Municipal Water Supplies from Forest Watersheds in Oregon: Fact Book and Catalog

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Municipal Water Supplies from Forest Watersheds in Oregon:

Fact Book and Catalog

by

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Sponsored by
Oregon Forest Resources Institute
Portland, Oregon

June 2001

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Fact Book and Catalog

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EXECUTIVE SUMMARY

Most of the major municipal water systems in Oregon rely heavily on surface water supplies that originate on forest lands. As a result, many Oregonians have a keen interest in how forests and their management may affect the quality and quantity of municipal water. However, few resources exist to help such citizens better understand their water supplies and the complex relationships between those supplies and forest watersheds and their management. This publication attempts to fill this gap through a review and summary of relevant research and other information, as well as a survey of 30 major municipal systems in Oregon.

Noteworthy facts from the review of research and other information include:

Characteristics of Forest Watersheds

- Forest cover typically results in significant losses of water (15-20 inches annually) through canopy interception and soil uptake and transpiration.

- Because of limited water storage in shallow upland soils, peak flows from forested watersheds in Oregon often respond rapidly to large rainstorms or heavy snowmelt.

- The quality of water from forest lands in Oregon generally is very high, although some dissolved, particulate, and biological constituents are commonly present.

- High sediment levels can occur in streams in undisturbed forest watersheds in Oregon, especially during large storms that cause natural erosion on hillslopes or in stream channels.

Effects of Forest Practices

- Because forest cover results in significant losses of water, timber harvest, afforestation or land use changes that markedly alter this cover can increase or decrease local streamflows.

- Timber harvest is most likely to increase streamflows, but a measurable increase in annual streamflows from forest watersheds in Oregon is not likely unless a large portion (25+%) of the forest area is clearcut within a short period.

- Because streamflow volume increases from timber harvest occur primarily during months of low water demand, water storage facilities are needed if these increases are to help meet the peak demands of summer.

- Soils, not trees, act like sponges by slowly releasing water to streams; management practices that maintain favorable soil infiltration and water storage are most vital in watershed conservation for desirable streamflow patterns.

- Timber harvest can increase, decrease or have insignificant effects on peak flows in Oregon; the largest increases occur with the smallest peak flows from small watersheds. Large floods causing major problems downstream of forest lands most likely result from storms that add too much water for soils and streams to absorb.

- Streamwater temperatures can increase where timber harvest or other practices remove vegetation that provides shade; recovery of cool temperatures can occur when revegetation restores shade.

- Timber harvest or related practices (slash burning, etc.) can increase stream sedimentation if soil is exposed near streams; practices that reduce soil disturbance or maintain streamside vegetation can reduce or avoid such increases.

- Rapid revegetation and favorable soil properties and climate patterns in western Oregon appear to greatly limit nutrient losses to streams following timber harvest.

- Direct application to stream channels is the most important way that manufactured chemicals can impact water quality; measures to control such entry can reduce or eliminate stream contamination.

- Landslides can occur in both logged areas and undisturbed, mature forests in unstable terrain, particularly during major storms; landslide rates can increase shortly after timber harvest but decrease thereafter.

- Forest roads can increase landslide and other erosion in steep terrain; improved road location, design, and maintenance can greatly reduce erosion and sedimentation.

- Much research on the effects of forest practices was done years ago and does not well reflect available technology or management methods now commonly in use or required by law.

<u>Studies in Municipal Watersheds</u>

- Fog drip from vegetation can add significant water inputs in some locations; temporary reductions in low flows from a sub-basin in Portland's Bull Run watershed could reflect reduced fog drip after logging followed by restored drip after rapid revegetation.

- Some local effects of historical road construction and timber harvest on water quality within Portland's Bull Run watershed have been observed; natural erosion can be an important sediment source and difficult to distinguish from management sources.

- Monitoring data from Portland's Bull Run watershed showed no evidence of water quality deterioration from historical levels, no violations of water quality standards, and "extraordinary" streamwater quality.

