.1%	10.1%	≥7.6%
% interior habitat	*0.0%*	0.0%	5.7%	≥4.6%
Habitats of Concern	5.0%	0.1%	9.1%	≥8.6%

The Lower Gales Creek sub-watershed lies primarily outside of the Metro region, with only 733 acres within the boundary. However, those acres are rich with Class I and II riparian habitat, with an average percent cover (32 percent) nearly double that of the regional average.

The area within 50 feet of streams and wetlands is more vegetated and more forested than the regional average. The area within 50-150 feet of streams and wetlands is also more vegetated than average, but forest cover is nearly 10 percent lower than the regional average. The portion of Lower Gales Creek within the Metro region contains over 200 acres of floodplain, primarily undeveloped and contributes nearly a percent to the region's total undeveloped floodplain acres.

The watershed contains little high value upland habitat and no interior habitat.

Table 43
Sub-watershed 23: Tualatin River

Summary statistics for the Tualatin River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Tualatin River *Gales Creek watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	2,009 acres	0.7%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	*23.0%*	0.2%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*4.5%*	0.1%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*21.7%*	0.2%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*3.6%*	0.1%	33.9%	
% Class I + Class II riparian habitat	*9.8%*	0.4%	17.8%	≥22.8%
% undeveloped floodplain	**95.5%**	0.5%	90.1%	≥80.1% undev.
% developed floodplain	*4.5%*	0.2%	9.9%	
% Class A + Class B wildlife habitat	*0.1%*	0.0%	10.1%	≥7.6%
% interior habitat	*1.9%*	0.2%	5.7%	≥4.6%
Habitats of Concern	6.0%	0.5%	9.1%	≥8.6%

The Tualatin River sub-watershed lies primarily outside the Metro region but nonetheless contributes more than 2,000 acres, or nearly 1 percent, to the region's total area.

The Tualatin River sub-watershed contains proportionally about half the amount of high value Class I and II riparian habitat compared to the regional average (10 percent vs. 18 percent, respectively). Within this portion of the watershed the area within 150 feet of streams and wetlands is poorly vegetated with little forest. The watershed area includes 175 acres of floodplain, including 167 undeveloped (better than the regional average) and 8 developed acres.

Only a tenth of a percent of the Tualatin River sub-watershed within the Metro region is comprised of Class A and B upland habitat, although it contains proportionally more interior habitat. This trend generally indicates a series of moderate-sized upland habitat areas that tend to be rounded rather than linear.

Table 44
Sub-watershed 24: Beaverton Creek

Summary statistics for the Beaverton Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Beaverton Creek *Lower Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	24,212 acres	8.2%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**73.7%**	10.0%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	41.3%	9.2%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	52.0%	8.6%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	32.0%	8.6%	33.9%	
% Class I + Class II riparian habitat	*12.0%*	5.5%	17.8%	≥22.8%
% undeveloped floodplain	*71.8%*	2.6%	90.1%	≥80.1% undev
% developed floodplain	**28.2%**	9.1%	9.9%	
% Class A + Class B wildlife habitat	8.0%	6.5%	10.1%	≥7.6%
% interior habitat	2.4%	3.5%	5.7%	≥4.6%
Habitats of Concern	*2.3%*	2.1%	9.1%	≥8.6%

The Beaverton Creek sub-watershed contributes more than 8 percent of the region's total area and lies entirely within the Metro boundary.

The sub-watershed contains 12 percent Class I and II riparian habitat, vs. a regional average of 18 percent. However, the area within 50 feet of streams and wetlands is 74 percent vegetated with 41 percent forest cover, compared to 63 percent and 39 percent region-wide, respectively, providing strong water quality protection and important fish and wildlife habitat. With just over 8 percent of the region's total area, Beaverton Creek contributes 12 percent of the region's most important riparian habitat. The area within 50-150 feet of streams and wetlands is slightly less vegetated and forested than the region's average, reflecting in part the urban nature of this drainage.

The sub-watershed's floodplains are more developed than many other of the region's sub-watersheds. Beaverton Creek includes 1,116 acres of floodplain, 72 percent undeveloped. This is nearly 20 percent lower than the region's average undeveloped floodplains and the developed floodplain acres contribute a very substantial 9 percent to the region's total developed floodplain area.

Beaverton Creek includes about 8 percent high value Class A and B upland habitat, slightly lower than the regional average. However, due to this watershed's large area within the Metro region it contributes nearly 7 percent of the region's total high value upland habitat. Similarly, the percent cover of interior habitat is relatively low but the watershed does contribute nearly 4 percent of the region's total interior habitat, providing key habitat and connectivity for many species.

Table 45
Sub-watershed 25: Fanno Creek

Summary statistics for the Fanno Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Fanno Creek *Lower Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	20,156 acres	6.8%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**70.3%**	8.3%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	42.9%	8.4%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*45.5%*	6.3%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	29.4%	6.6%	33.9%	
% Class I + Class II riparian habitat	*11.6%*	4.4%	17.8%	≥22.8%
% undeveloped floodplain	*80.4%*	2.3%	90.1%	≥80.1% undev
% developed floodplain	**19.6%**	5.1%	9.9%	
% Class A + Class B wildlife habitat	7.5%	5.0%	10.1%	≥7.6%
% interior habitat	1.0%	1.2%	5.7%	≥4.6%
Habitats of Concern	*2.4%*	1.8%	9.1%	≥8.6%

The Fanno Creek sub-watershed contributes about 7 percent of the region's area, most lying within the Metro boundary.

Fanno Creek contains a relatively low amount of Class I and II riparian habitat, 12 percent compared to the regional average of 18 percent. However, the area within 50 feet of streams and wetlands tends to be well vegetated, with 70 percent vegetation and 43 percent forest cover compared to regional averages of 63 percent and 39 percent, respectively. The proportion of vegetation and tree cover within 50-150 feet of streams and wetlands is somewhat lower than that within 50 feet, although tree cover comes close to the regional average.

Fanno Creek includes 894 acres of floodplain, with 80 percent undeveloped and 20 percent developed floodplain. Thus this watershed's floodplains are about twice as developed than the regional average.

The Fanno Creek sub-watershed includes about 8 percent of high value upland habitat compared to the regional average of 10 percent and contributes 5 percent of the region's total Class A and B habitat. Only 1 percent of that is interior habitat, suggesting a high degree of habitat fragmentation corresponding to the level of development and development patterns within the sub-watershed.

Table 46
Sub-watershed 26: Rock Creek/Lower Tualatin River

Summary statistics for the Rock Creek/Lower Tualatin River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Rock Creek/Lower Tualatin River *Lower Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	5,435 acres	1.8%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	59.1%	2.1%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*30.1%*	1.7%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*48.2%*	1.9%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*25.2%*	1.6%	33.9%	
% Class I + Class II riparian habitat	17.1%	1.8%	17.8%	≥22.8%
% undeveloped floodplain	91.9%	1.8%	90.1%	≥80.1% undev
% developed floodplain	8.1%	1.5%	9.9%	
% Class A + Class B wildlife habitat	10.8%	2.0%	10.1%	≥7.6%
% interior habitat	2.1%	0.7%	5.7%	≥4.6%
Habitats of Concern	9.5%	1.9%	9.1%	≥8.6%

The Rock Creek/Lower Tualatin River sub-watershed contributes 2 percent of the region's total area. About 500 acres of the drainage lie outside of the Metro boundary.

The percent cover Class I and II riparian habitat is 17 percent, quite close to the region's average. Within 50 feet of streams and wetlands the area is somewhat less vegetated (59 percent vs. 63 percent) and less forested (30 percent vs. 39 percent) than the regional average. Similarly, the area within 50-150 feet of streams and wetlands is less vegetated and forested than the region's average (48 percent vs. 55 percent vegetation and 25 percent vs. 34 percent tree cover).

The portion of Rock Creek/Lower Tualatin River that falls within the Metro region includes 621 acres of floodplain; 92 percent of that is undeveloped and 8 percent is developed.

The Rock Creek/Lower Tualatin River sub-watershed contains 11 percent high value Class A and B upland habitat, slightly higher than the regional average. About 2 percent of the drainage area is interior habitat, contributing less than a percent of the region's total interior habitat and suggesting a higher degree of habitat fragmentation than typical sub-watersheds of the region.

Table 47

Sub-watershed 27: Saum Creek/Lower Tualatin River

Summary statistics for the Saum Creek/Lower Tualatin River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Saum Creek/Lower Tualatin River *Lower Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	14,696 acres	5.0%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**81.2%**	6.1%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**47.7%**	5.9%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**72.5%**	6.6%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	**43.2%**	6.4%	33.9%	
% Class I + Class II riparian habitat	16.0%	4.5%	17.8%	≥22.8%
% undeveloped floodplain	**80.1%**	2.8%	90.1%	≥80.1% undev
% developed floodplain	**19.9%**	6.3%	9.9%	
% Class A + Class B wildlife habitat	**16.9%**	8.3%	10.1%	≥7.6%
% interior habitat	5.7%	4.9%	5.7%	≥4.6%
Habitats of Concern	6.3%	3.5%	9.1%	≥8.6%

Saum Creek/Lower Tualatin River sub-watershed comprises 5 percent of the region's total area. The entire sub-watershed lies within the Metro boundary.

Saum Creek/Lower Tualatin River contains important riparian resources. Class I and II riparian habitat covers 16 percent of the sub-watershed area; the regional average is 18 percent.

The area within 50 feet of streams and wetlands is more vegetated (81 percent vs. 63 percent) and more forested (48 percent vs. 39 percent) than the regional average. The pattern is similar within 50-150 feet of streams and wetlands, with 73 percent vegetation vs. the region's 55 percent average and 43 percent forest vs. the region's average of 34 percent. This vegetation provides key water quality protection and wildlife habitat.

The Saum Creek /Lower Tualatin River sub-watershed contains 1,090 acres of floodplain, 873 acres (80 percent) which are undeveloped with 217 acres (20 percent) of developed floodplain. Thus the floodplain area in Saum Creek watershed is more developed than the regional average of 10 percent. Urban areas near streams have experienced flooding in recent decades.

This watershed contains important high-value upland habitat, contributing 4.5 percent to the region's total Class A and B upland habitat and 5 percent to interior habitat.

Table 48

Sub-watershed 28: Beaver Creek/Willamette River

Summary statistics for the Beaver Creek/Willamette River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Beaver Creek/Willamette River *Rock Creek - Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	2,725 acres	0.9%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**70.2%**	0.6%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*31.2%*	0.4%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	58.3%	0.7%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*27.7%*	0.5%	33.9%	
% Class I + Class II riparian habitat	*7.2%*	0.4%	17.8%	≥22.8%
% undeveloped floodplain	*0.0%*	0.0%	90.1%	≥80.1% undev
% developed floodplain	*0.0%*	0.0%	9.9%	
% Class A + Class B wildlife habitat	7.1%	0.6%	10.1%	≥7.6%
% interior habitat	1.8%	0.3%	5.7%	≥4.6%
Habitats of Concern	*0.8%*	0.1%	9.1%	≥8.6%

The portion of the Beaver Creek/Willamette River sub-watershed falling within the Metro region comprises about 1 percent of the region's total area. Only about 50 acres fall outside of the Metro boundary.

The sub-watershed's Class I and II riparian habitat is proportionally lower than average, with 7 percent cover vs. the regional average of 18 percent. However, the area within 0-150 feet of streams and wetlands is substantially more vegetated and more forested than many other watersheds in the region, providing critical water quality protection, fish and wildlife habitat. The portion of this watershed within the Metro region contains no floodplain.

The sub-watershed contains 7 percent Class A and B upland habitat, somewhat lower than the regional average of 10 percent. Two percent of the area is comprised of interior habitat, also lower than the regional average of 6 percent.

Table 49
Sub-watershed 29: Chicken Creek

Summary statistics for the Chicken Creek sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Chicken Creek *Rock Creek – Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	1,906 acres	0.6%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**79.9%**	1.5%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**55.2%**	1.7%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	54.4%	1.0%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	36.2%	1.1%	33.9%	
% Class I + Class II riparian habitat	19.4%	0.7%	17.8%	≥22.8%
% undeveloped floodplain	**100.0%**	0.4%	90.1%	≥80.1% undev
% developed floodplain	*0.0%*	0.0%	9.9%	
% Class A + Class B wildlife habitat	5.4%	0.3%	10.1%	≥7.6%
% interior habitat	1.8%	0.2%	5.7%	≥4.6%
Habitats of Concern	13.9%	1.0%	9.1%	≥8.6%

The Chicken Creek sub-watershed contributes less than 1 percent to the region's total area, with about 250 more acres outside of the Metro boundary.

Chicken Creek contains proportionally somewhat more Class I and II riparian habitat than the regional average, but the habitat is generally in better shape. The area within 50 feet of streams and wetlands is substantially more vegetated (80 percent vs. 63 percent) and more forested (55 percent vs. 39 percent) than the regional average. This forested area contributes nearly 2 percent of the region's total. The area within 50-150 feet of streams and wetlands contains close to the region's average vegetation and forest cover. The drainage contains 136 acres of floodplain, none of which is developed.

Chicken Creek contains relatively low amounts of Class A and B upland habitat and interior habitat compared to other watersheds in the region.

Table 50

Sub-watershed 30: Lower Rock Creek/Tualatin River

Summary statistics for the Lower Rock Creek/Tualatin River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Lower Rock Creek/Tualatin River *Rock Creek - Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	12,461 acres	4.2%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	66.1%	7.0%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	*31.0%*	5.4%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	*48.6%*	4.7%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	*22.3%*	3.5%	33.9%	
% Class I + Class II riparian habitat	13.9%	3.3%	17.8%	≥22.8%
% undeveloped floodplain	**97.8%**	2.9%	90.1%	≥80.1% undev
% developed floodplain	*2.2%*	0.6%	9.9%	
% Class A + Class B wildlife habitat	*2.5%*	1.0%	10.1%	≥7.6%
% interior habitat	3.4%	2.5%	5.7%	≥4.6%
Habitats of Concern	*3.3%*	1.5%	9.1%	≥8.6%

The Lower Rock Creek/Tualatin River watershed contributes more than 4 percent of the Metro region's total area, with nearly 300 additional acres outside of the Metro boundary.

Lower Rock Creek includes 14 percent high value Class I and II riparian habitat, 4 percent lower than the regional average. The vegetation cover within 50 feet of streams and wetlands is slightly higher than the regional average, but the percent forest cover is 31 percent vs. 39 percent region-wide. The pattern within 50-150 feet of streams is similar, with 49 percent vegetation vs. 55 percent regionally and only 22 percent forest cover vs. the regional average of 34 percent.

Lower Rock Creek contains 934 acres of floodplain, of which only 2 percent is developed. It contributes 3 percent of undeveloped floodplain to the region's total.

The sub-watershed contains relatively little Class A and B upland habitat, about 3 percent vs. the regional average of 18 percent. Interior habitat is also lower than the regional average (3 percent vs. 6 percent region-wide).

Table 51
Sub-watershed 31: Upper Rock Creek/Tualatin River

Summary statistics for the Upper Rock Creek/Tualatin River sub-watershed. In the "Sub-watershed statistics" column, **bold** indicates 5 percent or more above the regional average and *italics* indicates 5 percent or more below the regional average.

Upper Rock Creek/Tualatin River *Rock Creek - Tualatin River watershed* *Tualatin River sub-basin*	**Sub-watershed statistics in Metro boundary**	**Contribution to region's total**	**Regional average**	**Regional target**
Acres within Metro	7,339 acres	2.5%	9,549 acres	
% vegetated acres within 50' of streams and wetlands	**84.5%**	4.4%	63.3%	≥73.3% total
% forested acres within 50' of streams and wetlands	**49.9%**	4.2%	38.7%	
% vegetated acres within 50-150' of streams and wetlands	**70.6%**	4.1%	55.1%	≥60.1% total
% forested acres within 50-150' of streams and wetlands	38.7%	3.7%	33.9%	
% Class I + Class II riparian habitat	18.3%	2.5%	17.8%	≥22.8%
% undeveloped floodplain	**99.3%**	0.6%	90.1%	≥80.1% undev
% developed floodplain	*0.7%*	0.0%	9.9%	
% Class A + Class B wildlife habitat	14.3%	3.5%	10.1%	≥7.6%
% interior habitat	4.3%	1.9%	5.7%	≥4.6%
Habitats of Concern	*3.2%*	0.9%	9.1%	≥8.6%

The Upper Rock Creek/Tualatin River sub-watershed is habitat-rich and contributes about 3 percent of the Metro region's total area. Another 600 acres lie outside the Metro boundary.

Upper Rock Creek includes slightly more high value riparian habitat than the regional average and it is generally in better condition. The area within 50 feet of streams and wetlands contains 85 percent vegetation and 50 percent forest cover, compared to 63 percent and 39 percent averages region-wide, respectively. The pattern within 50-150 feet of streams is similar with 71 percent vegetation vs. 55 percent region-wide and 39 percent forest cover vs. 34 percent region-wide. The drainage contains 190 acres of floodplain, only one acre of which is developed.

The Upper Rock Creek/Tualatin River sub-watershed includes 14 percent high value upland habitat compared to 10 percent regional average. It includes just over 4 percent interior habitat, slightly below the regional average.

Discussion

Each sub-watershed is unique in its natural resources and development patterns. For example, the Columbia River Islands and Upper Johnson Creek sub-watersheds each contain key natural resources, but not the same type of resource. Figure 5 compares floodplain extent and condition by sub-watershed. The Columbia River Islands sub-watershed is clearly a key contributor to the region's undeveloped floodplains, whereas Upper Johnson Creek contributes only a small portion of the region's floodplains.

Figure 6 depicting the amount of wildlife interior habitat by sub-watershed, paints an entirely different picture. Columbia River Islands contain substantially less interior habitat compared to Upper Johnson Creek and in fact, the latter is known to include some very important wildlife habitat resources. Figure 6 also shows that the Willamette River/Columbia River sub-watershed provides the majority of the region's interior habitat; although generally highly developed this sub-watershed also includes Forest Park, the largest and most intact wildlife habitat patch in the region.

Watershed- and sub-watershed-specific information about water quality can help with planning and implementation dealing with water quality and wildlife. In 2006 Oregon DEQ issued the Lower Willamette River TMDL report, documenting water quality issues and mandating that designated management agencies (typically local jurisdictions) produce a TMDL implementation plan by March 2008. The information provided in this report – in particular, the medium- and small-scale sub-watershed information – can provide valuable guidance about where and how to direct resources to improve water quality conditions. In addition, information relating to species and habitats of concern helps the region collaborate with larger agencies and efforts, such as ODFW's Conservation Strategy and the federal and state endangered species acts.

Conclusion

CONCLUSION

Region-wide about 39 percent of the areas within 50 feet of streams and wetlands is forested and in the area between 50-150 feet, the average drops to 34 percent. These numbers are substantially below the natural condition, and riparian areas provide some of the most important water quality and wildlife habitat functions. Increasing tree cover throughout all watersheds, but particularly near streams and most wetlands (some are naturally herbaceous), would improve water quality and wildlife habitat. About 10 percent of the region's floodplains are developed, substantially degrading ground and stream water quality. In addition, development in these areas is at risk of flooding. Minimizing new floodplain development and restoring existing floodplain will be a key water quality strategy for the region's future. In terms of wildlife habitat the results indicate a fragmented system, but one that still contains nearly 30,000 acres of the highest quality upland wildlife habitat, including some large habitat patches and many pockets of at-risk or declining habitats such as Oregon white oak.

At the smaller scale a wide variety of conditions reflects the unique nature of each area in terms of natural features as well as development patterns. Some watersheds are heavily developed and hold few remaining natural resources, but some developed areas also retain significant natural features. In most cases, the least developed watersheds provide disproportionately high contributions to the region's total habitat. Several watersheds contain a high proportion of a given indicator but due to the watershed's relatively small extent within the Metro boundary, do not contribute a great deal to the regional total.

For example, the region's total percent cover of the highest value upland habitat, Class A and B, is about 10 percent. By sub-watershed, the average percent cover ranges from less than 1 percent to more than 60 percent. The Columbia River Islands sub-watershed contributes only 0.1 percent to the region's total Class A and B habitat even though it comprises 3.4 percent of the region's total area; this is not due to poor condition, but is because the sub-watershed is nearly all high-value riparian habitat with no uplands. On the other hand, the Columbia Slough makes up about 13 percent of the region's total area but contributes just over 2 percent of the region's total Class A and B habitat, reflecting highly developed uplands.

At the smallest stream-reach scale, the next report is also likely to reveal a variety of conditions. Identifying stream reaches where trees and other vegetation is lacking will flag areas needing restoration. A closer examination of development and other conditions will help further refine which areas are most suitable and most important candidates for restoration.

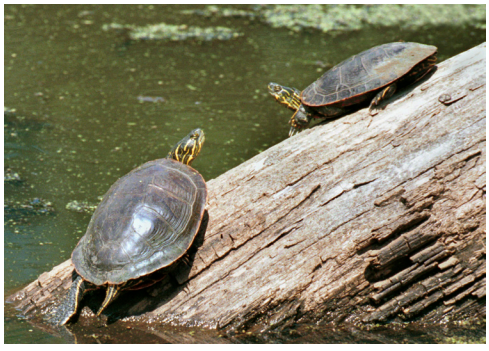
Comparing the region's watershed conditions over time will not always be easy because data quality, natural resources and political boundaries sometimes change over time. For example, the new city of Damascus is refining its natural resources inventory and that information was not available for this report. Streams sometimes shift their channels; floodplains change with urbanization. Projected population levels may result in future urban growth boundary expansions, adding to the region's total area. Future reports will take these changes into account. Where data quality or availability has substantially changed, it may be necessary to revisit old aerial photographs and collect data retroactively to enable true comparison of environmental conditions over time. The quality and resolution of those data sources change over time as well as adding to the challenge of comparisons.

Individual sub-watershed conditions come into play when considering Title 13's regional natural resource targets. For example, some highly developed sub-watersheds may literally lack space to plant trees near streams and in such cases, retaining what resources are there and re-developing with these targets in mind will be important tools to enhance streams over time. In contrast, new areas within the urban growth

boundary sometimes hold abundant natural resources, where urbanization may mean substantial natural resource loss. In many cases, however, a strategic approach to managing natural resources that includes restoration, environmental education and monitoring conditions over time may help slow the loss, maintain or improve watershed conditions. The outcome will depend on the decisions and behavior of individuals, organizations, agencies and businesses.

The indicators in this report will track environmental conditions at a variety of spatial scales to monitor the environment at local, watershed and regional scales. Monitoring will continue until at least 2015. Areas with high restoration potential will be identified. The 2008 report will present the first data on watershed changes over a two-year period. From that point the regional targets for the first 10-year monitoring period will be closely tracked, allowing Metro to identify where environmental trends are falling below target and encourage local jurisdictions, watershed groups and citizens to improve conditions in specific areas.

Citizens can help right now by reducing pesticide and fertilizer use, removing invasive species and planting native trees and shrubs as appropriate in their yards, along roadways and especially along streams and wetlands. Developers, business, local jurisdictions and others can help by reducing building footprints and hard surfaces, executing careful site design to control storm water and sediments and retaining and planting trees and native vegetation to help fish, wildlife and water quality. Street trees and green street design will also help. **Every single tree** contributes to a healthy urban environment.



Appendices

Appendix 1

Metro Council's performance objectives, targets, and example indicators as listed in Title 13

Appendix 1 Metro Council's performance objectives, targets and example indicators as listed in Title 13

Appendix Table

Performance and implementation objectives and indicators

As listed in Exhibit C, Ordinance No. 05-1077C, Urban Growth Management Functional Plan, Title 13, "Nature in Neighborhoods" (Table 3.07-13e on pages 29-31)

Performance objectives	Targets	Targeted condition based on 2004 Metro inventory	Example indicators
Performance objective 1: Preserve and improve streamside, wetland, and flood area habitat and connectivity.	**1a.** *10% increase in forest and other vegetated acres within 50 feet* of streams (on each side) and wetlands in each subwatershed over the next 10 years (2015).	**1a. 2004 baseline condition (regional data):** • 64% vegetated • 14,000 vegetated acres **10% increase**: • 70% vegetated • 1,400 acre increase in vegetation over 10 years	• Percentage of acres within 50 feet of streams (on each side) and wetlands with any vegetation • Percentage of acres within 50 feet of streams (on each side) and wetlands with forest canopy • Percentage of acres between 50 and 150 feet of streams (on each side) and wetlands with any vegetation • Percentage of acres between 50 and 150 feet of streams (on each side) and wetlands with forest canopy • Number of acres of Class I and II riparian habitat • Percentage of flood area acres that are developed* ** "Developed" for purposes of this indicator means the methodology used in Metro's Fish and Wildlife Inventory to identify developed flood areas.*
	1b. *5% increase in forest and other vegetated acres within 50 to 150 feet of streams* (on each side) and wetlands in each subwatershed over the next 10 years (2015).	**1b. 2004 baseline condition (regional data):** • 59% vegetated • 15,250 vegetated acres **5% increase:** • 62% vegetated • 760 acre increase in vegetation over 10 years	
	1c. No more than *10% increase in developed flood area acreage* in each subwatershed over the next 10 years (2015).	**1c. 2004 baseline condition (regional data):** • 10% of all flood area acres are developed • 3,450 total acres of developed flood areas **10% increase:** • 3,800 total acres of developed flood areas	
Performance objective 2: Preserve large areas of contiguous habitat and avoid fragmentation.	**2a.** *Preserve 75% of vacant Class A and B* upland wildlife habitat in each subwatershed over the next 10 years (2015).	**2a. 2004 baseline condition:** • 15,500 acres of vacant Class A and B upland wildlife habitat **75% retention:** • 11,600 acres of vacant Class A and B upland wildlife habitat remaining	• Number of acres of Class A habitat • Number of acres of Class B habitat • Number of wildlife habitat patches that contain 30 acres or more of upland wildlife habitat

Performance objectives	Targets	Targeted condition based on 2004 Metro inventory	Example indicators
	2b. Of the upland habitat preserved, *retain 80% of the number of patches 30 acres or larger* in each subwatershed over the next 10 years (2015).	**2b. 2004 baseline condition:** • 23,400 acres of upland habitat in 133 patches that contain 30 acres or more of upland wildlife habitat **80% retention:** • 106 upland habitat patches that contain 30 acres or more of upland habitat	
Performance objective 3: Preserve and improve connectivity for wildlife between riparian corridors and upland wildlife habitat.	**3a.** *Preserve 90% of forested wildlife habitat acres located within 300 feet of surface streams* in each subwatershed over the next 10 years (2015).	**3a. 2004 baseline condition:** • 28,300 acres within 1,453 patches of forested wildlife habitat located within 300 feet of surface streams **90% retention:** • 25,500 acres of forested wildlife habitat located within 300 feet of surface streams	• Number and miles of all wildlife corridors • Corridor quality: % of habitat acres within corridors with a vegetative width of 200 ft • Acres of wildlife patches with a connectivity score of 3 or greater • Acres and number of forested wildlife habitat patches (forest canopy or wetland with a total combined size greater than 2 acres) within 300 feet of surface streams compared to acres of the patches located outside of 300 feet of surface streams.
	3b. *Preserve 80% of non-forested wildlife habitat acres located within 300 feet of surface streams* in each subwatershed over the next 10 years (2015).	**3b. 2004 baseline condition:** • 14,400 acres within 1,633 patches of non-forested wildlife habitat located within 300 feet of surface streams **80% retention:** • 11,500 acres of non-forested wildlife habitat located within 300 feet of surface streams	• Acres and number of non-forested wildlife patches (shrub or low structure/open soils with a total combined size greater than 2 acres) located within 300 feet of a surface streams.
Performance objective 4: Preserve and improve special Habitats of Concern.	**4a.** *Preserve 95% of Habitats of Concern acres* in each subwatershed over the next 10 years (2015).	**4a. 2004 baseline condition:** • 33% of all habitat designated as HOCs • 26,700 total acres of HOCs **95% retention:** • 25,400 total acres of HOCs	• Number of acres of wetland • Number of acres of white oak woodland • Number of acres of bottomland hardwood forest • Number of acres of vegetated riverine islands • Number of acres of key connector habitat (list out HOC connectors)

Appendix 2

Pilot stream reach GIS model development

Appendix 2 Pilot stream reach GIS model development

Introduction

The Nature in Neighborhoods initiative (Title 13) calls for Metro to provide a watershed-based assessment of current conditions to track changes in land cover over time, and identify areas that can be enhanced to increase fish and habitat wildlife value. The December 2006 report represents baseline conditions, or the point at which we begin to measure changes in future reports. The reports are due on each even year.

The Title 13 ordinance calls for measuring specific GIS-based land cover at the level of large watersheds (5^{th}-field Hydrologic Unit Codes, or HUCS – a national standard for watershed delineation). The Portland metropolitan region includes all or part of six large watersheds, within which are nested 31 sub-watersheds. This is a large spatial scale. In order to meet the Metro Council's goal of improving watershed conditions over time, a more detailed analysis is needed to identify key sites with the highest potential for restoration and other beneficial activities. With such an analysis Metro can help inform jurisdictions, watershed groups and the public about areas needing restoration and work to increase local capacity in accomplishing the most beneficial watershed restoration actions.

We developed a pilot model, based on GIS measures and validated by water quality data, to estimate water quality based on adjacent and upstream land use. The model was developed in collaboration with Clackamas County Water Environment Services, who collected the GIS data. The water quality data was collected by Metro in 2003 to support the Damascus Concept Planning Process. The model breaks down watersheds into individual stream reaches on year-round streams.

Methods

Study area. The study area lies within Clackamas County and includes Rock, Richardson, Noyer, North Fork Deep, and Sunshine creeks and their major tributaries.

Data Collection. In 2003, we collected benthic macroinvertebrates and water quality data in the field. We used this field data to test which GIS variables should be used in a multivariate model. We identified stream reaches of approximately 1,500m upstream from the point of water quality data collection, and collected GIS land cover variables within 200m buffers on each side of the stream reach. We selected this spatial scale because two previous Metro water quality studies suggest that it is ecologically relevant, showing relatively strong relationships between water quality and land use variables. The table below shows GIS and water quality variables used in this model.

Appendix Table
GIS and water quality variables collected for Metro's GIS-based stream reach analysis

VARIABLE	SOURCE	COMMENTS
GIS variables *(Geographic Information Systems – computer mapping)*		
Total acres in buffer (1500m upstream) 200m wide	Clackamas County Water Environment Services (WES)	The buffer area was clipped to include only land that drains to the stream reach.
Percent tree cover	WES LIDAR data	This data includes both closed canopy forest and individual trees.
Percent closed canopy forest cover	Metro 2004 hand-digitized closed forest canopy	Includes forested areas covering 75% or more closure, at a 1-acre minimum.
Percent urban land cover	WES data	
Percent cover agricultural land use	WES data	
Percent cover Class I riparian habitat plus percent cover Class A upland wildlife habitat	Metro's Regionally Significant Fish and Wildlife Habitat Inventory developed for Title 13	Class I is the most valuable of three riparian habitat classes; Class A is the most valuable of three upland habitat classes.
Percent impervious (not water penetrable) surface	WES LIDAR data	Includes roads, rooftops, parking lots, etc.
Water quality variables *(collected in the field)*		
Water temperature	Metro's 2003 field surveys	This variable was collected in conjunction with macroinvertebrate and physical habitat data, at different hours during the day. This variable is somewhat time-dependent; therefore, additional variability is inherent due to the varying times of collection.
pH	Metro's 2003 field surveys	This variable was collected in conjunction with macroinvertebrate and physical habitat data, at different hours during the day. This variable is somewhat time-dependent; therefore, additional variability is inherent due to the varying times of collection.
Dissolved oxygen	Metro's 2003 field surveys	This variable was collected in conjunction with macroinvertebrate and physical habitat data, at different hours during the day. This variable is somewhat time-dependent; therefore, additional variability is inherent due to the varying times of collection.

Selecting model variables. Our goal was to create a GIS model that can relate changes in land cover to changes in stream quality over time. We began with the model created in collaboration with Clackamas County Water Environment Services (WES) for Rock Creek stream reaches. The Rock Creek model included all forest canopy (measured by LIDAR), closed forest canopy (hand-digitized by Metro), Class I plus Class A (modeled by Metro), and impervious surface (measured by LIDAR). We examined scatterplot graphs of response versus explanatory variables to look for relationships between the response (water quality) and explanatory (GIS-based) variables. This produced a set of variables with which to begin developing the model, including:

- B-IBI scores (water quality variable)
- Specific conductance (water quality variable)

- pH (water quality variable)
- Dissolved oxygen (water quality variable)
- Water temperature (water quality variable)
- Total acres in buffer (1,500m upstream) 200m wide (GIS variable)
- Percent tree cover (GIS variable)
- Percent closed canopy forest cover (GIS variable)
- Percent urban land cover (GIS variable)
- Percent cover agricultural land use (GIS variable)
- Percent cover Class I riparian plus Class A upland wildlife habitat (GIS variable)
- Percent impervious (not water penetrable) surface (GIS variable)

Relationships between B-IBI scores and specific conductance were the strongest among the water quality variables; therefore, we eliminated pH, dissolved oxygen and temperature from the initial model. The scatter plot graphs suggested relationships between all variables except "Total acres in buffer," the latter which was discarded from the model.

The relationship between water quality and impervious surface appeared uncertain. However, we elected to keep this variable in the model. We reasoned that most impervious levels in the study area are at or below 10 percent, while studies throughout the country suggest a 10 percent impervious threshold, beyond which water quality diminishes rapidly. If this model is expanded to the rest of the urban region, nearly all other stream reaches will exceed 10 percent imperviousness thus the variable is likely to be significant in stream reaches that are already urbanized.

We also omitted the agricultural land use variable. Although the study area contains significant agricultural land use, the study area is a new Urban Growth Boundary (UGB) addition and is likely to transition from agricultural to urban uses over the next few decades. Other watersheds within the UGB are already largely urbanized and contain little or no agriculture. It made sense to focus on urbanization in this model.

Statistical analysis. We used Canonical Correspondence Analysis (CCA) to analyze statistical relationships among the remaining variables. CCA is a means of sorting out complex statistical relationships when a number of inter-related environmental variables may be involved. CCA relates all of the response (y, or water quality) variables to all of the explanatory (x, or land cover) variables and if the relationship is valid, produces one or more linear relationship that clusters related explanatory variables related to the response variables. For example, a given water quality variable may be related to four or five land cover variables, and if all of the land cover variables are also related to one another, they are clustered into one relationship (an "axis," or linear relationship).

We included B-IBI scores and specific conductance as explanatory variables, and included all GIS variables as explanatory variables in the first model run. The model was rejected because the two tree cover measures were too closely correlated. Because the strongest relationship was with all tree cover we discarded the closed forest canopy variable and retained the LIDAR tree cover measure. The remaining variables produced a robust model for stream reach water quality, based on land use measures.

Results

The CCA model produced one significant axis that explained 66.4 percent of the variability within the data (r = +0.92; r^2 = 0.84). A Monte Carlo test to validate the significance of the axis was positive (P = 0.01). The axis related to the following land cover variables, in order of significance within the model below.

Appendix Table

Results of Canonical Correspondence Analysis (CCA) model producing one significant land cover axis, including four land cover variables significantly related to water quality measures

Explanatory (land cover) variable	Direction of relationship to Axis 1	Response (water quality) variable	Pearson correlation coefficient of response variable to Axis 1
Percent urban land cover	+	B-IBI score	r = -0.96; r^2 = 0.93
Percent Class I plus Class A habitat	-		
Percent impervious cover	+	Specific Conductance	r = +0.96; r^2 = 0.93
Percent forest cover	-		

These results may be interpreted as follows: axis 1 represents a rural-to-urban gradient in which stream reaches with high water quality have little urban or impervious cover, but significant amounts of high quality riparian/upland habitat and tree cover. As urban land cover and imperviousness increase, and as the stream reach includes less high quality habitat and tree cover, water quality declines.

Discussion

The results of the CCA analysis are in agreement with water quality studies in our area and elsewhere in the country.

In our naturally forested area, the importance of trees cannot be overemphasized; every tree matters to water quality. Local studies show this to be the case, where forest and habitat measures relate positively to field-based water quality measures at nearly every spatial scale measured. The dimensions within which land use was measured for each stream reach (200m on each side of the stream; 1,500m upstream) have proven particularly significant in previous studies, but the same studies suggest that trees in the uplands also contribute to water quality.

Habitat quantity and quality are both likely important to stream reach conditions. The initial CCA model failed when both tree cover measures were included, indicating that including both variables in the model did not add anything to a statistical description of the factors influencing water quality and in fact confounded the results. However, the model did succeed when both tree cover and habitat quality were included, indicating that each provides a different (but related) contribution to water quality.

Two measures of urbanization, the amount of urban land cover and the percent paved and other hard surfaces, provide a way to measure the impact of humans on water quality at the stream reach level. The negative impacts of impervious surfaces on water quality are well documented here and elsewhere in the country. According to the CCA model, the urban land cover provide an important additional measure to account for the effects of urbanization on water quality, and the two measures are apparently different enough to warrant their inclusion in the CCA model.

The scatterplot graphs of water quality measures vs. impervious surface cover failed to show a definite relationship between impervious surface cover and water quality measures, although visual examination suggests that trends may be present. However, the variable was significant when used in combination with the other variables in the CCA model. We surmise at least two reasons for the graphical findings.

First, the simple graphs do not account for the mitigating influence of tree cover and habitat quality on streams. A previous Metro study showed that if two watersheds with similar urban levels are compared, streams in the watershed with more tree cover are healthier. If impervious cover does not influence water quality, then the variable likely would not have appeared significant in the CCA model – but it did. Trees help offset the negative effects of impervious surfaces on water quality, and tree cover was significant in the model. Similarly, if habitat quality is not important, it would not have appeared significant in the model. Quality and quantity are both important, and both help offset the effects of impervious cover in somewhat different ways.

Second, most of the stream reaches in the study area contain low impervious levels. Numerous studies show a threshold effect at about 10 percent impervious surface cover; stream reaches in the study area currently have relatively low levels of impervious cover and most have yet to reach the 10 percent threshold. Impervious cover may become statistically significant to water quality, even if it is the only land use variable used, when measured in more urbanized stream reaches. In other words, if we include study sites with more impervious cover, the graphs may well exhibit the threshold effect of steeply declining water quality after 10 percent impervious cover is exceeded.

We call the model a pilot because it was developed as a sample, for only a small portion of the metropolitan region. The data used in this pilot study is from a special, high-quality LIDAR imagery set purchased by Clackamas County and generously provided here. However, this data has not been consistently collected across the region, and it is expensive and thus is not purchased on a regular basis. To accurately measure changes in stream reach conditions over time, accurate, reliable and repeatable measures are necessary, and we do not yet have such data.

However, Metro will soon have a new GIS data set that will enable much more accurate and detailed measurements of tree cover and other variables for the entire region. By the time the 2008 State of the Watersheds report is issued, we will have collected data for both the 2006 and 2008 time periods and will collect similar data every two years. We will use the new data to refine this pilot model, and potentially add in a variable or two if they are significant in the future CCA model (for example, shrub cover). We will field-test the model against real water quality measurements and examine how conditions have changed, stream reach by stream reach, between the first and second reports. We will include the improved stream reach model for the entire region in the 2008 report.

Conclusion

This pilot statistical model specifically addresses water quality at the stream reach level with existing data. It is a pilot because we will not have the needed high quality data for the entire region until the second State of the Watersheds report, due in 2008. At that time, we will provide measures and change detection for both the 2006 and 2008 time periods.