- Streamside alder stands can reduce the quality of domestic water supplies when extended low flows combine with heavy leaf fall; effective chlorination of such water can require more chlorine and produce undesirable chemical by-products.

- Logging and road construction between 1980-91 on 13 municipal watersheds in western Oregon did not result in sustained increases in turbidity at the water treatment facilities.

- Natural erosion processes, a unique clay mineral and non-forest management activities were the primary cause of turbidity problems in Salem's water supply during the 1996 flood; a relatively inefficient system of treatment and storage exacerbated water supply problems.

- Agricultural and urban/suburban areas have become major sediment sources in the Eugene and Salem watersheds; Eugene's improved water treatment and storage system can handle very high sediment levels during large storms.

- Federal, state and local agencies and private landowners have made significant progress in mitigating human impacts on water quality and in ensuring safe drinking water in the region.

<u>Regulations Affecting Water Supplies & Watersheds</u>

- Most cities and towns in Oregon hold formal water rights and priority access to their current and anticipated sources of municipal water, as filed and administered by the Oregon Water Resources Department.

- High water quality and safety of municipal water supplies are required under state and federal laws; rules and guidelines include specific standards for water quality monitoring, maximum contaminants, water treatment and personnel certification.

- Oregon's Forest Practice Rules include many different and specific requirements to protect water quality for domestic and other uses; the original Rules and subsequent revisions reflect evolving knowledge (research findings, etc.) and resource concerns.

- Management of municipal watersheds can be affected by other state and federal laws and policies, including those involving wetlands and threatened and

endangered species; some can enhance protection of water supplies while others may increase risks (e.g., wildfire).

Noteworthy findings from the survey of 30 major municipal water systems include:

- Nearly all of these major water systems now use filtration to treat their raw water supplies; some notable exceptions such as Portland and Bend have received exemptions from federal requirements for such advanced treatment.

- Some of these major water systems have had water quality violations in recent years; these primarily represent deficiencies in monitoring and reporting rather than violations due to impaired water quality.

- Most of the watersheds for these systems have experienced significant timber harvest and other forest management activities within the last few decades; active forest management continues on several watersheds but has been greatly reduced in recent years on watersheds with much federal land.

- Maintaining water quality was the most frequent concern expressed by city personnel (14 of 27 responses) about their watershed and water supply; some specific areas of concern include turbidity and sediment (7 of 27), urban and agricultural influences (9 of 27) and forest practices (8 of 27).

- A significant number of city personnel (8 of 27 responses), including several in western Oregon, expressed concern about their ability to increase water supply quantities to meet future demands.

- A significant number of city personnel (7 of 27 responses) expressed specific concerns about the risk of wildfire on their watersheds.

INTRODUCTION

Clean water is among the most basic necessities and comforts of life, and since the 1960's each American has used about 100 gallons per day (Brown 1999). Yet very few give much thought to the complex and vital systems, both natural and engineered, that allow us to sustain such water use. Oregonians are especially fortunate in that most of the municipal water used in our largest cities originates on forest lands, which help ensure a reliable and high quality supply that requires little treatment. In contrast, most other Americans get their water from municipal supplies that originate from watersheds that often include some developed areas and diverse land uses that have significant effects on local water quality.

But the fact that most of the major municipal systems in Oregon rely heavily on waters from forest lands has not lessened public interest and concerns about those supplies. A clear sign of this in the Portland area are the many newspaper articles, commentaries and letters to the editor about the Bull Run watershed printed over the past two decades. Surveys of citizens throughout the state also show that water resources are among the highest values associated with forest lands and that management practices to protect these resources are a priority concern (Davis and Hibbitts 1999; Moore Information 1994).

If Oregon residents are like most Americans, however, many have only vague knowledge of the source of their municipal water (NEETF 1999). This fact book and catalog thus is intended to help raise Oregonians' awareness and understanding of the major municipal water supplies that originate on forest watersheds in the state. Because of continued questions and concerns about management activities such as timber harvesting, local research and other information about such practices and water supplies also are reviewed and summarized. In addition, basic information about regulations and other policies that affect municipal watersheds and supplies are briefly discussed.

METHODS

Review of Research & Other Information

Many technical references and other writings are available on the characteristics and management of forest watersheds that provide municipal water supplies. Because these features vary considerably by location, the review and summary provided here focuses primarily on designed studies and other information specific to Oregon. To help ensure technical accuracy and quality, priority also was given to published research papers and other references most likely to have been professionally peer reviewed and edited. However, because such reviews are not infallible and the discussion here is based primarily on the findings as stated by the authors, some errors in the original analyses or interpretations remain possible.

Watershed Catalog - Survey of Municipal Water Systems

The watershed catalog portion of this publication includes basic information about the 30 largest municipal water systems in Oregon that rely primarily on surface supplies from watersheds that are largely forested. Some of this information is based on public records available from the Drinking Water Program of the Oregon Health Division, which administers water quality regulations and related concerns for municipal water systems in the state.

The catalog provides further information based on responses to a written survey (see Appendix for survey text) sent to administrators of these 30 municipal water systems. Although these responses are expected to be generally reliable, they are transcribed here with only limited editing and their accuracy has not been verified. In addition, only a few municipalities own and manage most or all of their watershed and some information about other public or private ownerships may be limited. Thus, it is possible that the text includes some rough estimates or subjective observations that have not been validated with monitoring or other controlled evaluations.

RESEARCH ON FOREST WATERSHEDS IN OREGON

Studies specific to municipal watersheds on forest lands in Oregon are somewhat limited, but research on other forest watersheds in the region is substantial and provides a general understanding of basic characteristics and management effects. Much of this research has been summarized in several published references (e.g., Adams and Godwin 1998; Adams and Ringer 1994; Binkley and Brown 1993; Brown 1985; Fredriksen and Harr 1979; Harr 1976; Harr 1983; Higgins and others 1989; Satterlund and Adams 1992; Troendle 1983). Some key watershed characteristics and findings are summarized here.

Characteristics of Forest Watersheds

Forests require considerable moisture to prevail, so forested watersheds in Oregon are found in areas of significant rainfall or snowfall (i.e., about 15 inches or more of water annually). Forest canopies lose large amounts of water through the natural processes of interception, evaporation and transpiration, which are called collectively, evapotranspiration. The amount of annual runoff from forested watersheds thus is roughly the total precipitation minus evapotranspiration losses. In a western Oregon forest watershed with 60 inches of annual rainfall, evapotranspiration losses are about 20 inches, so the expected net runoff is about 40 inches annually. Soil water storage also plays an important role in the variability and timing of runoff seen in forest streams.

Of course, streamflow is not uniform throughout the year, and many forest watersheds show wide changes in flow between seasons and in response to individual storms. Peak flows in western Oregon normally occur during major winter rainstorms, when evapotranspiration losses are very low and soil storage capacities also become limited as they become wetter. In forested watersheds of central and eastern Oregon, peak flows usually are seen during periods of heavy snow melt, typically late spring.

The lowest flows from forest watersheds throughout Oregon often occur in late summer or early fall, due to a combination of very low rainfall and the high cumulative evapotranspiration losses during the warm temperatures and low humidity of summer. Because summer is the period of peak demand for municipal and irrigation water, reservoirs and other storage facilities often are used to help ensure reliable supplies. As seen in recent years, even seemingly water-rich western Oregon is not immune to low municipal reserves and potential shortages during peak summer use.