This model provides a pilot study that allows us to measure land use changes without fieldwork, enabling an affordable, repeatable measure of stream reach and, cumulatively, watershed conditions. We will adjust the model as better data becomes available, using field water quality data collected by other agencies within the region. The model will provide important information on where change has occurred

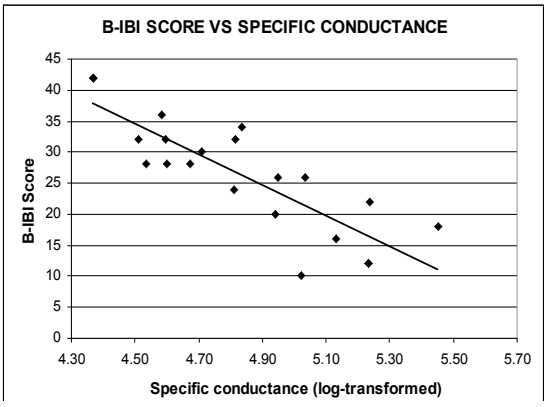
(for better or for worse), where help is needed, and where restoration efforts may be focused to provide the highest environmental benefit. The spatial scale is large enough to be feasible for the entire region, yet small enough to pinpoint when and where change occurs. Stream reach information can be aggregated up to the watershed level for a more general assessment.

The stream reach model is just one part of the environmental picture. Land cover beyond that measured within the defined stream reach areas also contributes to water quality. Thus, each State of the Watersheds report will include Metro's other GIS-based measures to account for wildlife habitat quantity, quality and connectivity. Examining existing conditions and assessing change over time for land and water, starting at a small scale and aggregating up, can help citizens, watershed groups, schools, cities and counties plan at the small scale and also integrate their work into the region. Informed, integrated decisions are likely to yield good results for the environment as the region changes over time.

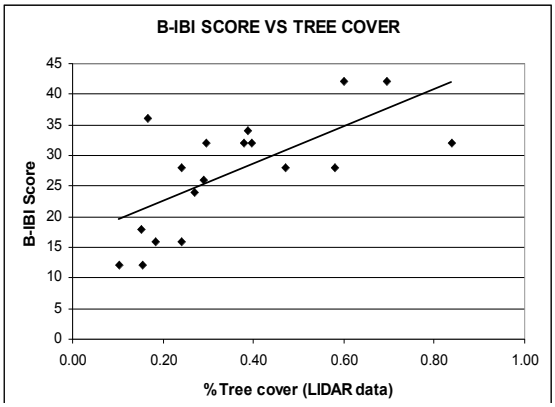
Appendix Figure 1

Relationships between Benthic Index of Biotic Integrity (B-IBI) scores versus environmental variables

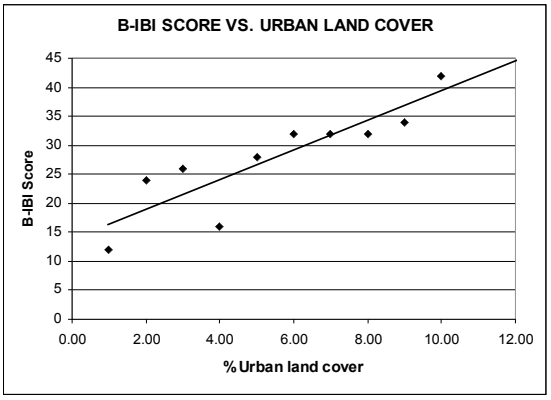
Collected via Geographic Information Systems, or GIS. The first relationship shows a strong relationship between B-IBI scores and Specific Conductance, a field-collected chemical measure of water quality; both measures appear appropriate for use in this model.



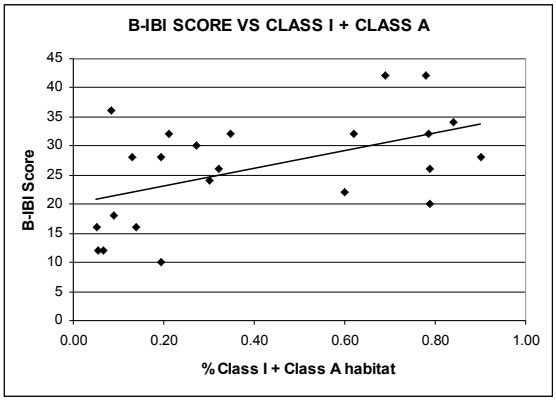
r^2 = 0.70; P < 0.001 (statistically significant)



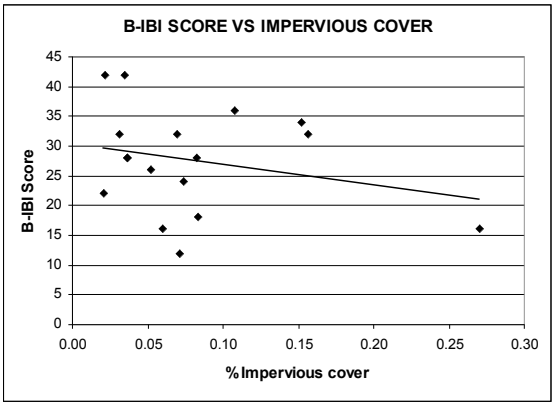
r^2 = 0.46; P = 0.001 (statistically significant)



r^2 = 0.77; P < 0.001 (statistically significant)



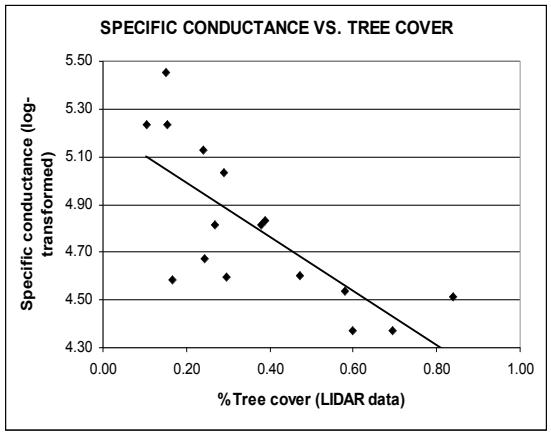
r^2 = 0.26; P = 0.01 (statistically significant)



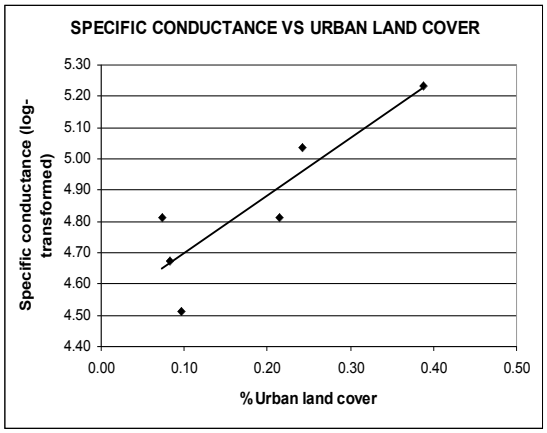
r^2 = 0.06; P = 0.33. This relationship is not statistically significant, probably due to low impervious levels in the study area and interactions with the other variables. Studies show a threshold effect at about 10 percent impervious surface. This variable was significant when used in combination with the other variables (above) in the model.

Appendix Figure 2
Relationships between Specific Conductance versus environmental variables

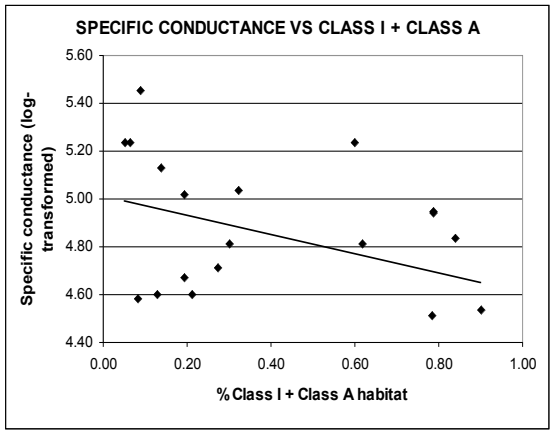
Collected via Geographic Information Systems, or GIS. Specific Conductance is a chemical measure of how well water conducts electricity. In general, higher scores equate to lower water quality



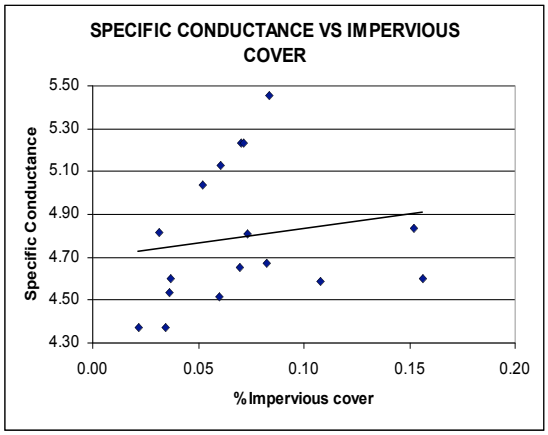
r^2 = **0.55; *P* = 0.001** (statistically significant)



r^2 = **0.78; *P* = 0.02** (statistically significant)



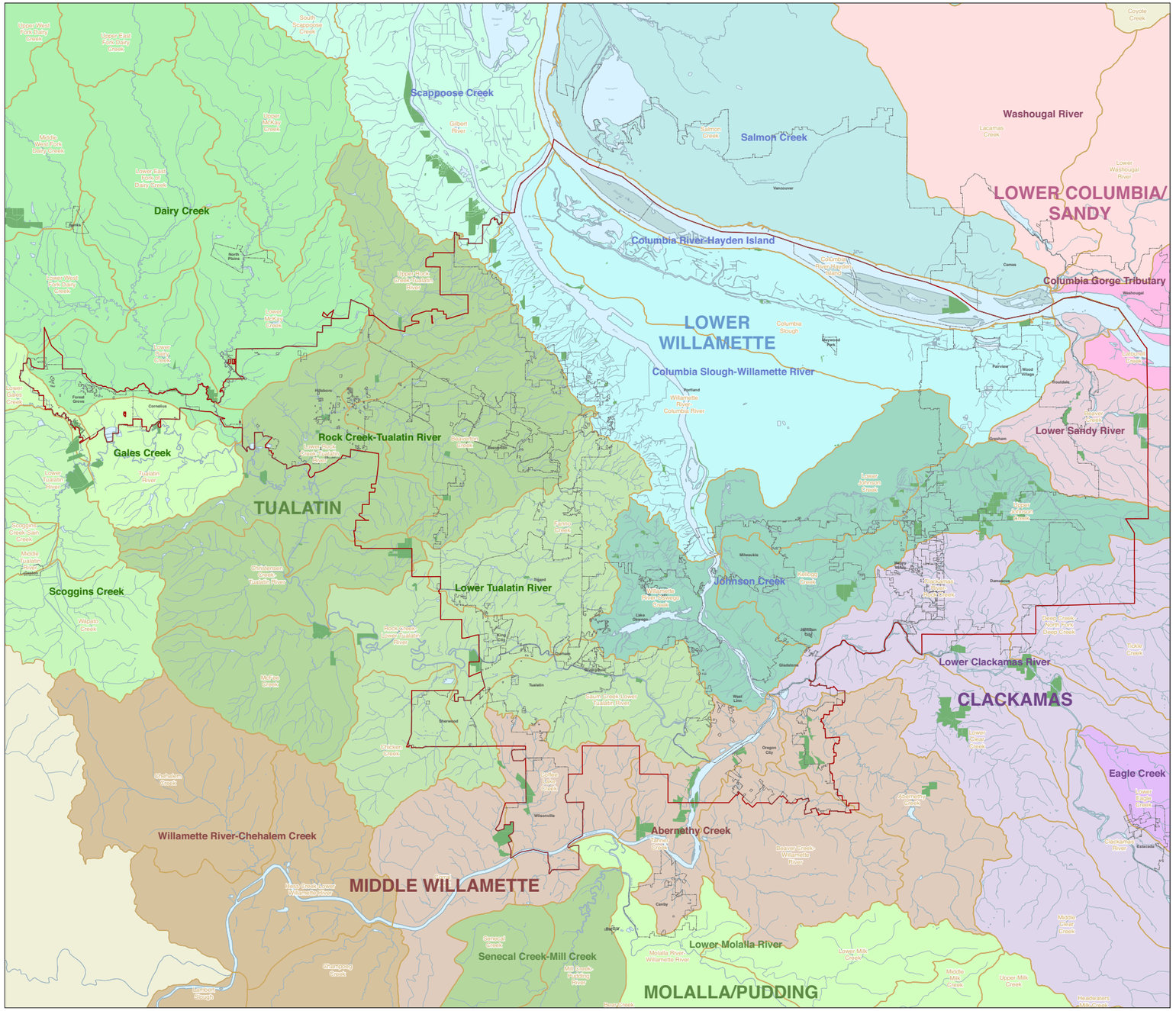
r^2 = **0.17; *P* = 0.06.** This relationship falls just outside the generally accepted *P* level of 0.05. However, when combined with the other variables, this variable was significant in the model.



r^2 = **0.16; *P* = 0.24.** This relationship is not statistically significant, probably due to low impervious levels in the study area and interactions with other variables. Studies threshold effect at about 10 percent impervious surface. This variable was significant when used in combination with the other variables (above) in the model.

Appendix 3

Map of the Metro region's watersheds



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R L I S
REGIONAL LAND INFORMATION SYSTEM

Nature in Neighborhoods

Hydrologic Unit Boundaries

5th field watershed
6th field sub-watershed

- City boundary
- Metro jurisdictional boundary
- Openspace acquisitions
- HUC 6: Subwatersheds

HUC 5: Sub-basin name, Watershed name

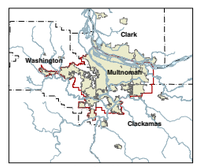
- Clackamas, Eagle Creek
- Clackamas, Lower Clackamas River
- Lower Columbia-Sandy, Columbia Gorge Tributary
- Lower Columbia-Sandy, Lower Sandy River
- Lower Columbia-Sandy, Salmon River
- Lower Columbia-Sandy, Washougal River
- Lower Willamette, Columbia River-Hayden Island
- Lower Willamette, Columbia Slough-Willamette River
- Lower Willamette, Johnson Creek
- Lower Willamette, Scappoose Creek
- Lower Willamette, Salmon Creek
- Middle Willamette, Abernethy Creek
- Middle Willamette, Willamette River-Chehalem Creek
- Molalla-Pudding, Lower Molalla River
- Molalla-Pudding, Senecal Creek-Mill Creek
- Tualatin, Dairy Creek
- Tualatin, Gales Creek
- Tualatin, Lower Tualatin River
- Tualatin, Rock Creek-Tualatin River
- Tualatin, Scoggins Creek

TUALATIN
SUB-BASIN NAME

GALES CREEK
WATERSHED NAME

Tualatin River
Sub-Watershed Name

1 inch = 1.25 Miles
0 0.5 1 2 3 4 Miles



Location Map

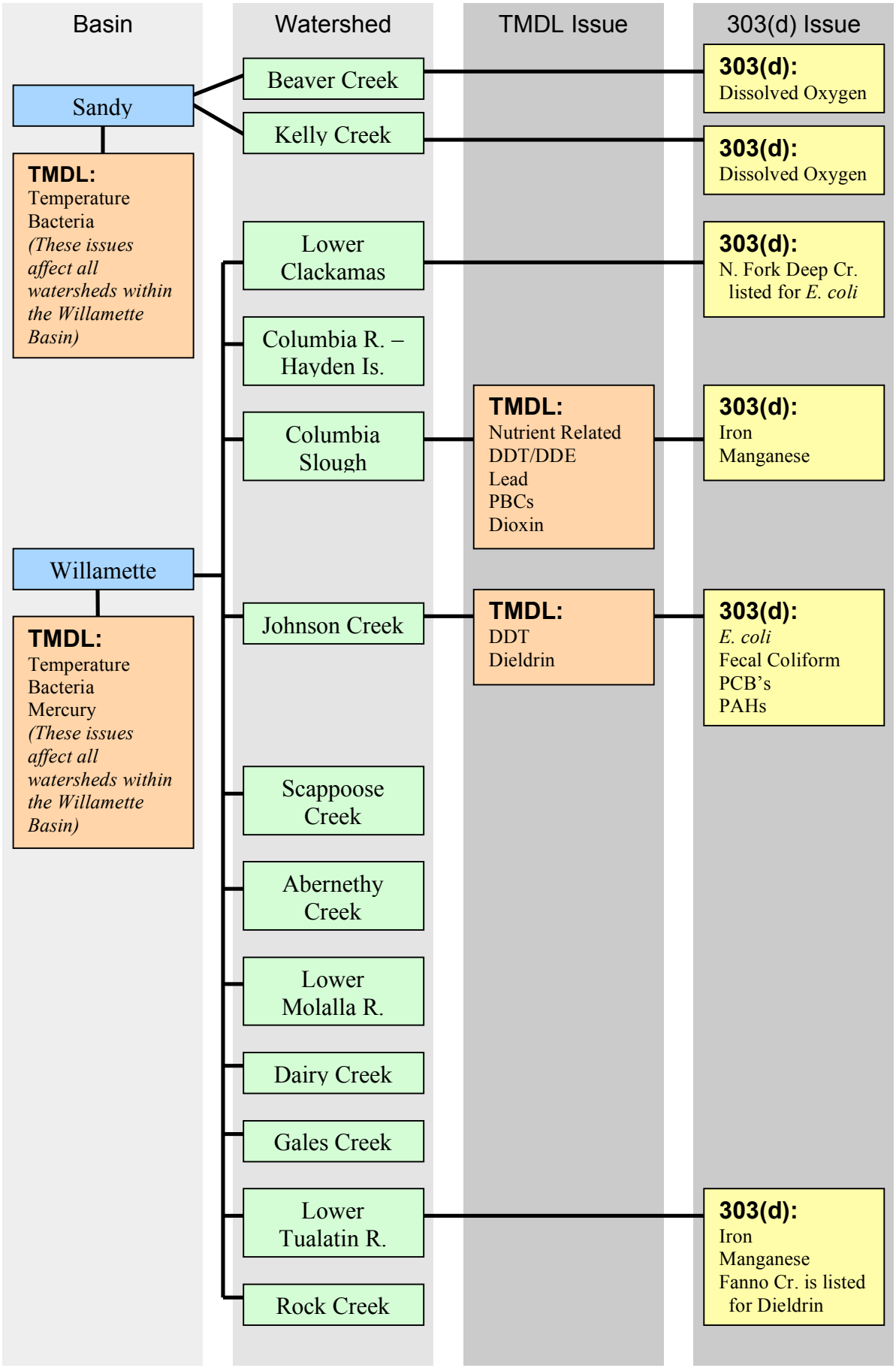
METRO
METRO DATA RESOURCE CENTER
600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232-2736
TEL (503) 797-1742 | FAX (503) 797-1909
drc@metro.dst.or.us | www.metro-region.org

Appendix 4

TMDL and 303(d) water quality listing flowchart

TMDL and 303 (d) listings by watershed

Once the DEQ creates a TMDL rule for a specific 303(d) pollutant, it is removed from the 303(d) list.