The quality of water from forest lands in Oregon generally is very high. However, even in areas undisturbed by human activity, streams and other water bodies are not pure water (H_2O). Certain dissolved, particulate, and biological constituents are common to nearly all waters, although their relative amounts may vary considerably with different watershed conditions. In small streams in undisturbed, old-growth forests in the Oregon Cascades, for example, average concentrations of major dissolved chemicals (i.e., bicarbonate, silica, calcium, magnesium, sodium, potassium, nitrogen and phosphorus) can exceed 35 parts per million (Martin and Harr 1988).

Sediment levels in such forest streams can be much higher, especially during major winter storms that cause natural erosion on hillslopes and in stream channels. In an undisturbed forest watershed in the Coast Range that was monitored for many years, for example, suspended sediment levels in excess of 100 parts per million were recorded many times during larger storm flows (Figure 1). The turbidity associated with such sediment concentrations not only would be highly visible, it would also require treatment under federal law if used directly for municipal supplies (Spellman and Drinan 2000).

Effects of Forest Practices

Our understanding of the effects of forest practices on watershed resources has evolved from over 40 years of research in the Pacific Northwest. This research includes some of the first comprehensive, large-scale studies (i.e., entire watersheds treated and monitored) conducted in the U.S. on the effects of logging and road construction on water resources. The wide extent of timber harvesting and forest roads in the region clearly has helped stimulate the broad interest among researchers, managers and the public about potential watershed effects.

This review is based largely upon the research studies and summary found in “The effects of timber harvesting and forest roads on water quantity and quality in the Pacific Northwest: Summary and annotated bibliography” (Adams and Ringer 1994). However, discussions of some important topics (e.g., landslides, peak flows) incorporate findings from several more recent studies. The number and diversity of studies required that major findings be summarized here in a general manner, although key comments often are supported by one or more specific references. The discussion also includes how the results relate to some popular perceptions of timber harvest and road effects.

Streamflows

As mentioned, forested watersheds typically show rather large water losses to the atmosphere through evapotranspiration from the forest canopy. Thus, some streamflow changes are possible when timber harvest, reforestation or land use changes significantly alter the forest cover in a drainage area. Popular perceptions of logging effects, interestingly, include both increases (e.g., "logging causes floods") and decreases (e.g., "logging dries up streams") in streamflow. Watershed science indicates that although such a wide range of effects is possible, the more likely result is an insignificant change in flow because typically only a small portion of a watershed is newly harvested at any time (note: Oregon’s Forest Practice Rules currently limit single clearcuts to 120 acres or less). This is especially likely for larger stream and river basins that often provide municipal water supplies.

Due to the naturally high variation in annual streamflows seen in western Oregon watersheds, a measurable change in such flows is highly unlikely unless at least at least 25 percent of the area is clearcut within a short period (Stednick 1996). If such an

extensive area is clearcut (or a similar percent of the total forest basal area is cut using non-clearcut harvest), annual streamflows typically increase because evapotranspiration loss by forest cover is temporarily reduced, leaving more water for streamflow. Because this relationship was generally understood many years ago, the intent of many of the original forest watershed studies in the U.S. was to evaluate possible opportunities for increasing water supplies through timber harvest practices (Ponce 1983).

However, even two decades ago the limited effect of timber harvest on streamflow in western Oregon already was recognized (Harr 1983). This study noted that due to the large treated areas needed to yield significant flow increases, it would not be realistic to manage forested watersheds in the region to produce more water and any yield increases would continue to be only a small and variable byproduct of logging activities. Another limitation is that streamflow increases after timber harvest are not permanent, i.e., replanted forests eventually begin losing as much water to the atmosphere as the original forest. In western Oregon streamflow increases very likely will decline to zero within about 20-40 years, whereas the slower growing conditions in eastern Oregon require perhaps 40-60 years. Thus, forests would need to be repeatedly harvested at very young ages throughout a watershed in order to achieve maximum water yields.