Appendix 5

ODFW Conservation Strategy species in the Metro region

Appendix 5 ODFW Conservation Strategy species in the Metro region

Appendix Table

Oregon Department of Fish and Wildlife's Conservation Strategy Species known to occur in the Metro region (excludes extirpated species)

Includes brief descriptions of habitat needs, limiting factors and potential conservation actions that may help each species. Species that Metro monitors on selected properties are indicated with an asterisk.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
FISH					
Chinook salmon *Oncorhynchus tshawtscha* • Lower Columbia R. ESU • Upper Will. R spring run • Snake River Fall-run ESU • Snake River Spr/Sum run	Sensitive	Yes	Require streams with clean gravel, complex habitat and cool temperature for spawning and rearing; require access for anadromous migration.	Water quality; alterations of hydrology and watershed function; fish passage; riparian condition; marine survival.	Maintain or restore aquatic and riparian habitat; continue ongoing restoration efforts involving landowners, tribes and agency partners (NOAA, NMFS, ODFW, OWEB).
Chinook salmon *Oncorhynchus tshawtscha* • Upper Columbia R – Spr run	Sensitive	No	Require streams with clean gravel, complex habitat and cool temperature for spawning and rearing; require access for anadromous migration.	Water quality; alterations of hydrology and watershed function; fish passage; riparian condition; marine survival.	Maintain or restore aquatic and riparian habitat; continue ongoing restoration efforts involving landowners, tribes and agency partners.
Chum salmon *Oncorhynchus keta* • Columbia R ESU – currently considered extinct; further survey work planned to determine status	Extant; Sensitive	Yes	Require stream gravel bars and side channels near tidewaters for spawning; migrate to ocean soon after emergence.	Alterations of hydrology and watershed function; fish passage; marine survival; loss of estuarine habitat.	Maintain or restore aquatic, estuarine and riparian habitat; continue ongoing restoration efforts involving landowners, tribes and agency partners (NOAA, NMFS, ODFW, OWEB).
Coastal cutthroat trout *Oncorhynchus clarki* • SW WA/Columbia R ESU • Upper Willamette R ESU	Extant; sensitive	Yes	Large woody debris, in-stream structures and vegetation important for protection while in freshwater; juveniles prefer side channels, backwaters or pools for rearing; clean gravel for spawning and rearing; migratory corridors.	Habitat fragmentation or actions that increase population isolation; water quality; alterations of hydrology and watershed function; loss of estuarine habitat for rearing; ocean productivity.	Maintain or restore aquatic, estuarine and riparian habitat, providing suitable water quality and habitat complexity; continue restoration efforts involving landowners, tribes and agency partners; reduce localized impacts where populations could become increasingly fragmented.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Coho salmon *Oncorhynchus kisutch* • Oregon Coast ESU (not native above Will. Falls)	Extant; sensitive	Yes	Require streams with clean gravel, complex habitat and cool temperatures for spawning and rearing; require access for anadromous migration.	Stream complexity; water quality; fish passage; riparian condition; altered watershed processes; marine survival.	Implement measures identified in Coastal Coho Assessment with landowners and agency partners (NOAA, NMFS, OWEB, ODFW, IMST); Coastal Coho Stakeholder Team.
Coho salmon *Oncorhynchus kisutch* • Lower Columbia R/SW WA Coast ESU	Extant; sensitive	Yes	Require streams with clean gravel, complex habitat and cool temperatures for spawning and rearing; require access for anadromous migration.	Water quality; altered hydrology and watershed function; fish passage; riparian condition; marine survival.	Maintain or restore aquatic and riparian habitat; continue ongoing restoration efforts involving landowners, tribes and agency partners (NOAA, NMFS, ODFW, OWEB).
Pacific lamprey *Lampetra tridentate*	Extant; sensitive	Yes	May aggregate in high densities; requires fine gravel beds for spawning; larvae burrow in fine sediment; timing of development closely linked to water temperature.	Reduced water quality; passage barriers; altered flow patterns; dredging; rapid water drawdowns; marine survival.	Improve passage; alter timing of water draw-down; use species-specific habitat requirements to guide management actions; see results of ODFW Lamprey Workgroup 2005 for strategies.
Steelhead *Onchorhynchus mykiss* • Lower Columbia R ESU • Upper Will. R ESU, winter run • Middle Columbia R ESU • Snake R Basin ESU • Upper Columbia R ESU	Extant; sensitive	Yes	Requires streams with clean gravel, complex habitat and cool temperatures for spawning and rearing; requires access for anadromous migration.	Water quality; hydrologic and watershed function alterations; fish passage; riparian condition; marine survival.	Maintain or restore aquatic and riparian habitat; continue ongoing restoration efforts involving landowners, tribes and agency partners (NOAA, NMFS, ODFW, OWEB).
Western brook lamprey *Lampetra richardsoni*	Extant; not sensitive	Yes	May aggregate in high densities; requires fine gravel beds for spawning; larvae burrow in fine sediment; timing of development closely linked to water temperature.	Reduced water quality; passage barriers; altered flow patterns; dredging; rapid water draw-downs; marine survival.	Improve passage; alter timing of water draw-down; use species-specific habitat requirements to guide management actions. See results of ODFW Lamprey Workgroup 2005 for strategies.
AMPHIBIANS					
Cascade torrent salamander *Rhyacotriton cascadae*	Extant; sensitive	Yes	Cold, fast-flowing, clear, permanent headwater streams, seeps and waterfall splash zones in forested areas; gravel or cobble substrate with continuous but shallow water flow for larvae and adults foraging and hiding. May only occur in streams on basalt rock; continuous access to cold water.	Larvae take several years to reach sexual maturity; small clutch size (7-16 eggs) and long time to hatch (up to 10 months); larvae have minute gill surface area, so very sensitive to increased temperature and sediment.	Maintain stream buffers for cool water temperatures and water clarity; little or no sediment coating or embedding rocky substrates; replace culverts to remove barriers in continuous, natural streambed, streambank habitats.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Clouded salamander *Aneides ferreus*	Extant; sensitive	Yes	Forest habitats or burned areas; require large decaying logs, especially Douglas-fir.	Limited range – occurs primarily in Oregon; loss of large logs.	Maintain large logs during forest management activities.
Tailed frog *Ascaphus truei*	Extant; sensitive	Yes	Cold, fast-flowing, clear streams in forested areas; adults need streambanks, logs, headwater springs, and gravelly seeps for foraging and hiding, and small boulders in streams for egg laying; tadpoles need permanent streams with moss- and sediment-free cobble and boulder substrate for clinging to rock surfaces while feeding.	Limited range (northwest endemic); low reproductive rate due to several-year larval stage; remains close to water source; low dispersal abilities may limit recovery of populations; sedimentation; increases in water temperature.	Maintain stream buffers for cool water temperatures and water clarity; little or no sediment coating or embedding rocky substrates; replace culverts to remove barriers in continuous, natural streambed, streambank habitats.
Columbia torrent salamander *Rhyacotriton kezeri*	Extant; sensitive	Yes	Cold mountain streams, spring heads and seeps; require loose gravel stream beds with specific geologic and stream gradient characteristics.	Limited dispersal; adults are highly sensitive to drying; larvae are sensitive to changes in stream flow.	Maintain stream buffers to maintain cool water temperatures and water clarity; minimize disturbance at known suitable sites.
Cope's giant salamander	Extant; sensitive	Yes	Cold, fast-flowing, clear, permanent streams in coniferous forests; deep cobble and small boulder substrate for foraging and hiding; rocky streambanks or in-channel logs with crevices for eggs and larvae.	Limited range in Oregon; rarely or never metamorphose, so highly vulnerable to channel dewatering and barriers to stream connectivity; very small gill surface area, so sensitive to increases in temperature and sediment.	Maintain stream buffers to maintain cool water temperatures and water clarity; minimize disturbance at known suitable sites.
Northern red-legged frog* *(Rana aurora)*	Extant; sensitive	Yes	Ponds and wetlands with shallow areas and emergent plants; access to forested habitats (forested wetland, upland).	Loss of egg-laying habitat; predation and competition by invasive fish and bullfrogs; roadkill adjacent to major breeding sites.	Maintain wetland habitat with emergent plants; maintain adjacent forested habitats; control bullfrogs and invasive fish at key sites.
Oregon slender salamander *Batrachoseps wrightorum*	Extant; sensitive	Yes	Late successional and second-growth forest where there are abundant mid to advanced decay stage, large diameter Douglas-fir logs and bark debris mounts at the base of snags; talus and lava fields that retain moisture; can clump together in groups to remain damp.	Endemic to Cascade Mountains of Oregon; restricted distribution; vulnerable to random events; Columbia River limits dispersal; require habitat complexity characteristic of old growth and unmanaged younger forests; high site fidelity for reproduction.	Maintain habitat with late successional attributes suitable for this species.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Western toad *Bufo boreas*	Extant; sensitive	Yes	Wetlands, ponds and lakes for breeding; extensive, sunny shallows with short, sparse or no vegetation for egg laying and for tadpole schools to move widely as they forage on organic mud and surface diatoms.	Loss of breeding habitat due to changes in water level management; egg-destroying pathogen (*Saprolegnia ferax*); siltation; roadkill adjacent to major breeding sites; recreational impacts at certain sites.	Maintain water levels and vegetation buffers at major breeding sites; install culverts or drift fences at problem road crossings near major breeding sites; inform recreationalists about the importance of minimizing shoreline impacts; periodic control of vegetation height and density at occupied sites where these factors could interfere with breeding.
REPTILES					
Western painted turtle* (past surveys) *Chrysemys picta*	Extant; sensitive	Yes	Range limited to North Willamette Valley and Columbia River marshy ponds, small lakes, slow-moving streams and quiet off-channel portions of rivers; muddy bottoms with aquatic vegetation; need open ground for nesting; need logs/ vegetation for basking.	Loss of aquatic and nesting habitats (conversion, invasive species); predation by bullfrogs, bass and raccoons; competition with invasive turtles.	Provide basking structures and nesting habitats; control invasive plants and animals; protect important nesting sites from disturbance; use wire cages to protect nests from raccoons at key sites in the short-term where this is a problem.
Northwestern pond turtle *Clemys marmorata marmorata)*	Extant; sensitive	Yes	Marshes, streams, rivers, ponds, and lakes; sparsely-vegetated ground nearby for digging nests; basking structures such as logs.	Loss of aquatic and nesting habitats (conversion, invasive plants); predation by bullfrogs, bass and raccoons; competition with invasive turtles.	Provide basking structures and nesting habitats; control invasive plants and animals; protect important nesting sites from disturbance.
BIRDS					
Acorn woodpecker *Melanerpes formicivorus*	Extant; sensitive	Yes	Oak woodlands with a high canopy and relatively understory; dead limbs or snags for storing acorns.	Loss of oak woodlands; small, localized populations; competition for nesting cavities from European starlings; colonial.	Work with private landowners to maintain and restore oak woodlands with open understories, especially large patches; maintain snags and older trees with dead limbs.
Aleutian Canada goose *Branta canadensis leucopareia* Note: AOU name is Aleutian cackling goose, *Branta hutchinsii leucopareia*.	Extant; sensitive; winter and migration only	Yes	In Oregon, coastal, grass-dominated fields and pastures for foraging and offshore islands for roosting. (Note: known to occur in Metro region.)	Declined historically due to non-native foxes in Alaska breeding areas, Semidi Islands (still not fully recovered); currently in Oregon there is a small migrant and wintering population; currently foraging sites are limited and occur on private land.	Aleutian Canada Goose Recovery Plan provides information on conservation strategies; use incentives and cooperative approaches to manage foraging habitat on private land; removed from federal threatened list in 2001 and from

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
					Oregon state endangered species list in 2005; winters in Metro region, so can contribute to its conservation.
American bald eagle *Haliaeetus leucocephalus*	Extant; sensitive	Yes	Associated with large water bodies (rivers, lakes, ocean) which support fish populations and have large trees for nesting nearby; variable habitat for wintering based on food availability.	Poor reproduction in Lower Columbia River estuary linked to contaminants; loss of large nesting trees. (Note: Portland Audubon documents frequent shootings of this species.)	Continue to monitor eagle productivity and contaminant levels present in fish in the Lower Columbia; maintain large trees near suitable feeding habitat.
American peregrine falcon *Falco peregrinus anatum*	Extant; sensitive	Yes	Rock cliffs for nest sites. (Note: in Metro region, most breeding pairs nest on large bridges.)	Eggshell thinning caused by organochlorine pesticides (e.g., residual DDT in Oregon); human disturbance at nests; loss of prey species. (Note: Metro population feeds largely on pigeons and starlings.)	The federal monitoring plan provides information on management and conservation actions for this formerly listed federal species. Note: although the American peregrine falcon has been down-listed from the federal endangered species list, it has not met recovery goals in southeast Oregon.
Band-tailed pigeon *Columba fasciata*	Extant; sensitive	Yes	Mineral sites; large conifer forest landscape with a variety of forest stand age and structure.	Reduction in quality, quantity of mineral sites; large territories; disease.	Maintain existing mineral sites; maintain, plant or otherwise manage for elderberry, cascara and other food plants.
Barrow's goldeneye (duck) *Bucephala islandica*	Extant; sensitive; winter and migration only	Yes	High elevation lake or pond habitat with abundant invertebrates (prey) and surrounded by forests; snags or large trees for nest sites nearby; logs, rocks for loafing.	Relatively small breeding populations; at southern end of range; needs suitable snags in conjunction with suitable water bodies.	Maintain, create snags near mountain lakes; nest boxes can be used as a short-term strategy to establish and/or expand populations; winters in Metro region, so can contribute to its conservation.
Bufflehead (duck) *Bucephala albeola*	Extant; sensitive; winter and migration only	Yes	High elevation lake or pond habitat with abundant invertebrates (prey) and surrounded by forests; snags or large trees for nest sites nearby; logs, rocks for loafing.	Relatively small breeding populations; at southern end of range; needs suitable snags in conjunction with suitable water bodies.	Maintain, create snags near mountain lakes; nest boxes can be used as a short-term strategy to establish and/or expand populations; winters in Metro region, so can contribute to its conservation.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Caspian tern *Sterna caspia*	Extant; not on sensitive species list	Yes	Unvegetated nesting islands free of mammalian predators.	Require long-term availability of nesting sites; colonial nester, so vulnerable to random, human-induced or natural events.	USFWS Status Assessment and Conservation Recommendations provide information on appropriate conservation actions for this non-listed species.
Chipping sparrow* *Spizella passerina*	Extant; not on sensitive species list (although declining in Metro region)	Yes	Open areas of herbaceous vegetation for foraging in understory of oak woodlands.	Declining populations; oak woodland loss and degradation; invasives in understory; altered fire regimes; possibly cowbird parasitism.	Maintain areas of open herbaceous understory in oak woodlands; control key invasive plants.
Common nighthawk *Chordeiles minor*	Extant but nearly extirpated; sensitive	Yes	Gravel bars, sparsely vegetated grasslands for nesting; aerial insect prey base.	Nesting habitat loss; increased predation by corvids, gulls, house cats; fewer insects.	Maintain sparsely vegetated grassland patches, restore riparian and wetland habitats for insect prey base.
Dusky Canada goose *Branta canadensis occidentalis*	Extant; sensitive	Yes	Adequate food resources (high quality, high protein herbaceous plants) in sufficient spatial and temporal distribution to sustain migratory and wintering populations.	Decline in this species is primarily due to poor reproduction in its breeding range in Alaska.	Information on conservation strategies available in Pacific Flyway management plan and Conservation Assessment for the Dusky Canada Goose (USFWS); winters in Metro region, so can contribute to its conservation.
Lewis' woodpecker *Melanerpes lewis*	Extirpated as breeding species; sensitive	Yes	Lives in ponderosa pine, oak or oak-pine woodlands, riparian cottonwood forests, and areas burned by wildfires; needs aerial insects for foraging; large snags for nesting, especially soft or well-decayed; fairly open canopy for flycatching.	Population declines and local extirpations; habitat loss and degradation; loss of old cottonwood snags; competition from starlings for nest cavities; large areas of suitable habitat on private lands.	Maintain or restore open oak, ponderosa pine and cottonwood woodlands along with post-fire ponderosa pine habitats that provide canopy cover <40% and shrub cover 30-80% with 6 trees/acre > 32 ft tall and 6 snags/acre > 20 inches dbh.
Little willow flycatcher* *Empidonax traillii brewsteri*	Extant; sensitive	Yes	Brushy patches of vegetation adjacent to water for nesting and foraging.	Declining populations; loss of riparian shrub habitat.	Restore brushy patches of willow and other native shrubby habitats near water.
Northern goshawk *Accipiter gentilis*	Extant; sensitive; winter and migration only	Yes	Large area requirements with a mosaic of forest stages, forest openings, and habitat components (e.g., snags, down logs); open forest floor for access to ground dwelling prey.	Large area requirements; affected by reductions in amount of late successional forest.	Maintain late successional forest habitat; maintain natural forest openings through prescribed fire, thinning and removal of encroaching conifers; winters in Metro region, so can contribute to its conservation.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Olive-sided flycatcher* *Contopus cooperi (= borealis)*	Extant; sensitive	Yes	Open older conifer forest, forested riparian habitat, forest openings (e.g., burns, harvested forest), or forest edge with tall, prominent trees and/or snags; hemlocks or true first for nest trees.	Relatively large territory compared to other songbirds; higher predation rates in harvest units within older or highly fragmented forests.	Maintain scattered large dead trees in patchy wildfires; maintain natural openings but minimize harvested forest openings within landscapes of older forest.
Oregon vesper sparrow *Pooecetes gramineus affinis*	Nearly extirpated as breeding species; sensitive	Yes	Grasslands for foraging and nesting, usually with scattered shrubs/trees and some bare ground.	Small disjunct populations; grassland loss, degradation due to invasive plants and lack of fire; nest failure due to timing of land management practices (e.g., mowing, haying, spraying); predation by house cats in some areas.	Maintain or restore grassland habitat, increase plant diversity for greater insect diversity, control key invasive plants, minimize disturbance during breeding season (4/15 – 7/15) at known nesting areas.
Pileated woodpecker *Dryocopus pileatus*	Extant; sensitive	Yes	Mixed coniferous forests, esp. late successional stands; large-diameter trees, snags for nest and roost sites; large-diameter snags, logs for foraging sites.	Habitat fragmentation; reductions in snag availability due to fire suppression and forest health management.	Maintain and create large-diameter hollow trees, snags and logs during forest management activities.
Short-eared owl *Asio flammeus*	Extant; not on sensitive species list; winter and migration only	Yes	Large expanses of marshes and wet prairies for foraging and nesting.	Loss of large wetland (marsh and wet prairie) habitat; small population; nests and communally roosts on ground, which makes species vulnerable to disturbance.	Maintain and restore wetland habitats, with an emphasis on maintaining large patches and/or expanding smaller ones; minimize disturbance at known communal roost sites; winters in Metro region, so can contribute to its conservation.
Slender-billed (white-breasted) nuthatch* *Sitta carolinensis aculeate*	Extant; not on sensitive species list, but declining in Metro region	Yes	Mature oak trees for foraging and nesting cavities.	Fewer mature oaks, fewer cavities.	Maintain large oaks >22 inches dbh; develop nest box programs for cavity habitat in the short-term.
Streaked horned lark *Eremophila alpestris strigata*	Extant; sensitive	Yes	Open, treeless expanse of sparsely vegetated grassland areas (including bare ground patches) for nesting and foraging.	Declining populations; loss and degradation of grassland habitat; nesting failure due to timing of land management practices (e.g., mowing, haying, spraying).	Maintain or restore sparsely vegetated grassland habitat, create nesting areas, increase plant diversity for greater insect diversity, control key non-native plants; designate locations to be managed for core populations; minimize disturbance during breeding season at known nesting areas.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Western bluebird* *Sialia mexicana*	Extant; sensitive	Yes	Grasslands and oak savannas for foraging; cavities, especially in savanna oaks for nesting; scattered trees or shrubs as hunting perches.	Habitat loss, habitat degradation due to invasive non-native plants and lack of fire, competition from non-native birds, predation by house cats.	Maintain or restore grassland and oak savanna habitat; maintain oaks > 22 inches dbh; create snags from competing conifers; maintain nest box programs for cavity habitat in the short term; design and place nest boxes to minimize use by starlings.
Western meadowlark *Sturnella neglecta*	Extant but extirpated as breeding species; sensitive	Yes	Large expanses of grasslands for foraging and nesting due to relatively large home range requirements; scattered shrubs, trees or posts for singing perches.	Declining populations; loss and degradation of grassland habitats; nesting failure due to timing of land management practices (e.g., mowing, haying, spraying).	Maintain or restore grassland habitat – especially large expanses of habitat (e.g., >100 acres); increase plant diversity for greater insect diversity; control key non-native plants; minimize disturbance during breeding season (4/15 – 7/1) at known nesting areas.
Western purple martin *Progne subis*	Extant; sensitive	Yes	Abundant cavities for colonial nesting; proximity to water or large, open areas for foraging.	Loss of nesting cavities; competition with starlings for nest cavities; adequate aerial insect prey base.	Create and maintain appropriate snags; maintain nest box programs for cavity habitat in the short-term; design and place nest boxes to minimize use by starlings.
Yellow-breasted chat *Icteria virens*	Extant; sensitive	Yes	Dense brushy thickets, especially near streams.	Loss of larger patches of dense riparian shrub habitat.	Restore relatively large areas of dense thickets of native shrub-dominated riparian habitats.
MAMMALS					
Columbian white-tailed deer *Odocoileus virginianus luecurus*	Extirpated; sensitive	Yes	Riparian habitat along the Lower Columbia River.	Habitat loss due to agricultural and residential development; flooding impacts on island and low-elevation mainland populations.	For existing Columbia River population, continue to implement Conservation actions identified in the Columbian white-tailed deer Recovery Plan.
Fringed myotis (bat) *Myotis thysanodes*	Extant; sensitive	Yes	Forest habitats; large snags and rock features for day, night and maternity roosts (occasionally uses bridges for night roosting); caves and mines for hibernacula; beetles for prey.	Disturbance at roosts; patchy distribution and rarity; reduction of large snags.	Use gates and seasonal closures to protect known hibernacula; maintain and create large-diameter hollow trees and large-diameter, newly dead snags during forest management activities.