Not surprisingly, some of the largest percent increases in streamflow seen after timber harvest in Oregon occur when evapotranpiration is high (e.g., summer). However, because summer flows are very low to begin with, these flow increases typically do not represent a very large volume of water. On a volume basis, the largest increases in streamflow after logging tend to occur during the rain or snowmelt seasons (i.e., mid-fall to late spring). This presents another limitation to managing forest watersheds for increased municipal water supplies, i.e., reservoirs or other storage facilities are needed to take advantage of larger flow changes that could significantly augment supplies during the season of peak water demand (summer).

Examples of decreased streamflows after timber harvest are relatively rare in the Pacific Northwest research literature. One study in a small watershed (237 acres) in the Oregon Cascades initially showed an increase in summer streamflows after extensive clearcut logging, but eventually this changed to a decrease in summer flow (Hicks and others 1991). High evapotranspiration by alder regrowth in the streamside areas likely led to this pattern, which would not be expected under current practices that greatly restrict riparian timber harvest.

Research in other regions of the U.S. and in other countries suggests that the most common scenario for decreased streamflows related to forest cover changes is when watersheds with large areas of agricultural or other open lands are planted to forests (Bosch and Hewlett 1982; Trimble and Weirich 1987). Higher water losses from evapotranspiration by forest cover clearly is a primary factor in these observed flow decreases. Recognition of this issue has prompted scientists and decision makers in some countries to carefully assess large scale tree planting programs for their potentially negative effects on local steamflows and water supplies.

Increased air temperatures, earlier snowmelt, and some drying of the surface soil and duff are often seen in logged areas, which helps explain the perception that "logging dries up streams." Historical logging and road construction practices also have led to some sedimentation of stream channels, which could have caused more water to flow below the surface of the stream bed. In each of these examples downstream flows probably would have been maintained or increased due to reduced evapotranspiration losses, but locally there could have been the appearance of drier conditions and related perceptions of reduced flows.

The idea that "trees act like sponges and then slowly release water to streams" generally is not supported by research findings. Trees do act like sponges because their roots soak up enormous quantities of water from the soil, but most of this water is lost to the air through the transpiration process. Rain or snowmelt that enters the soil and is not absorbed by trees or other plants provides nearly all the water for stream and river flow. Moreover, the watershed feature that functions most like a sponge is its soils, as suggested recently by some very unique research (Richardson and Siccama 2000). Vegetation does play a role, but management practices that help maintain these favorable soil properties are most vital in watershed conservation.

The floods of 1996 renewed broad interest in the potential effects of timber harvest and roads on peak streamflows. This interest was heightened by the publication of a research study (Jones and Grant 1996) that was featured in a major article in The Oregonian newspaper shortly after the floods of February (March 8, 1996) under the headline: “Swollen streams tied to logging - the legacy of clearcutting and road-building.” A related paper published later the same year (Wemple and others 1996) also received considerable attention, particularly regarding its inferences about the effects of forest roads on peak flows.

Other recent studies in Oregon have shown both increases, decreases and insignificant changes in peak flows after timber harvest (Beschta and others 2000; Jones 2000). Increases were most obvious in small, upland watersheds with a relatively large area logged at one time or with both partially logged and heavily roaded areas. Very importantly, the largest increases occurred with peak flows from relatively common, small storms, whereas less frequent large storms produced smaller or no increases in peak flows after logging. Thus the greatest effects of timber harvest were on the smallest peak flows, changes which likely had the least environmental significance. In addition, regrowth of the forest canopy after logging generally led to diminishing effects on peak flows over time.

Concerns that "logging causes flooding" focus primarily on areas downstream in larger watersheds that include managed forests in the uplands. Although Jones and Grant (1996) concluded that peak flow increases due to timber harvest and roads occurred in western Cascade basins as large as 230 square miles in area, subsequent analysis of the same data by other researchers showed either insignificant or considerably smaller flow effects in the larger watersheds (Beschta and others 2000; Thomas and Megahan

1998). Thus it remains likely that the large floods that cause property damage and other major problems occur primarily when an extended period of very heavy rains adds too much water for soils and streams to absorb, regardless of land use.

Water Quality

Water quality includes a wide variety of specific characteristics, including physical (e.g., temperature, clarity, sediment), chemical (e.g., dissolved oxygen, nutrients, manufactured chemicals) and biological (e.g., bacteria, algae, insects) components. Important water quality characteristics and related standards depend on the primary use (e.g. domestic supply, fish habitat, irrigation) of the water body or supply, with municipal drinking water generally requiring the highest quality levels (see “Regulations...” Section that follows).

Most research on forest practices and water quality has focused on physical and chemical characteristics. Water temperature increases, for example, were documented in several locations in Oregon where timber harvesting removed trees or other vegetation that had shaded the stream (Binkley and Brown 1993; Brown 1985), generally under practices allowed in the 1960's. Soon after, Forest Practice Rules were established in Oregon to help protect water quality, including requirements for maintaining most shade along major forest streams (see “Regulations...” section that follows). Further research documented additional benefits of streamside buffers (e.g., sediment control, fish and wildlife habitat), as well as key characteristics that contributed to their effectiveness and stability.

Increased stream sedimentation after timber harvest was noted in several studies and locations in Oregon (Binkley and Brown 1993; Brown 1985). However, many studies did not clearly distinguish logging effects from those of related activities like road construction or slash burning, which very likely contributed to some or much of the observed increases (Larson and Sidle 1980). Moreover, treatments typically were conducted using standards and equipment of the 1960's, including high-lead logging with limited log suspension and complete cutting of streamside areas. The widespread practice of stream cleanup (removing woody debris to enhance fish passage, etc.) during this period also may have contributed to channel erosion and sedimentation (Beschta 1979). Where water quality measurements continued for several years, sediment increases generally declined or disappeared as revegetation and other stabilization occurred (Beschta 1978). Where patch cutting or other practices increased soil and stream protection, stream sediment increases generally were significantly reduced or avoided (Binkley and Brown 1993; Brown 1985).

Small or no changes in water chemistry (i.e., dissolved nutrients and other constituents) generally have been observed after timber harvest in Oregon, and these limited changes did not adversely affect water quality (Binkley and Brown 1993; Brown 1985; Salminen and Beschta 1991). Slash burning after logging undoubtedly played a role in some of the observed increases, because fire often releases more soluble forms of many nutrients. Nutrient increases generally declined within a few years with

revegetation, and in some cases nutrient concentrations eventually became lower in treated areas, presumably due to the heavy uptake of nutrients by young, rapidly growing vegetation (Gholz and others 1985). Forest soil conditions and climate patterns common in western Oregon also appear to markedly limit nutrient losses via deep leaching after timber harvest (Martin and Harr 1989).

Although manufactured chemicals (e.g., herbicides, fertilizers) are used much less in both amount and frequency in forest management than in agriculture, their effects on water quality have received considerable study in Oregon and other Pacific Northwest locations (Brown and Binkley 1993; Brown 1985). This research shows that the most important means of entry of chemicals to streams is direct application to stream channels, and that measures to control entry (e.g., application methods and timing, streamside buffers) are highly effective in reducing or eliminating stream contamination (note: Oregon's Forest Practice Rules require many of these measures). Water quality can be further protected by careful selection of chemicals that are of relatively low toxicity, solubility, and persistence.

Landslides & Forest Roads

The storms of 1996 caused not only major floods, but also hundreds of landslides and forest road washouts that were highly visible in and near logged areas in steep terrain of the Oregon Coast Range and Cascades. Like the logging and flooding controversy, these landslides and other erosion renewed significant concerns and debate about the potential role of forest practices in these problems. The issue peaked soon after a big storm in November 1996, when a landslide that began in a clearcut area killed four people in rural Douglas County. In response to related questions and concerns raised by the Oregon Board of Forestry, Governor Kitzhaber and many others, several major studies of both past and new data were conducted (Pyles and others 1998; Pyles and Skaugset 1998; Robison and others 1999; Skaugset and Wemple 1999).