Species	Metro list status	ODFW Strategy Species?	Habitat needs	Limiting factors	Conservation actions
Hoary bat *Lasiuris cinereus*	Extant; sensitive	Yes	Forest habitats, including late successional conifer forests which are used for roosting.	Habitat loss; migratory behavior increases vulnerability to habitat changes and mortality.	Little is known about this species; investigate data gaps and use results to guide management actions.
Long-legged myotis (bat) *Myotis volans*	Extant; sensitive	Yes	Often associated with late successional conifer forests or its components, esp. snags; uses large snags and hollow trees, primarily riparian for day, night, maternity roosts; may use bridges in forested habitat, caves or mines; forages in riparian forest/edges.	Reduction of late successional forest; loss of hollow trees and large diameter, tall, newly dead snags; loss of healthy riparian habitat; untimely bridge replacement.	Maintain and create large-diameter hollow trees and large diameter, tall, newly dead snags in riparian and upland habitat; maintain and restore diverse riparian areas; complete bridge replacement and maintenance when bats are absent.
Red tree vole *Arborimus (= Phenacomys) longicaudus*	Extant; sensitive	Yes	Dense, moist conifer forests; prefers large stand size; highly specialized diet of primarily Douglas-fir needles; requires large branches for protection of nests, typically at least 50 ft above the ground.	Very large home range; poor dispersal ability; low reproductive rates.	Continue to monitor populations in response to forest management activities. Note: a major food item for northern spotted owl.
Silver-haired bat *Lasionycteris noctivagans*	Extant; sensitive	Yes	Late-successional conifer forests; uses large snags and hollow trees for day, night, and maternity roosts; found in other habitats during migration.	Reduction of old growth conifer forests; loss of hollow trees and large diameter, tall, newly dead snags; migratory behavior increases risk due to habitat changes and mortality.	Maintain late successional conifer habitats; maintain and create large-diameter hollow trees and large diameter, tall, newly dead snags during forest management activities.
Western gray squirrel* *Sciurus griseus*	Extant; sensitive	Yes	Oak woodland and savanna; mixed oak-pine-fir woodlands; older trees with large limbs; continuous canopy for movement.	Habitat loss and fragmentation; vegetation changes due to fire suppression; residential and urban development.	Work with private landowners to maintain and restore oak and mixed oak/pine/fir woodlands, especially large patches; maintain continuous canopy within 200 ft of nest sites; maintain or plant mast species such as Oregon white oak and California hazel; maintain older trees with large limbs.

Appendix 6

Metro vertebrate species list

Appendix 6 Metro vertebrate species list

Purpose and limitations

The purpose of Metro's species list is threefold:

1. To identify fish and wildlife species that occur in the Metro region.
2. To identify the relative importance of various types of habitat to fish and wildlife species.
3. To provide a biologically meaningful way in which to describe the biodiversity of the Metro region.

THE LIST IS NOT A STATEMENT OF POLICY. In keeping with Metro's Streamside CPR Vision Statement, the focus of the list is on native fish and wildlife species whose historic ranges include the metropolitan area and whose habitats are or can be provided for in urban habitats. Urban habitats may never be conducive to significant populations of some species, such as black bear and cougar. Further analysis and Metro Council deliberation will help determine (to the extent possible) the type, amount, and location of fish and wildlife habitats that should be protected and/or restored. For example, landowner incentives will be developed for conservation purposes.

This list contains:

- All known native vertebrate species that currently exist within the Metro region (the final version will include a map of area involved) for at least a portion of the year and could be found in the region through diligent search by a knowledgeable person. Vagrant species (those that do not typically occur every year) are not included on this list.
- Extirpated (locally extinct) native vertebrate species known to have inhabited the region in the past.
- Nonnative vertebrate species with established breeding populations in the region.

The species list is based on the opinion of more than two dozen local wildlife experts. The Oregon Natural Heritage Program (ORNHP), Endangered Species Act (ESA), and Oregon Department of Fish and Wildlife (ODFW) status categories were obtained from ORNHP's February, 2001 *Rare, Threatened and Endangered Plants and Animals of Oregon* publication. Habitat associations were obtained from Johnson and O'Neil's new book, *Wildlife Habitats and Relationships in Oregon and Washington*. The taxonomic standards for common and scientific names for birds is based on the American Ornithological Union Check-list. We are also developing a separate aquatic and terrestrial invertebrate list, but this will not be as comprehensive in scope as the vertebrate species list.

Key to notations

- Indicates species that are **non-native** (also known as alien or introduced) to Metro region.

( ) Indicates a species that was **historically present but was extirpated** from the Metro region within approximately the last century.

Code (type of animal)
A = Amphibians
B = Birds
F = Fish
M = Mammals
R = Reptiles

Migratory Status (indicates trend for the majority of a given species in the Metro region):

A = Anadromous (fish; lives in the ocean, spawns in fresh water)

C = Catadromous (fish; lives in fresh water, spawns in the ocean)

M = Migrates through area without stopping for long time periods

N = Neotropical migratory species (birds; majority of individuals breeding in the Metro region migrate south of U.S./Mexico border for winter)

R = Permanent resident (lives in the area year-round)

S = Short-distance migrant (from elevational to regional migration, e.g., across several states)

W = Winters in the Metro region

Federal Status is based on current Endangered Species Act listings. **E** = Endangered, **T** = Threatened. Endangered taxa are those which are in danger of becoming extinct within the foreseeable future throughout all or a significant portion of their range. Threatened taxa are those likely to become endangered within the foreseeable future.

LE = Listed Endangered. Taxa listed by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS) as Endangered under the Endangered Species Act (ESA), or by the Departments of Agriculture (ODA) and Fish and Wildlife (ODFW) of the state of Oregon under the Endangered Species Act of 1987 (OESA).

LT = Listed Threatened. Taxa listed by the USFWS, NMFS, ODA, or ODFW as Threatened.

PE = Proposed Endangered. Taxa proposed by the USFWS or NMFS to be listed as Endangered under the ESA or by ODFW or ODA under the OESA.

PT = Proposed Threatened. Taxa proposed by the USFWS or NMFS to be listed as Threatened under the ESA or by ODFW or ODA under the OESA.

C = Candidate taxa for which NMFS or USFWS have sufficient information to support a proposal to list under the ESA, or which is a candidate for listing by the ODA under the OESA.

SoC = Species of Concern. Former C2 candidates which need additional information in order to propose as Threatened or Endangered under the ESA. These are species which USFWS is reviewing for consideration as Candidates for listing under the ESA.

ODFW Status (state status) is based on current Oregon Department of Fish and Wildlife "Oregon Sensitive Species List," 2001. See Federal Status (above) for definitions of LT and LE.

SC (Critical) = Species for which listing as threatened or endangered is pending; or those for which listing as threatened or endangered may be appropriate if immediate conservation actions are not taken. Also considered critical are some peripheral species which are at risk throughout their range, and some disjunct populations.

SV (Vulnerable) = Species for which listing as threatened or endangered is not believed to be imminent and can be avoided through continued or expanded use of adequate protective measures and monitoring. In some cases the population is sustainable, and protective measures are being implemented; in others, the population may be declining and improved protective measures are needed to maintain sustainable populations over time.

SP (Peripheral or Naturally Rare) = Peripheral species refer to those whose Oregon populations are on the edge of their range. Naturally rare species are those which had low population numbers historically in Oregon because of naturally limiting factors. Maintaining the status quo for the habitats

and populations of these species is a minimum requirement. Disjunct populations of several species which occur in Oregon should not be confused with peripheral.

SU (Undetermined Status): Animals in this category are species for which status is unclear. They may be susceptible to population decline of sufficient magnitude that they could qualify for endangered, threatened, critical or vulnerable status, but scientific study will be required before a judgment can be made.

ORNHP Rank (ABI – Natural Heritage Network Ranks): ORNHP participates in an international system for ranking rare, threatened and endangered species throughout the world. The system was developed by The Nature Conservancy and is maintained by The Association for Biodiversity Information (ABI) in cooperation with Heritage Programs or Conservation Data Centers (CDCs) in all 50 states, 4 Canadian provinces, and 13 Latin American countries. The ranking is a 1-5 scale, primarily based on the number of known occurrences, but also including threats, sensitivity, area occupied and other biological factors. On Metro's Species List the first ranking (**rank**/rank) is the Global Rank and begins with a "G". If the taxon has a trinomial (a subspecies, variety or recognized race), this is followed by a "T" rank indicator. A "Q" at the end of this ranking indicates the taxon has taxonomic questions. The second ranking (rank/**rank**) is the State Rank and begins with the letter "S". The ranks are summarized below.

1 = Critically imperiled because of extreme rarity or because it is somehow especially vulnerable to extinction or extirpation, typically with 5 or fewer occurrences

2 = Imperiled because of rarity or because other factors demonstrably make it very vulnerable to extinction (extirpation), typically with 6-20 occurrences

3 = Rare, uncommon or threatened, but not immediately imperiled, typically with 21-100 occurrences

4 = Not rare and apparently secure, but with cause for long-term concern, usually more than 100 occurrences

5 = Demonstrably widespread, abundant and secure

H = Historical Occurrence, formerly part of the native biota with the implied expectation that it may be rediscovered

X = Presumed extirpated or extinct

U = Unknown rank

? = Not yet ranked, or assigned rank is uncertain

ORNHP List is based on Oregon Natural Heritage Program data.

List 1 contains taxa that are threatened with extinction or presumed to be extinct throughout their entire range.

List 2 contains taxa that are threatened with extirpation or presumed to be extirpated from the state of Oregon. These are often peripheral or disjunct species which are of concern when considering species diversity within Oregon's borders. They can be very significant when protecting the genetic diversity of a taxon. ORNHP regards extreme rarity as a significant threat and has included species which are very rare in Oregon on this list.

List 3 contains species for which more information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.

List 4 contains taxa which are of conservation concern but are not currently threatened or endangered. This includes taxa which are very rare but are currently secure, as well as taxa which are

declining in numbers or habitat but are still too common to be proposed as threatened or endangered. While these taxa currently may not need the same active management attention as threatened or endangered taxa, they do require continued monitoring.

Riparian Association indicates use of any of the 4 water-based habitats. Single "X" in any habitat type (upland or water-associated) indicates general association; "XX" indicates close association, as per Johnson and O'Neil 2001.

Habitat Types based on Johnson and O'Neil (2001). These habitats are described more fully within the text of the upland and riparian chapters.

WLCH = Westside Lowlands Conifer-Hardwood Forest

WODF = Westside Oak and Dry Douglas-fir Forest and Woodlands

WEGR = Westside Grasslands

AGPA = Agriculture, Pasture and Mixed Environs

URBN = Urban and Mixed Environs

WATR = Open Water – Lakes, Rivers, Streams

HWET = Herbaceous Wetlands

RWET = Westside Riparian-Wetlands

Appendix 1. Species list and habitat associations for species normally occurring within the Metro region. Study area is the Metro jurisdictional boundary plus 1 mile buffer.

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
F	River Lamprey	*Lampetra ayresi*	A	SoC	None	G4/S4	4	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Western Brook Lamprey	*Lampetra richardsoni*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Pacific Lamprey	*Lampetra tridentata*	A	SoC	SV	G5/S3	2	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	White Sturgeon	*Acipenser transmontanus*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	American Shad*	*Alosa sapidissima*	A	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chiselmouth	*Acrocheilus alutaceus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Goldfish*	*Carassius auratus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Common Carp*	*Cyprinus carpio*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Peamouth Chub	*Mylocheilus caurinus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
(F)	(Oregon Chub - extirpated from Metro area)	*Oregonichthys crameri*	R	LE	SC	G2/S2	1	(XX)	(XX)	(XX)	N/A	N/A	N/A	N/A	N/A	N/A
F	Northern Pikeminnow (Squawfish)	*Ptychocheilus oregonensis*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Longnose Dace	*Rhynichthys cataractae*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Leopard Dace	*Rhynichthys falcatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Speckled Dace	*Rhynichthys osculus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Redside Shiner	*Richardsonius balteatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Largescale Sucker	*Catostomus macrocheilus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Brown Bullhead*	*Ameiurus nebulosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	N/A	N/A	N/A	N/A	N/A	N/A
F	Eulachon (Columbia River Smelt)	*Thaleichthys pacificus*	A	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coastal Cutthroat Trout, SW WA/Col. R. ESU	*Oncorhynchus clarki clarki*	A	PT	SC	G4T2Q/S2	2	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F	Coastal Cutthroat Trout, Upper Will. R. ESU	*Oncorhynchus clarki clarki*	A	SoC	None	G4T?Q/S3?	4	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F	Chum Salmon, Columbia River ESU	*Oncorhynchus keta*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coho Salmon, Oregon Coast ESU	*Oncorhynchus kisutch*	A	LT	SC	G4T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Coho Salmon, Lower Columbia R./Southwest Washington ESU	*Oncorhynchus kisutch*	A	C	LE	G4T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Rainbow Trout (resident populations)	*Oncorhynchus mykiss*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead (anadromous Rainbow Trout), Oregon Coast ESU	*Oncorhynchus mykiss*	A	C	SV	G5T2T3Q/S2S3	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Lower Columbia River ESU	*Oncorhynchus mykiss*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Upper Willamette River ESU, winter run	*Oncorhynchus mykiss*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Middle Columbia River ESU	*Oncorhynchus mykiss*	A	LT	SC/SV	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Snake River Basin ESU	*Oncorhynchus mykiss*	A	LT	SV	G5T2T3Q/S2S3	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Steelhead, Upper Columbia River ESU	*Oncorhynchus mykiss*	A	LE	None	G5T2Q/SU	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Sockeye Salmon, Snake River ESU	*Oncorhynchus nerka*	A	LE	None	G5T1Q/SX	1 - ex	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Lower Columbia R. ESU	*Oncorhynchus tshawytscha*	A	LT	SC	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Upper Will. R spring run	*Oncorhynchus tshawytscha*	A	LT	None	G5T2Q/S2	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Snake River Fall-run ESU	*Oncorhynchus tshawytscha*	A	LT	LT	G5T1Q/S1	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Snake River Spr/Sum.run	*Oncorhynchus tshawytscha*	A	LT	LT	G5T1Q/S1	1	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Chinook Salmon, Upper Col. R. Spring-run	*Oncorhynchus tshawytscha*	A	LE	None	G5T1Q/SU	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Mountain Whitefish	*Prosopium williamsoni*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Sand Roller	*Percopsis transmontanus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Mosquitofish*	*Gambusia affinis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	N/A	N/A	N/A	N/A	N/A	N/A
F	Three-spined Stickleback	*Gasterosteus aculeatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Prickly Sculpin	*Cottus asper*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Reticulate Sculpin	*Cottus perplexus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Green Sunfish*	*Lepomis cyanellus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Pumpkinseed Sunfish*	*Lepomis gibbosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Warmouth*	*Lepomis gulosus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Bluegill*	*Lepomis macrochirus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Smallmouth Bass*	*Micropterus dolomieu*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Largemouth Bass*	*Micropterus salmoides*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F*	White Crappie*	*Pomoxis annularis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Black Crappie*	*Pomoxis nigromaculatus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F*	Yellow Perch*	*Perca flavescens*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	X	N/A	N/A	N/A	N/A	N/A	N/A
F*	Walleye*	*Stizostedion vitreum vitreum*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A
F	Starry Flounder	*Platichthys stellatus*	R	None	None	None	None	XX	XX	?	N/A	N/A	N/A	N/A	N/A	N/A

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
A	Northwestern Salamander	*Ambystoma gracile*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Long-toed Salamander	*Ambystoma macrodactylum*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Pacific Giant Salamander	*Dicamptodon tenebrosus*	R	None	None	None	None	XX			XX	X	X	X		X
A	Cope's Giant Salamander	*Dicamptodon copei*	R	None	SU	G3/S2	2	XX	X		XX	X				
A	Columbia Torrent Salamander	*Rhyacotriton kezeri*	R	None	SC	G3/S3	2	XX			XX	X				
A	Cascade Torrent Salamander	*Rhyacotriton cascadae*	R	None	SV	G3/S3	2	XX			XX	X				
A	Rough-skinned Newt	*Taricha granulosa*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Dunn's Salamander	*Plethodon dunni*	R	None	None	None	None	X			X	X	X			X
A	Western Red-backed Salamander	*Plethodon vehiculum*	R	None	None	None	None	X			X	X	X			X
A	Ensatina	*Ensatina eschscholtzii*	R	None	None	None	None	X			X	XX	X	X	X	X
A	Clouded Salamander	*Aneides ferreus*	R	None	SU	G3/S3	3					X	X		X	X
A	Oregon Slender Salamander	*Batrachoseps wrighti*	R	SoC	SU	G4/S3	1	X			X	X				
A	Western Toad	*Bufo boreas*	R	None	SV	G4/S4	4	XX	XX	XX	XX	X	X	X	X	X
A	Tailed Frog	*Ascaphus truei*	R	SoC	SV	G4/S3	2	XX			XX	X				
A	Pacific Chorus Frog (tree frog)	*Hyla regilla*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
A	Northern Red-legged Frog	*Rana aurora aurora*	R	SoC	SV/SU	G4T4/S3	2	XX	XX	XX	XX	XX	X	X	X	X
(A)	(Oregon Spotted Frog - extirpated)	*Rana pretiosa*	R	C	SC	G2G3/S2	1	(XX)	(XX)	(XX)	(XX)	(X)	(X)	(X)	(X)	
A*	Bullfrog*	*Rana catesbeiana*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	XX	X	X	X	X	X
R*	Common Snapping Turtle*	*Chelydra serpentina*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	X				X	X
R	Painted Turtle	*Chrysemys picta*	R	None	SC	G5/S2	2	XX	XX	XX	X		X		X	X
R	Northwestern Pond Turtle	*Clemmys marmorata marmorata*	R	SoC	SC	G3T3/S2	1	XX	XX	XX	XX	X	XX	X	X	X
R*	Red-eared Slider*	*Trachemys scripta elegans*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	X				X	X
R	Northern Alligator Lizard	*Elgaria coerulea*	R	None	None	None	None	X			X	X	X	X		X
R	Southern Alligator Lizard	*Elgaria multicarinata*	R	None	None	None	None	X			X	X	X	X	X	X
R	Western Fence Lizard	*Sceloporus occidentalis*	R	None	None	None	None					X	X	X	X	X
R	Western Skink	*Eumeces skiltonianus*	R	None	None	None	None					X	X	X	X	X
R	Rubber Boa	*Charina bottae*	R	None	None	None	None	X			X	X		X	X	X
R	Racer	*Coluber constrictor*	R	None	None	None	None						X	X	X	X
R	Sharptail Snake	*Contia tenuis*	R	None	SV	G5/S3	4	X			X	X	X	X	X	X
R	Ringneck Snake	*Diadophis punctatus*	R	None	None	None	None	X			X	X	X	X	X	X
R	Gopher Snake	*Pituophis catenifer*	R	None	None	None	None						X	X	X	X
R	Western Terrestrial Garter Snake	*Thamnophis elegans*	R	None	None	None	None	X		X	X		X	X	X	X
R	Northwestern Garter Snake	*Thamnophis ordinoides*	R	None	None	None	None	X			X	X	X	X	X	X
R	Common Garter Snake	*Thamnophis sirtalis*	R	None	None	None	None	XX		XX	XX	X	X	X	X	X
B	Red-throated Loon	*Gavia stellata*	W / M	None	None	None	None	XX			XX					
B	Pacific Loon	*Gavia pacifica*	W / M	None	None	None	None	XX			XX					
B	Common Loon	*Gavia immer*	W / M	None	None	None	None	XX	X	XX						
B	Pied-billed Grebe	*Podilymbus podiceps*	S / N	None	None	None	None	XX	X	XX	X					
B	Horned Grebe	*Podiceps auritus*	W / M	None	SP	G5/S2B, S5N	2	XX	XX	XX						
B	Eared Grebe	*Podiceps nigricollis*	W	None	None	None	None	XX	XX	XX						
B	Western Grebe	*Aechmophorus occidentalis*	W	None	None	None	None	XX	XX	XX						
B	Clark's Grebe	*Aechmophorus clarkii*	W / M	None	None	None	None	XX	XX	XX						
B	Doubled-crested Cormorant	*Phalacrocorax auritus*	R / S	None	None	None	None	XX	XX	X	X					X
B	American Bittern	*Botaurus lentiginosus*	S / N	None	None	None	None	XX		XX					X	
B	Great Blue Heron	*Ardea herodias*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	XX	X
B	Great Egret	*Ardea alba*	W / M	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Green Heron	*Butorides virescens*	N / S	None	None	None	None	XX	X	XX	XX					
B	Black-crowned Night Heron	*Nycticorax nycticorax*	S	None	None	None	None	XX	XX	XX	X					
(B)	(California Condor - extirpated)	*(Gymnogyps californianus)*	R	LE	None	G1SX	1-ex	(X)			(X)			(X)		

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Turkey Vulture	*Cathartes aura*	N	None	None	None	None	X		X	X	X	X	X	X	X
B	Greater White-fronted Goose	*Anser albifrons*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Snow Goose	*Chen caerulescens*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Ross's Goose	*Chen rossii*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Canada Goose	*Branta canadensis*	VARIABLE	None	None	None	None	XX	XX	XX	X				XX	
B	Dusky Canada Goose	*Branta canadensis occidentalis*	W / M	None	None	G5T2T3/ S2N	4	XX	XX	XX	X				XX	
B	Aleutian Canada Goose (wintering)	*Branta canadensis leucopareia*	W / M	LT	LE	G5T3/S2N	1	XX	XX	XX	X				XX	
B	Trumpeter Swan	*Cygnus buccinator*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Tundra Swan	*Cygnus columbianus*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Wood Duck	*Aix sponsa*	S	None	None	None	None	XX	XX	X	XX	X			X	
B	Gadwall	*Anas strepera*	W / M	None	None	None	None	XX	XX	XX				X	X	
B	Mallard	*Anas platyrhynchos*	R	None	None	None	None	XX	X	XX	XX				X	X
B	Eurasian Wigeon	*Anas penelope*	W / M	None	None	None	None	XX	XX	X					X	
B	American Wigeon	*Anas americana*	W / M	None	None	None	None	XX	X	XX	X				XX	
B	Blue-winged Teal	*Anas discors*	W / M	None	None	None	None	XX	X	XX				X	XX	
B	Cinnamon Teal	*Anas cyanoptera*	N	None	None	None	None	XX	X	XX				X	XX	
B	Northern Shoveler	*Anas clypeata*	W / M	None	None	None	None	XX	XX	XX				X	X	
B	Northern Pintail	*Anas acuta*	W / M	None	None	None	None	XX	XX	XX					X	
B	Green-winged Teal	*Anas crecca*	S	None	None	None	None	XX	X	XX	X			X	X	
B	Canvasback	*Aythya valisineria*	W / M	None	None	None	None	XX	XX	XX						
B	Redhead	*Aythya americana*	W / M	None	None	None	None	XX	XX	XX						
B	Ring-necked Duck	*Aythya collaris*	W / M	None	None	None	None	XX	X	X	XX					
B	Greater Scaup	*Aythya marila*	W / M	None	None	None	None	XX	XX							
B	Lesser Scaup	*Aythya affinis*	W / M	None	None	None	None	XX	XX	XX						
B	Surf Scoter	*Melanitta perspicillata*	W / M	None	None	None	None	X	X							
B	Harlequin Duck	*Histrionicus histrionicus*	W / M	SoC	SU	G4/S2B, S3N	2	XX	XX		XX					
B	Bufflehead	*Bucephala albeola*	W / M	None	SU	G5/S2B,S5N	4	XX	XX	XX	X					
B	Common Goldeneye	*Bucephala clangula*	M	None	None	None	None	XX	XX	X						
B	Barrow's Goldeneye	*Bucephala islandica*	W / M	None	SU	G5/S3B,S3N	4	XX	XX	X						
B	Hooded Merganser	*Lophodytes cucullatus*	W / M	None	None	None	None	XX	XX	X	XX	XX				
B	Common Merganser	*Mergus merganser*	W / M	None	None	None	None	XX	XX		XX	XX				
B	Red-breasted Merganser	*Mergus serrator*	W / M	None	None	None	None	X	X							
B	Ruddy Duck	*Oxyura jamaicensis*	W / M	None	None	None	None	XX	XX	XX						
B	Osprey	*Pandion haliaetus*	N	None	None	None	None	XX	XX		X	X	X		X	X
B	White-tailed Kite (appears to be undergoing range expansion)	*Elanus leucurus*	W / M	None	None	G5/S1B, S3N	2	X			X	X		X	XX	
B	Bald Eagle[a]	*Haliaeetus leucocephalus*	S	LT[a]	LT	G4/S3B, S4N	2	XX	XX	X	X	X	X	X	X	X
B	Northern Harrier	*Circus cyaneus*	N	None	None	None	None	X		X	X			X	X	X
B	Sharp-shinned Hawk	*Accipiter striatus*	N	None	None	None	None	X		X		X	X	X	X	X
B	Cooper's Hawk	*Accipiter cooperii*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Northern Goshawk	*Accipiter gentilis*	W / M	SoC	SC	G5/S3	2	X		X	X	X	X			
B	Red-shouldered Hawk (appears to be undergoing range expansion)	*Buteo lineatus*	?	None	None	None	None	X			X	X			X	
B	Red-tailed Hawk	*Buteo jamaicensis*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Rough-legged Hawk	*Buteo lagopus*	W / M	None	None	None	None	X		X	X	X	X	X	X	X
B	American Kestrel	*Falco sparverius*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Merlin	*Falco columbarius*	W / M	None	None	G5/S1B	2	X	X	X	X	X	X	X	X	X
B	American Peregrine Falcon	*Falco peregrinus anatum*	N	None	LE	G4T3/S1B	2	X	X	X	X	X	X	X	X	X
B*	Ring-necked Pheasant*	*Phasianus colchicus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X		X	X	X	X	XX	XX	X
B	Ruffed Grouse	*Bonasa umbellus*	R	None	None	None	None	XX			XX	XX	X		X	
B	Blue Grouse	*Dendragapus obscurus*	R	None	None	None	None	X			X	XX	X			
B*	Wild Turkey*	*Meleagris gallopavo*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X	X	X	X	X	X

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
(B)	(Mountain Quail - extirpated)	*Oreortyx pictus*	R / S	SoC	SU	G5/S4?	4	(X)			(X)	(X)	(X)		(X)	(X)
B	California Quail	*Callipepla californica*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Virginia Rail	*Rallus limicola*	R / S	None	None	None	None	XX		XX					X	
B	Sora	*Porzana carolina*	S / N	None	None	None	None	XX		XX					X	
B	American Coot	*Fulica americana*	R / S	None	None	None	None	XX	XX	XX					X	X
B	Lesser Sandhill Crane	*Grus canadensis*	W / M	None	None	None	None	XX		XX					XX	
B	Black-bellied Plover	*Pluvialis squatarola*	M	None	None	None	None	X	X						XX	
B	American Golden-plover	*Pluvialis dominica*	W / M	None	None	None	None	X	X						XX	
B	Semipalmated Plover	*Charadrius semipalmatus*	M	None	None	None	None	XX	XX						X	
B	Killdeer	*Charadrius vociferus*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Greater Yellowlegs	*Tringa melanoleuca*	W / M	None	None	None	None	XX	XX	XX	X			X	X	
B	Lesser Yellowlegs	*Tringa flavipes*	W / M	None	None	None	None	XX	XX	XX	X			X	X	
B	Solitary Sandpiper	*Tringa solitaria*	W / M	None	None	None	None	XX	XX	XX	XX			X	X	
B	Spotted Sandpiper	*Actitis macularia*	N	None	None	None	None	XX	X	X	XX				X	
B	Semipalmated Sandpiper	*Calidris pusilla*	W / M	None	None	None	None	XX	XX							
B	Western Sandpiper	*Calidris mauri*	W / M	None	None	None	None	XX	XX	XX					X	
B	Least Sandpiper	*Calidris minutilla*	W / M	None	None	None	None	XX	X	XX					X	
B	Baird's Sandpiper	*Calidris bairdii*	W / M	None	None	None	None	XX	X	XX					X	
B	Pectoral Sandpiper	*Calidris melanotos*	W / M	None	None	None	None	XX	X	XX					X	
B	Dunlin	*Calidris alpina*	W / M	None	None	None	None	XX	XX	XX					XX	
B	Short-billed Dowitcher	*Limnodromus griseus*	W / M	None	None	None	None	X		X					X	
B	Long-billed Dowitcher	*Limnodromus scolopaceus*	W / M	None	None	None	None	XX	X	XX					XX	
B	Common Snipe	*Gallinago gallinago*	S / N	None	None	None	None	XX		XX				X	XX	
B	Wilson's Phalarope	*Phalaropus tricolor*	W / M	None	None	None	None	XX	X	X						
B	Red-necked Phalarope	*Phalaropus lobatus*	W / M	None	None	None	None	X	X							
B	Bonaparte's Gull	*Larus philadelphia*	M / W	None	None	None	None	XX	X						X	X
B	Mew Gull	*Larus canus*	W / M	None	None	None	None	XX	XX						X	X
B	Ring-billed Gull	*Larus delawarensis*	W / M	None	None	None	None	XX	XX	X					X	X
B	California Gull	*Larus californicus*	S	None	None	None	None	XX	XX	X					X	X
B	Herring Gull	*Larus agentatus*	W / M	None	None	None	None	XX	XX	X					X	X
B	Thayer's Gull	*Larus thayeri*	W / M	None	None	None	None	XX	XX	X					X	X
B	Western Gull	*Larus occidentalis*	R / S	None	None	None	None	X	X							XX
B	Glaucous Gull	*Larus hyperboreus*	W / M	None	None	None	None	XX	XX	X						X
B	Glaucous-winged Gull	*Larus glaucescens*	W / M	None	None	None	None	XX	X							XX
B	Caspian Tern	*Sterna caspia*	N	None	None	None	None	XX	XX	XX						
B	Forster's Tern	*Sterna forsteri*	M	None	None	None	None	XX	XX	XX						
B	Common Tern	*Sterna hirundo*	W / M	None	None	None	None	X	X							
B*	Rock Dove*	*Columba livia*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien							X	XX	XX
B	Band-tailed Pigeon	*Columba fasciata*	S	SoC	None	G5/S4	4	XX			XX	XX	XX		X	X
B	Mourning Dove	*Zenaida macroura*	S	None	None	None	None	XX			XX	X	X	X	XX	X
B	Barn Owl	*Tyto alba*	R / S	None	None	None	None	X		X	X		X	X	XX	X
B	Western Screech-Owl	*Otus kennicottii*	R	None	None	None	None	X		X	X	X	X		X	X
B	Great Horned Owl	*Bubo virginianus*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Northern Pygmy-Owl	*Glaucidium gnoma*	R	None	SC	G5/S4?	4	X		X	X	XX	X		X	X
(B)	(Northern Spotted Owl - extirpated from Metro region)	*(Strix occidentalis caurina)*	(S)	LT	LT	G3T3S3	1					(XX)	(X)			
B	Barred Owl	*Strix varia*	R	None	None	None	None	X			X	XX	X			X
B	Long-eared Owl	*Asio otus*	W / M	None	None	None	None	X		X		X	X	X	X	
B	Short-eared Owl	*Asio flammeus*	W / M	None	None	None	None	XX		XX				X	XX	
B	Northern Saw-whet Owl	*Aegolius acadicus*	R / S	None	None	None	None	X			X	XX	XX		X	X
B	Common Nighthawk (nearly extirpated)	*Chordeiles minor*	N	None	SC	G5/S5	4	X	X	X	X	X	X	X	X	X
B	Vaux's Swift	*Chaetura vauxi*	N	None	None	None	None	XX	XX	X	X	X	X	X		X

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Anna's Hummingbird	*Calypte anna*	R	None	None	None	None	X			X	XX	X			X
B	Rufous Hummingbird	*Selasphorus rufus*	N	None	None	None	None	X		X	X	X	X	X	X	X
B	Belted Kingfisher	*Ceryle alcyon*	S	None	None	None	None	XX	XX		XX					
B	Lewis's Woodpecker (extirpated as breeding species)	*Melanerpes lewis*	W / M	SoC	SC	G5/S3B, S3N	4	X			X		XX	X	X	X
B	Acorn Woodpecker	*Melanerpes formicivorus*	R	SoC	None	G5/S3?	4						XX	X		X
B	Red-breasted Sapsucker	*Sphyrapicus ruber*	S	None	None	None	None	X			X	X	X	X	X	X
B	Downy Woodpecker	*Picoides pubescens*	R	None	None	None	None	XX			XX	X	X		X	X
B	Hairy Woodpecker	*Picoides villosus*	R	None	None	None	None	X			X	X	X	X	X	X
B	Northern Flicker	*Colaptes auratus*	R	None	None	None	None	X			X	X	X	X	X	X
B	Pileated Woodpecker	*Dryocopus pileatus*	R	None	SV	G5/S4?	4	X			X	X	X		X	X
B*	Monk Parakeet*	*Myiopsitta monachus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX			XX		X		X	XX
(B)	(Yellow-billed Cuckoo; extirpated)	*Coccyzus americanus*	N	SoC	SC	G5/S1B	2	(XX)			(XX)					
B	Olive-sided Flycatcher	*Contopus cooperi (= borealis)*	N	SoC	SV	G5/S4	4	X			X	XX				
B	Western Wood-Pewee	*Contopus sordidulus*	N	None	None	None	None	X			X	X	X		X	X
B	Willow Flycatcher (western OR race)	*Empidonax traillii brewsteri*	N	None	SV	G5TU/S1B	4	XX			XX	X	X		X	X
B	Hammond's Flycatcher	*Empidonax hammondii*	N	None	None	None	None					X	X			
B	Dusky Flycatcher	*Empidonax oberholseri*	M	None	None	None	None	X			X	X	X			
B	Pacific-slope Flycatcher	*Empidonax dificilus*	N	None	None	None	None	X			X	XX	X			
B	Say's Phoebe	*Sayornis saya*	N	None	None	None	None							X	X	X
B	Western Kingbird	*Tyrannus verticalis*	N	None	None	None	None						X	X	X	X
B	Northern Shrike	*Lanius excubitor*	W / M	None	None	None	None	X		X				X	XX	
B	Cassin's Vireo	*Vireo cassinii*	N	None	None	None	None					X	XX			X
B	Hutton's Vireo	*Vireo huttoni*	R / S	None	None	None	None	X			X	X	XX		X	X
B	Warbling Vireo	*Vireo gilvus*	N	None	None	None	None	XX			XX	XX	X		X	X
B	Red-eyed Vireo	*Vireo olivaceus*	N	None	None	None	None	XX			XX	X				
B	Steller's Jay	*Cyanocitta stelleri*	R	None	None	None	None	X			X	X	X		X	X
B	Western Scrub-Jay	*Aphelocoma californica*	R	None	None	None	None	X			X	X	XX	X	X	X
B	Gray Jay	*Perisoreus canadensis*	R	None	None	None	None	X			X	X	X			X
B	American Crow	*Corvus brachyrhynchos*	R	None	None	None	None	X		X	X	X	X	X	XX	XX
B	Common Raven	*Corvus corax*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Streaked Horned Lark	*Eremophila alpestris strigata*	S	SoC	SC	G5T2/S2?	2							XX	X	X
B	Purple Martin	*Progne subis*	N	SoC	SC	G5/S3B	2	XX	XX	X	X	X	X	X		X
B	Tree Swallow	*Tachycineta bicolor*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Violet-green Swallow	*Tachycineta thalassina*	N	None	None	None	None	X	X	X	X	X	X	X	X	X
B	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
B	Cliff Swallow	*Petrochelidon pyrrhonota*	N	None	None	None	None	XX	XX	X	XX	X	X	X	X	X
B	Barn Swallow	*Hirundo rustica*	N	None	None	None	None	XX	XX	XX	XX	X	X	X	XX	X
B	Black-capped Chickadee	*Poecile atricapilla*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Mountain Chickadee	*Poecile gambeli*	W / M	None	None	None	None	X			X	X	X			X
B	Chestnut-backed Chickadee	*Poecile rufescens*	R	None	None	None	None	X			X	X	X		X	X
B	Bushtit	*Psaltriparus minimus*	R	None	None	None	None	X			X	X	X		X	X
B	Red-breasted Nuthatch	*Sitta canadensis*	R	None	None	None	None	X			X	X	X		X	X
B	White-breasted Nuthatch	*Sitta carolinensis*	R	None	None	None	None	X			X		X	X	X	X
B	Brown Creeper	*Certhia americana*	R	None	None	None	None	X			X	X	X	X	X	X
B	Bewick's Wren	*Thryomanes bewickii*	R	None	None	None	None	X		X	X	X	X		X	X
B	House Wren	*Troglodytes aedon*	N	None	None	None	None	X			X	X	X	X	X	X
B	Winter Wren	*Troglodytes troglodytes*	R	None	None	None	None	X			X	X	X			X
B	Marsh Wren	*Cistothorus palustris*	N	None	None	None	None	XX		XX						
B	American Dipper	*Cinclus mexicanus*	R / S	None	None	None	None	XX	XX	X	XX					
B	Golden-crowned Kinglet	*Regulus satrapa*	R	None	None	None	None	X			X	XX	X			X
B	Ruby-crowned Kinglet	*Regulus calendula*	W / M	None	None	None	None	X		X	X	X	X	X	X	X
B	Western Bluebird	*Sialia mexicana*	S	None	SV	G5/S4B, S4N	4					XX	XX	X	X	X

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
B	Townsend's Solitaire	*Myadestes townsendi*	W / M	None	None	None	None	X			X	X	X		X	X
B	Swainson's Thrush	*Catharus ustulatus*	N	None	None	None	None	X			X	X	X		X	X
B	Hermit Thrush	*Catharus guttatus*	S	None	None	None	None	X			X	X	X		X	X
B	American Robin	*Turdus migratorius*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Varied Thrush	*Ixoreus naevius*	W / M	None	None	None	None					XX	X		X	X
B*	European Starling*	*Sturnus vulgaris*	R / S	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX		X	XX	X	X	X	X	XX
B	American Pipit	*Anthus rubescens*	W / M	None	None	None	None	X		X				X	XX	
B	Cedar Waxwing	*Bombycilla cedrorum*	S	None	None	None	None	X		X	X	X	X		X	X
B	Orange-crowned Warbler	*Vermivora celata*	N	None	None	None	None	X			X	X	X	X	X	X
B	Nashville Warbler	*Vermivora ruficapilla*	N	None	None	None	None	X			X	X	X		X	
B	Yellow Warbler	*Dendroica petechia*	N	None	None	None	None	XX			XX					
B	Yellow-rumped Warbler	*Dendroica coronata*	S	None	None	None	None	X		X	X	X	X		X	X
B	Black-throated Gray Warbler	*Dendroica nigrescens*	N	None	None	None	None	XX			XX	XX	XX		X	X
B	Townsend's Warbler	*Dendroica townsendi*	S / N	None	None	None	None	X			X	X	X		X	X
B	Hermit Warbler	*Dendroica occidentalis*	N	None	None	None	None	X			X	XX	X			
B	MacGillivray's Warbler	*Oporornis tolmiei*	N	None	None	None	None	X			X	X	X		X	
B	Common Yellowthroat	*Geothlypis trichas*	N	None	None	None	None	XX		XX	XX	X	X	X		X
B	Wilson's Warbler	*Wilsonia pusilla*	N	None	None	None	None	XX			XX	XX	X		X	X
B	Yellow-breasted Chat	*Icteria virens*	N	SoC	SC	G5/S4?	4	XX			XX	X	X		X	
B	Western Tanager	*Piranga ludoviciana*	N	None	None	None	None	X			X	XX	XX			X
B	Spotted Towhee	*Pipilo maculatus*	R	None	None	None	None	X			X	X	XX		X	X
B	Chipping Sparrow	*Spizella passerina*	N	None	None	None	None	X			X	X	X	X	X	X
B	Oregon Vesper Sparrow	*Pooecetes gramineus affinis*	S / N	SoC	SC	G5T3/S2B, S2N	2							XX	XX	
B	Savannah Sparrow	*Passerculus sandwichensis*	S / N	None	None	None	None	X		X	X			XX	XX	X
B	Fox Sparrow	*Passerella iliaca*	W / M	None	None	None	None	X			X	X	X		X	X
B	Song Sparrow	*Melospiza melodia*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Lincoln's Sparrow	*Melospiza lincolnii*	S / N	None	None	None	None	XX		XX	XX	X			X	
B	Swamp Sparrow	*Melospiza georgiana*	W / M	None	None	None	None	XX		XX	XX				X	
B	White-throated Sparrow	*Zonotrichia albicollis*	W / M	None	None	None	None								X	X
B	Harris's Sparrow	*Zonotrichia querula*	W / M	None	None	None	None								X	X
B	White-crowned Sparrow	*Zonotrichia leucophrys*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Golden-crowned Sparrow	*Zonotrichia atricapilla*	R	None	None	None	None	X		X	X	X	X	X	X	X
B	Dark-eyed Junco	*Junco hyemalis*	S	None	None	None	None	X			X	X	X		X	X
B	Black-headed Grosbeak	*Pheucticus melanocephalus*	N	None	None	None	None	X			X	X	X		X	X
B	Lazuli Bunting	*Passerina amoena*	N	None	None	None	None	X			X	X	X	X	XX	X
B	Red-winged Blackbird	*Agelaius phoeniceus*	S	None	None	None	None	XX		XX	X			X	X	X
B	Tricolored Blackbird	*Agelaius tricolor*	S	SoC	SP	G3/S2B	2	XX		XX					X	
B	Western Meadowlark (extirpated as breeding species)	*Sturnella neglecta*	W / M	None	SC	G5/S5	4	X		X				XX	XX	
B	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	N	None	None	None	None	XX		XX					X	
B	Brewer's Blackbird	*Euphagus cyanocephalus*	S	None	None	None	None	X		X	X		X	X	XX	X
B	Brown-headed Cowbird	*Molothrus ater*	S / N	None	None	None	None	X		X	X	X	X	X	XX	X
B	Bullock's Oriole	*Icterus bullockii*	N	None	None	None	None	XX			XX		XX		X	X
B	Purple Finch	*Carpodacus purpureus*	S	None	None	None	None	XX			XX	X	XX		X	X
B	House Finch	*Carpodacus mexicanus*	R	None	None	None	None	X		X	X	X	X	X	XX	XX
B	Red Crossbill	*Loxia curvirostra*	R / S	None	None	None	None	X			X	X	X			X
B	Pine Siskin	*Carduelis pinus*	S	None	None	None	None	X		X	X	X	X		X	X
B	Lesser Goldfinch	*Carduelis psaltria*	S	None	None	None	None	XX			XX	X	XX	X	X	X
B	American Goldfinch	*Carduelis tristis*	S	None	None	None	None	X		X	X	X	X	X	X	X
B	Evening Grosbeak	*Coccothraustes vespertinus*	W / M	None	None	None	None	X			X	X	X			X
B*	House Sparrow*	*Passer domesticus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								XX	XX
M*	Virginia Opossum*	*Didelphis virginiana*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X	X	X	X	XX	XX
M	Vagrant Shrew	*Sorex vagrans*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Pacific Water Shrew	*Sorex bendirii*	R	None	None	None	None	XX		X	XX	X	X			
M	Water Shrew	*Sorex palustris*	R	None	None	None	None	XX			XX	X				

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
M	Trowbridge's Shrew	*Sorex trowbridgii*	R	None	None	None	None	X			X	XX	X		X	X
M	Shrew-mole	*Neurotrichus gibbsii*	R	None	None	None	None	X		X	X	XX	X		X	X
M	Townsend's Mole	*Scapanus townsendii*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Coast Mole	*Scapanus orarius*	R	None	None	None	None	X			X	XX	X	X	X	X
M	Yuma Myotis	*Myotis yumanensis*	R / S	SoC	None	G5/S3	4	XX	XX	XX	XX	X	X	X	X	X
M	Little Brown Myotis	*Myotis lucifugus*	R / S	None	None	None	None	X	X	X	X	X	X	X	X	X
M	Long-legged Myotis	*Myotis volans*	R / S	SoC	SU	G5/S3	4	X	X	X	X	XX	X	X	X	X
M	Fringed Myotis	*Myotis thysanodes*	R / S	SoC	SV	G4G5/S2?	2	X	X	X	X	X	X		X	X
M	Long-eared Myotis	*Myotis evotis*	R / S	SoC	SU	G5/S3	4	X	X	X	X	X	X	X	X	X
M	Silver-haired Bat	*Lasionycteris noctivagans*	L	SoC	SU	G5/S4?	4	X	X	X	X	XX	X	X	X	X
M	Big Brown Bat	*Eptesicus fuscus*	R / S	None	None	None	None	X	X	X	X	X	XX	X	XX	XX
M	Hoary Bat	*Lasiuris cinereus*	L	None	None	G5/S4?	4	X	X	X	X	X	X	X	X	X
M	Pacific Western Big-eared Bat	*Corynorhinus townsendii townsendii*	R / S	SoC	SC	G4T3T4/S2?	2	XX	XX	X	X	X	X	X	X	X
M	Brush Rabbit	*Sylvilagus bachmani*	R	None	None	None	None	X			X	X	X	X	X	X
M*	Eastern Cottontail*	*Sylvilagus floridanus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	X			X				X	X
M	Mountain Beaver	*Aplodontia rufa*	R	None	None	None	None	XX			XX	XX				
M	Townsend's Chipmunk	*Tamias townsendii*	R	None	None	None	None	X			X	XX	X			X
M	California Ground Squirrel	*Spermophilus beecheyi*	R	None	None	None	None					X	X	X	X	X
M*	Eastern Fox Squirrel*	*Sciurus niger*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien							XX	XX	XX
M*	Eastern Gray Squirrel*	*Sciurus carolinensis*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien						XX		X	XX
M	Western Gray Squirrel	*Sciurus griseus*	R	None	SU	G5/S4?	3					X	XX		X	X
M	Douglas' Squirrel	*Tamiasciurus douglasii*	R	None	None	None	None		XX	XX	X					
M	Northern Flying Squirrel	*Glaucomys sabrinus*	R	None	None	None	None	X			X	XX	XX			X
(M)	(Western pocket gopher)	*(Thomomys mazama)*	(R)	None	None	None	None					(XX)	(XX)	(X)	(X)	(X)
M	Camas Pocket Gopher	*Thomomys bulbivorus*	R	SoC	None	G3G4/S3 S4	3							XX	XX	X
M	American Beaver	*Castor canadensis*	R	None	None	None	None	XX	XX	XX	XX	X	X		X	X
M	Deer Mouse	*Peromyscus maniculatus*	R	None	None	None	None	XX		XX	XX	XX	XX	XX	XX	XX
M	Bushy-tailed Woodrat	*Neotoma cinerea*	R	None	None	None	None	X			X	XX	XX		XX	X
M	Western Red-backed Vole	*Clethrionomys californicus*	R	None	None	None	None	X			X	X				
M	Heather Vole	*Phenacomys intermedius*	R	None	None	None	None	X			X		X			
M	White-footed Vole	*Arborimus (= Phenacomys) albipes*	R	SoC	SU	G3G4/S3	4	XX			XX	XX				
M	Red Tree Vole	*Arborimus (= Phenacomys) longicaudus*	R	SoC	None	G3G4/S3S4	3	X			X	XX	XX			
M	Gray-tailed Vole	*Microtus canicaudus*	R	None	None	None	None							XX	XX	
M	Townsend's Vole	*Microtus townsendii*	R	None	None	None	None	XX		XX	X	X	X	X	X	
M	Long-tailed Vole	*Microtus longicaudus*	R	None	None	None	None	XX		XX	XX	X	X	X	X	
M	Creeping Vole	*Microtus oregoni*	R	None	None	None	None	X			X	X	X	X	X	X
M	Water Vole	*Microtus richardsoni*	R	None	None	None	None	X			X	X				
M	Common Muskrat	*Ondatra zibethicus*	R	None	None	None	None	XX	XX	XX	XX				X	X
M*	Black Rat*	*Rattus rattus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								X	XX
M*	Norway Rat*	*Rattus norvegicus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								X	XX
M*	House Mouse*	*Mus musculus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien								XX	XX
M	Pacific Jumping Mouse	*Zapus trinotatus*	R	None	None	None	None	XX		X	XX	X	X		X	
M	Common Porcupine	*Erethizon dorsatum*	R	None	None	None	None	XX		X	XX	XX	XX		X	X
M*	Nutria*	*Myocastor coypus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	XX	XX	XX	XX				X	X
M	Coyote	*Canis latrans*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Red Fox	*Vulpes vulpes*	R	None	None	None	None	X			X	X	X	XX	X	X
M	Gray Fox	*Urocyon cinereoargenteus*	R	None	None	None	None	X			X	XX	X	X	X	
(M)	(Gray Wolf - extirpated)	*(Canis lupus)*	S	None	None	None	None	(X)			(X)	(X)	(X)	(X)		
M	Black Bear	*Ursus americanus*	S	None	None	None	None	X		X	X	X	X	X	X	X
(M)	(Grizzly Bear)	*(Ursus arctos)*	(R)	LT	None	G4/SX	2-ex	(X)			(X)	(X)		(X)		
M	Common Raccoon	*Procyon lotor*	R	None	None	None	None	XX	X	XX	XX	X	X	X	XX	XX
M	Ermine	*Mustela erminea*	R	None	None	None	None	X			X	X	X	X	X	
M	Long-tailed Weasel	*Mustela frenata*	R	None	None	None	None	X		X	X	X	X	X	X	X
M	Mink	*Mustela vison*	R	None	None	None	None	XX	XX	XX	XX	X	X	X	X	X
M	Striped Skunk	*Mephitis mephitis*	R	None	None	None	None	X		X	X	X	X	X	X	X

Code[1]	Common Name	Genus/Species	Migratory Status[2]	Federal Status[3]	ODFW Status[4]	ORNHP Rank[5]	ORNHP List[6]	Riparian Assn.[7]	Habitat Type[8]							
									WATR	HWET	RWET	WLCH	WODF	WEGR	AGPA	URBN
M	Western Spotted Skunk	*Spilogale gracilis*	R	None	None	None	None	X			X	X	X	X	X	X
M	Northern River Otter	*Lontra canadensis*	R	None	None	None	None	XX	XX	XX	XX					X
M	Mountain Lion (Cougar)	*Puma concolor*	S	None	None	None	None	X		X	X	X	X		X	X
M	Bobcat	*Lynx rufus*	S	None	None	None	None	X		X	X	X	X	X	X	X
M*	Domestic Cat (feral)*	*Felis domesticus*	R	N/A - alien	N/A - alien	N/A - alien	N/A - alien	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
M	California Sea Lion	*Zalophus californianus*	S	None	None	None	None	XX	XX							
M	Roosevelt Elk	*Cervus elaphus roosevelti*	S	None	None	None	None	X		X	X	X	X	X	X	X
(M)	(Columbian White-tailed Deer)	*(Odocoileus virginiana leucurus)*	(R)	LE	SV	G5T2QS2	1	(X)		(X)	(X)	(X)	(XX)	(X)	(X)	(X)
M	Mule Deer	*Odocoileus hemionus*	R	None	None	None	None	X		X	X	X	X	X	X	X

[a] Bald eagle is currently proposed for de-listing at the federal level.

Appendix 7

Oregon Department of Fish and Wildlife's Conservation Opportunity Areas map

R L I S
REGIONAL LAND INFORMATION SYSTEM

Metro
2006 Natural Area Program

2006 Target Areas &
Oregon Department of Fish and Wildlife (ODFW)
Conservation Opportunity Areas

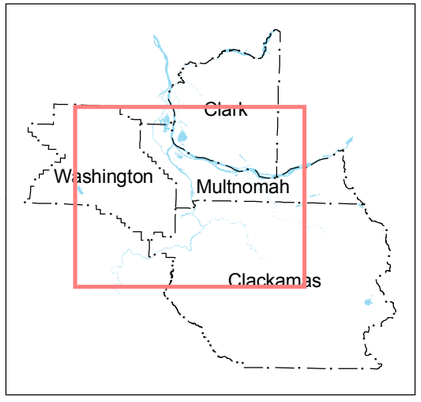
- Natural Areas Program-Target Areas
- Natural Area Program-Greenway and Trail Corridors
- ODFW-Conservation Opportunity Areas
- Urban growth boundary
- Parks and Open Spaces

Killin Wetland
Forest Park Connections (Northwest)
Columbia Slough & Trail (Lower)
Columbia Slough & Trail (Upper)
Rock Creek Headwaters & Greenway
Forest Park Connections (Southeast)
Willamette River Greenway
Gresham/Fairview Trail
Dairy & McKay Creek Confluence
Rock Creek (Lower)
Sandy River Gorge
Wapato Lake & Chehalem Ridgetop to Refuge
Tualatin River Greenway
Westside Trail
Johnson Creek & Watershed (Lower)
Johnson Creek & Watershed (Upper)
East Buttes (Portland/Clackamas)
East Buttes (Gresham/Damascus)
Cooper Mountain
Tryon Creek
Deep Creek & Tributaries
Cazadero Trail
Clackamas River Bluffs & Greenway
Lower Tualatin Headwaters
Stafford Basin (including Wilson Creek)
Clear Creek
Abernethy & Newell Creeks
Tonquin Geologic Area & Trail
Willamette Narrows & Canemah Bluff
Tonquin Trail
N

The information on this map was derived from digital databases on Metro's GIS. Care was taken in the creation of this map. Metro cannot accept any responsibility for errors, omissions, or positional accuracy. There are no warranties, expressed or implied, including the warranty of merchantability or fitness for a particular purpose, accompanying this product. However, notification of any errors will be appreciated.

1 inch equals 4.22 miles

0 1 2 4 6 8 Miles



Location Map

METRO

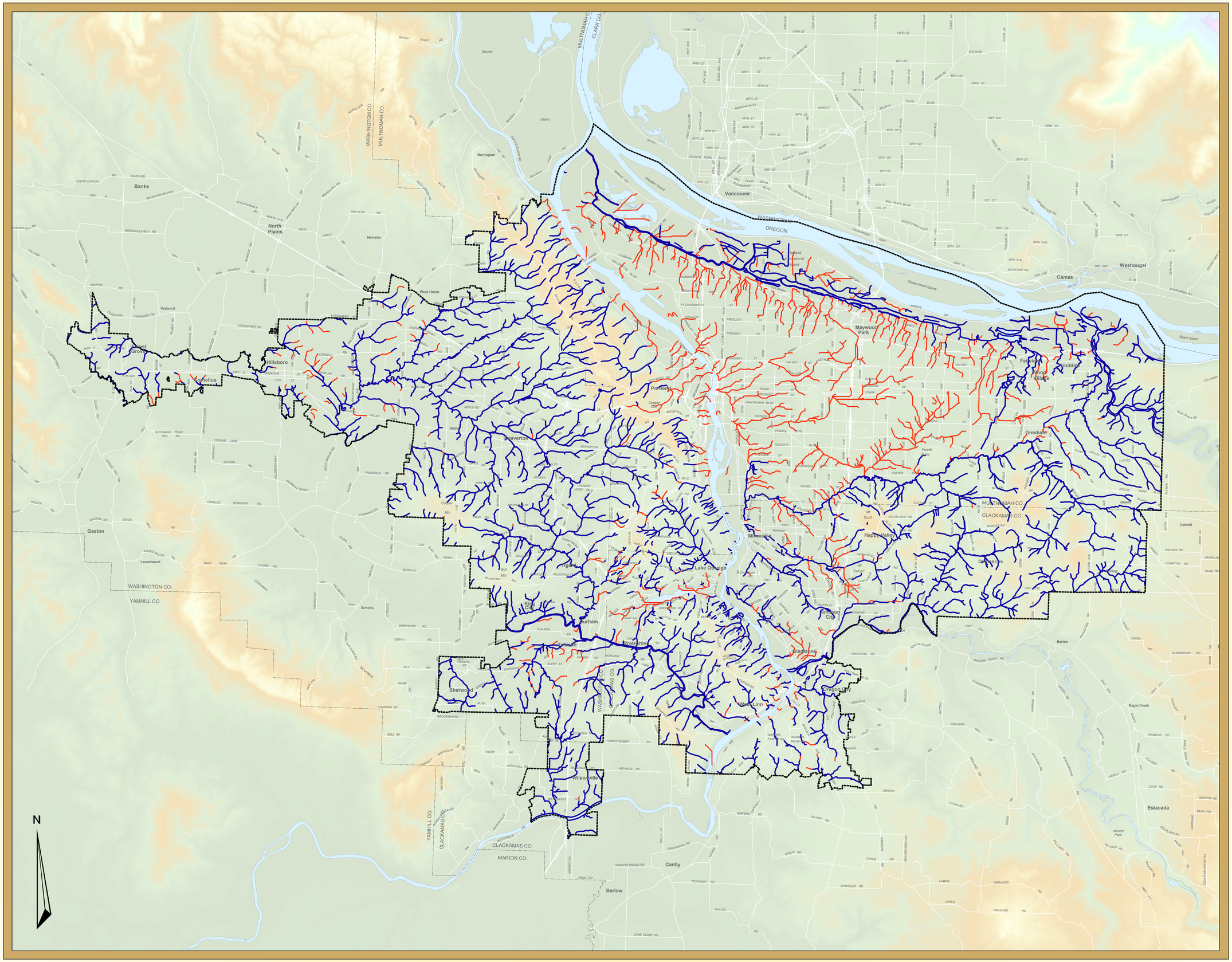
METRO DATA RESOURCE CENTER
600 NORTHEAST GRAND AVENUE | PORTLAND, OREGON 97232-2736
TEL (503) 797-1742 | FAX (503) 797-1909
drc@metro.dst.or.us | www.metro-region.org

Project Date: Apr 9, 2007 Plot time: Apr 9, 2007 J:\nbrown\RefinementMapping\Map_template\hennings\040907_hennings_odfw_conservationAreas.mxd

Appendix 8

Disappearing Streams map

Disappearing Streams



Development patterns in the Metro region have historically resulted in piping, culverting, or filling of streams and stream beds.

A computer mapping program was used to evaluate the terrain in the region, and to generate areas where major streams (those draining 50 + acres of land) *may have once existed*.

While this does not represent an authoritative analysis, it does visually describe the effect of urbanization on the regions natural systems. This excercise indicates that an estimated 388 miles of previously-existing streams are now underground.

Legend

- Existing streams
- Possible historic streams
- Metro boundary/Study Extent
- County lines

0 2.5 5 10 Miles

May 8, 2007 J://Jobs/Bosworth/DisappearingStreams/disapear.mxd

Appendix 9

Summary of Indicator 9 Habitats of Concern by sub-watershed

Appendix 9 Summary of Indicator 9 Habitats of Concern by sub-watershed

Appendix Table
Summary of Indicator 9 Habitats of Concern by sub-watershed

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
1. Christensen Cr./Tualatin R.	734	107	Oak, Bottomland Hardwood, Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species	Fanno Creek; Rock Creek/Lower Tualatin River
2. Deep Cr./N. Fork Deep Cr.	4,476	140	Bottomland Hardwood, Important connector or corridor, Important Migratory Stopover Habitat	
		141	Bottomland Hardwood, Important connector or corridor, Important Migratory Stopover Habitat	
3. Latourell Creek	2,069	19	Wetland, Bottomland Hardwood, River delta area, Important Migratory Stopover Habitat	Beaver Creek
		90	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat	Beaver Creek
		92	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Beaver Creek
4. Coffee Lake Creek	7,365	152	Bottomland Hardwood, Wetland, Oak, Site with unique or critical wildlife functions	Saum Creek/Lower Tualatin River
		153	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
		156	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Rock Creek/Lower Tualatin River
5. Columbia River Islands	10,095	20	Wetland, Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat (Government Island)	
		34	Bottomland Hardwood, Wetland, Riverine island, Important Migratory Stopover Habitat (West Hayden Island)	
		63	Bottomland Hardwood, Wetland, Riverine island	
		70	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat (Tomahawk Island)	
		84	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat (McGuire Island)	
6. Willamette R./ Columbia R.	40,182	1	Oak	
		2	Oak	
		3	Oak	
		4	Oak	
		8	Wetland, Bottomland Hardwood, Important Migratory Stopover Habitat	Columbia Slough

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
24. Beaverton Creek	24,212	14	Oak, Wetland, Bottomland Hardwood, Important connector or corridor	
		49	Bottomland Hardwood, Important elk movement corridor, Important Migratory Stopover Habitat	Gilbert R.; Upper Rock Cr./Tualatin R.; Columbia R. Islands
		50	Bottomland Hardwood, Important elk movement corridor, Important Migratory Stopover Habitat	Columbia River Islands
		51	Bottomland Hardwood, Wetland, Important connector or corridor	
		52	Bottomland Hardwood, Wetland	
		53	Wetland, Important Migratory Stopover Habitat	
		54	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		58	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Lower Rock Cr./Tualatin R.; Upper Rock Cr./Tualatin R.
		93	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		163	Bottomland Hardwood, Wetland	
25. Fanno Creek	20,156	94	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
		95	Bottomland Hardwood, Wetland, Site with unique or critical wildlife functions	
		96	Bottomland Hardwood, Important connector or corridor, Important Migratory Stopover Habitat	
		97	Bottomland Hardwood, Wetland	
		98	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		100	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Rock Cr./Lower Tualatin R.; Saum Cr./Lower Tualatin R.
		105	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		107	Oak, R, Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species	Christensen Cr./ Tualatin R.; Rock Cr./ Lower Tualatin R.
		168	Wetland	
26. Rock Cr./ Lower Tualatin R.	5,435	99	Bottomland Hardwood, Wetland	
		100	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Fanno Creek; Saum Creek/Lower Tualatin River
		106	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Chicken Creek
		107	Oak, R, Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species	Christensen Creek/Tualatin River; Fanno Creek

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
		15	Oak	
		16	Oak	
		22	Wetland, Bottomland Hardwood, Important Migratory Stopover Habit	
		23	Oak	
		24	Oak	
		25	Oak	
		26	Oak	
		27	Oak	
		28	Oak	
		29	Important Migratory Stopover Habitat, Site with unique or critical wildlife functions, Contains sensitive of unique plant populations	
		30	Important Migratory Stopover Habitat, Site with unique or critical wildlife functions	
		31	Important Migratory Stopover Habitat, Site with unique or critical wildlife functions	
		33	Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species, Contains sensitive or unique plant populations	Lower Johnson Creek
		35	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	Columbia Slough
		49	Bottomland Hardwood, Important elk movement corridor, Important Migratory Stopover Habitat	Beaverton Creek, Gilbert River, Upper Rock Creek/Tualatin R.
		50	Bottomland Hardwood, Important elk movement corridor, Important Migratory Stopover Habitat	Beaverton Creek
		61	Bottomland Hardwood, Wetland	Gilbert River
		75	Oak	
		76	Oak	Columbia Slough
		77	Oak, Wetland, Contains sensitive or unique plant populations	
		79	Oak, Bottomland Hardwood	
		81	Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species	
		88	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	Columbia Slough
		115	Bottomland Hardwood, Important Migratory Stopover Habitat	Willamette River/ Oswego Creek
		129	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		130	Bottomland Hardwood, Wetland, Oak	
		132	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat	
		162	Oak	Willamette River/ Oswego Creek
		164	Bottomland Hardwood	
		167	Bottomland Hardwood	

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
7. Columbia Slough	37,060	6	Wetland, Bottomland Hardwood	
		8	Wetland, Bottomland Hardwood, Important Migratory Stopover Habitat	Willamette River/Portland
		9	Wetland, Bottomland Hardwood, Grassy hilltop important to migrants and grassland-associated species, Important Migratory Stopover Habitat, Area critical to sensitive species life history (or Great Blue Heron rookery), Contains sensitive or unique plant populations	
		35	Bottomland Hardwood, Wetland, Important Migratory Stopover Habit	
		48	Bottomland Hardwood, Wetland, Contains sensitive or unique plant populations	
		62	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		64	Bottomland Hardwood, Wetland	
		65	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		66	Bottomland Hardwood, Wetland, Site with unique or critical wildlife functions	
		67	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		68	Bottomland Hardwood, Wetland	
		69	Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		71	Bottomland Hardwood, Wetland	
		72	Bottomland Hardwood, Wetland, Area critical to sensitive species life history (or Great Blue Heron rookery)	
		73	Bottomland Hardwood, Wetland	
		74	Bottomland Hardwood, Wetland, Area critical to sensitive species life history (or Great Blue Heron rookery)	
		76	Oak	Columbia River Islands
		78	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
		85	Bottomland Hardwood, Wetland	
		86	Bottomland Hardwood, Wetland, Important connector or corridor	
		88	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	Willamette River/Columbia River
		89	Bottomland Hardwood, Wetland, River delta area	Beaver Creek
		136	Wetland, Grassy hilltop important to migrants and grassland-associated species, Important Migratory Stopover Habitat	Lower Johnson Creek; Upper Johnson Creek
8. Kellogg Creek	11,067	18	Oak, Bottomland Hardwood, Important Migratory Stopover Habitat	
		32	Bottomland Hardwood, Wetland	

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
		116	Bottomland Hardwood, Wetland, Riverine island, Important Migratory Stopover Habitat	Willamette River/Oswego Creek
		123	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Clackamas River/Rock Creek; Upper Johnson Creek
		124	Oak, Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		166	Oak	
9. Lower Johnson Creek	15,859	12	Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species	Upper Johnson Creek
		33	Important Migratory Stopover Habitat, Grassy hilltop important to migrants and grassland-associated species, Contains sensitive or unique plant populations	Columbia River Islands
		126	Wetland, Contains sensitive or unique plant populations, Site with unique or critical wildlife functions	
9. Lower Johnson Creek		127	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		128	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		133	Important Migratory Stopover Habitat	Upper Johnson Creek
		134	Wetland	
		135	Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		136	Wetland, Grassy hilltop important to migrants and grassland-associated species, Important Migratory Stopover Habitat	Columbia Slough; Upper Johnson Creek
		161	Wetland	
10. Upper Johnson Creek	15,116	12	Grassy hilltop important to migrants and grassland-associated species, Important Migratory Stopover Habitat	Lower Johnson Creek
		123	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Clackamas River/Rock Creek; Kellogg Creek
		133	Important Migratory Stopover Habitat	Lower Johnson Creek
		136	Wetland, Grassy hilltop important to migrants and grassland-associated species, Important Migratory Stopover Habitat	Columbia Slough; Lower Johnson Creek
		137	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
11. Willamette R./Oswego Cr.	16,389	21	Wetland, Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat	
		111	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Saum Creek/Lower Tualatin River

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
		114	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
		115	Bottomland Hardwood, Important Migratory Stopover Habitat	Columbia River Islands
		116	Bottomland Hardwood, Wetland, Riverine island, Important Migratory Stopover Habitat	Kellogg Creek
		117	Bottomland Hardwood, Wetland, Riverine island, Important Migratory Stopover Habitat	
		118	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat	
		119	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat, Area critical to sensitive species life history (or Great Blue Heron rookery)	Tanner Creek
		120	Bottomland Hardwood, Wetland	
		145	Oak, Contains sensitive or unique plant populations, Site with unique or critical wildlife functions	Tanner Creek
		162	Oak	Columbia River Islands
12. Gilbert River	700	49	Bottomland Hardwood, Important elk movement corridor, Important Migratory Stopover Habitat	Beaverton Cr.; Upper Rock Cr./Tualatin R.; Columbia R. Islands
		61	Bottomland Hardwood, Wetland	Columbia R. Islands
13. Abernethy Creek	3,212	0	Limited area within Metro region; no known Habitats of Concern	
14. Beaver Creek	13,997	19	Wetland, Bottomland Hardwood, River delta area, Important Migratory Stopover Habitat	Latourell Creek
		89	Bottomland Hardwood, Wetland, River delta area	Columbia Slough
		90	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat	Latourell Creek
		91	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
		92	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Latourell Creek
		143	Bottomland Hardwood, Important connector or corridor, Important Migratory Stopover Habitat	
15. Clackamas R./Rock Cr.	13,227	121	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		122	Bottomland Hardwood, Wetland, Important connector or corridor	
		123	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Kellogg Creek; Upper Johnson Creek
		139	Bottomland Hardwood, Important connector or corridor, Important Migratory Stopover Habitat	

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
16. Corral Creek	128	0	Limited area within Metro region; no known Habitats of Concern	
17. Tanner Creek	5,839	119	Bottomland Hardwood, Riverine island, Important Migratory Stopover Habitat, Area critical to sensitive species life history (or Great Blue Heron rookery)	Willamette River/Oswego Creek
		145	Oak, Contains sensitive or unique plant populations, Site with unique or critical wildlife functions	Willamette River/Oswego Creek
		148	Oak, Site with unique or critical wildlife functions, Important Migratory Stopover Habitat	Beaver Creek/Willamette River
		149	Riverine island, Important Migratory Stopover Habitat	
		150	Oak, Important Migratory Stopover Habitat, Site with unique or critical wildlife functions	
18. Molalla R./ Willamette R.	40	0	Limited area within Metro region; no known Habitats of Concern	
19. Lower Dairy Creek	3,383	39	Oak, Area critical to sensitive species life history (or Great Blue Heron rookery)	
		40	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor, Site with unique or critical wildlife functions	Lower Rock Creek/Tualatin River
		43	Bottomland Hardwood, Wetland	
		44	Bottomland Hardwood, Wetland	
		45	Bottomland Hardwood, Wetland	Lower McKay Creek
		46	Bottomland Hardwood, Wetland	
		59	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Lower Rock Creek/Tualatin River
20. Lower McKay Creek	3,368	42	Bottomland Hardwood, Wetland	
		45	Bottomland Hardwood, Wetland	Lower Dairy Creek
		47	Bottomland Hardwood. Wetland	
		60	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
21. Lower W. Fork Dairy Cr.	50	0	Limited area within Metro region; no known Habitats of Concern	
22. Lower Gales Creek	733	165	Bottomland Hardwood	
23. Tualatin River	2,009	38	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
		41	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Site with unique or critical wildlife functions	

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
		156	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Coffee Lake Creek
27. Saum Cr./ Lower Tualatin R.	14,696	100	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Fanno Creek; Rock Creek/Lower Tualatin River
		101	Bottomland Hardwood, Wetland	
		109	Bottomland Hardwood, Wetland	
		110	Bottomland Hardwood, Wetland, Important connector or corridor	
		111	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Willamette River/Oswego Creek
		112	Bottomland Hardwood, Important connector or corridor	
		152	Bottomland Hardwood, Wetland, Oak, Site with unique or critical wildlife functions	Coffee Lake Creek
28. Beaver Cr./ Willamette R.	2,725	148	Oak, Site with unique or critical wildlife functions, Important Migratory Stopover Habitat	Tanner Creek
29. Chicken Creek	1,906	106	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Rock Creek/Lower Tualatin River
		154	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	
		155	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat	
30. Lower Rock Cr./Tualatin R.	12,461	40	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor, Site with unique or critical wildlife functions	Lower Dairy Creek
		58	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Beaverton Creek; Upper Rock Creek/Tualatin River
		59	Bottomland Hardwood, Wetland, Important Migratory Stopover Habitat, Important connector or corridor	Lower Dairy Creek
		108	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
31. Upper Rock Cr./Tualatin R.	7,339	49	Bottomland Hardwood, Important elk movement corridor, Important Migratory Stopover Habitat	Beaverton Cr.; Gilbert River; Columbia River Islands
		55	Bottomland Hardwood, Wetland, Important connector or corridor	
		56	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	
		57	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	

Sub-watershed	Acres in Metro	Habitat of Concern ID #	HOC reason	Connectivity to other sub-watersheds
		58	Bottomland Hardwood, Wetland, Important connector or corridor, Important Migratory Stopover Habitat	Beaverton Creek; Lower Rock Creek/Tualatin River
TOTAL	296,028			

Appendix 10

Breeding Bird Survey species trends

Appendix 10 Breeding Bird Survey species trends

Appendix Table
Breeding Bird Survey

Tualatin route species whose population trends are substantially different in the Metro area compared to statewide (1966-2005)

Species[1]	Portland area (avg. % change per year)	All Oregon BBS routes (avg. % change per year)	Trend difference Metro area versus statewide	Comments (risk factors?)
Hairy Woodpecker	-19.9	No significant change	-19.9	Cavity nester Conifer associated
Chipping Sparrow	-14.4	-3.1	-11.3	Open cup nester Neotropical migrant
Yellow-breasted Chat	-13.1	No significant change	-13.1	Open cup nester Riparian associated Neotropical migrant
Yellow Warbler	-12.0	No significant change	-12.3	Open cup nester Riparian associated Neotropical migrant
White-breasted Nuthatch	-11.8	No significant change	-11.8	Native oak specialist Cavity nester
House Wren	-13.4	-3.1	-10.3	Native oak specialist Neotropical migrant Cavity nester
MacGillivray's Warbler	-11.9	-2.0	-9.9	Open cup nester Neotropical migrant Native shrub habitat
Swainson's Thrush	-8.7	-1.8	-6.9	Open cup nester Neotropical migrant Prefers large habitats or undeveloped areas
Savannah Sparrow	-6.6	No significant change	-6.6	Open cup nester Neotropical migrant Grassland specialist Nests on or near ground
Olive-sided Flycatcher	-10.5	-4.0	-6.5	Open cup nester Neotropical migrant Burn or clearing specialist, needs snag plus older trees around clearing
Western Tanager	-6.4	No significant change	-6.4	Open cup nester Neotropical migrant Conifer specialist

[1] Species names are the official common names as designated by the American Ornithological Union (AOU). Asterisked species are non-native.

Ring-necked Pheasant*	-8.0	-2.2	-5.8	Non-native Grassland species Needs shrub/herbaceous connectivity Agriculture associated
Black-headed Grosbeak	-5.6	No significant change	-5.6	Open cup nester Neotropical migrant Prefers large habitats or undeveloped areas
Purple Finch	-5.5	No significant change	-5.5	Open cup nester Conifer or oak associated
Cedar Waxwing	-5.1	No significant change	-5.1	Open cup nester
Brown-headed Cowbird	-6.8	-1.9	-4.9	Neotropical migrant Nest parasite (lays eggs in other birds' open cup nests) Agriculture associated
Brewer's Blackbird	-6.8	-2.2	-4.6	Open cup nester Agriculture associated
Common Yellowthroat	-3.9	No significant change	-3.9	Open cup nester Neotropical migrant Riparian specialist Nests low shrub
Willow Flycatcher	-8.8	-5.1	-3.7	Open cup nester Riparian specialist Neotropical migrant
Western Wood-Pewee	-5.8	-2.3	-3.5	Open cup nester Conifer specialist Neotropical migrant
Band-tailed Pigeon	-3.0	No significant change	-3.0	Open cup nester Prefers large habitats or undeveloped areas Needs specific mineral areas
House Sparrow*	-3.0	No significant change	-3.0	Non-native, human-associated
Spotted Towhee	-2.9	No significant change	-2.9	Open cup nester Nests on or near ground Needs leaf litter
American Goldfinch	-6.2	-3.5	-2.7	Open cup nester Grasslands, shrublands
Steller's Jay	-2.2	No significant change	-2.2	Open cup nester Conifer specialist Prefers nesting away from development
Black-capped Chickadee	-2.2	No significant change	-2.2	Cavity nester Tends to conifers during breeding season
Killdeer	-5.6	-3.6	-2.0	Ground nester Grasslands, agriculture associated
Western Scrub-Jay	0.0	-1.8	-1.8	Open cup nester Shrub/deciduous habitat

American Crow	0.0	-1.6	-1.6	Open stick nest Holding steady here
Red-tailed Hawk	0.0	-1.2	-1.2	
White-crowned Sparrow	-5.3	-4.2	-1.1	Nests low, open cup Uplands/hilltops
Song Sparrow	-2.4	-1.3	-1.1	Nests low, open cup Riparian associated
American Robin	-2.7	-1.7	-1.0	Open cup nester
Barn Swallow	-3.0	-2.6	-0.4	Neotropical migrant Agriculture specialist
Orange-crowned Warbler	-4.2	-3.9	-0.3	Open cup nester Neotropical migrant High native shrub habitat
Following are species with positive trends				
Violet-green Swallow	1.9	No significant change	1.9	Cavity nester; insectivore
Mourning Dove	No significant change	2.4	2.4	Does well around humans Human adapted High shrub, native or not
Pacific-slope Flycatcher	No significant change	2.8	2.8	Open cup nester Often nests on bridges Neotropical migrant
Golden-crowned Kinglet	No significant change	3.6	3.6	Conifer specialist High, protected nest
Bewick's Wren	5.0	No significant change	5.0	Cavity nester
Vaux's Swift	6.0	No significant change	6.0	Cavity nester – formerly old-growth associated, but nests in chimneys Neotropical migrant

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Clean air and clean water do not stop at city limits or county lines. Neither does the need for jobs, a thriving economy and good transportation choices for people and businesses in our region. Voters have asked Metro to help with the challenges that cross those lines and affect the 25 cities and three counties in the Portland metropolitan area.

A regional approach simply makes sense when it comes to protecting open space, caring for parks, planning for the best use of land, managing garbage disposal and increasing recycling. Metro oversees world-class facilities such as the Oregon Zoo, which contributes to conservation and education, and the Oregon Convention Center, which benefits the region's economy.

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