Although the common perception is that timber harvest invariably increases landslides, the studies show that when the bias for the high visibility of slides in cutover areas was accounted for with ground surveys, landslides were found to occur in both logged and unlogged areas. In some cases landslides were more frequent in cutover areas during the first decade after harvest, but many studies were done years ago and thus reflect older equipment and practice standards (e.g., 1960's and 70's) that generally resulted in more soil disturbance than is common today. Moreover, when landslide surveys included logged areas that had developed forests 10 to 100 years old, some of these areas showed lower landslide rates than those seen in unlogged, mature forests.

Thus, although there is evidence that timber harvest can increase landslide rates, the actual degree and scope of this effect under current forest practice standards is much less clear. This lack of clarity of effects is important because it can markedly influence both the benefits and costs of policies and practices used to reduce landslides, depending on which locations and practices are affected. In spite of this uncertainty, the Oregon legislature and Board of Forestry took some significant steps not long after

the November 1996 storms to restrict timber harvest and other forest practices in steep, unstable areas, particularly where the safety of local residents is a primary concern.

Negative effects of forest roads on landslides and other erosion generally have been observed more consistently than those of timber harvest, particularly when older roads in steep terrain were considered. Research in steep, unstable areas of the Cascades and Coast Range has shown a number of clear examples of increased landslides or other erosion and stream sedimentation from forest roads. Major storms shortly after road construction resulted in some of the greatest effects, with erosion and sedimentation generally declining with revegetation of roadsides and other natural stabilization. However, landslides and other erosion seen years after construction show that ongoing operations to maintain proper drainage during wet weather (e.g., grading and culvert cleaning) are essential to forest road stability. Moreover, because only a relatively small proportion of forest roads have been observed actually delivering sediment to streams, research that identifies road characteristics that favor erosion and sedimentation (e.g., Skaugset and Allen 1998) can help target more effective road maintenance, location and design improvements.

Like the studies of timber harvest effects, most research has been on forest roads constructed in the 1960's and 70's. Where improved road location, design and maintenance were used, less erosion was observed (Luce and Black 1999; Sessions and others 1987; Skaugset and Wemple 1999). Similarly, many forest roads constructed to support older logging systems (e.g., high-lead cable) would not be needed with newer harvesting technologies (e.g., long-reach skylines). Other studies of various roadside treatments (e.g., seeding, mulching, filter strips) have shown reductions in erosion and sedimentation. The level of vehicle use also can affect sediment losses from forest roads, and thus traffic control during wet weather may effectively reduce sedimentation.

Conclusions

The research literature includes many examples of effects of timber harvest and forest roads on water quality and quantity in Oregon watersheds. Popular perceptions commonly are that forest practices invariably have negative and relatively permanent impacts. However, study findings show insignificant, positive, negative, and complex effects that are greatly influenced by the specific location, treatments, and study duration. Much of the research on forest practices and watershed resources was done years ago, and these results should be tempered in light of current management standards and available technologies. In fact, many of today’s common practices and regulatory requirements were stimulated by these earlier research findings. Further research can help clarify complex cause and effect relationships, but current knowledge is substantial and if carefully used, allows managers to address key concerns about watershed resources when local objectives include some active forest management for economic or other benefits.

Studies in Forested Municipal Watersheds in Oregon

Although limited in number, scope and location, some noteworthy research has been conducted in several forested municipal watersheds in Oregon. This work includes studies in watersheds that supply water for two of the largest cities in the state (Portland and Salem), as well as analyses of some concerns specific to forested areas.

Portland (Bull Run)

Portland's Bull Run watershed is located within the Mt. Hood National Forest, which has contributed to a long history of research and other data collection by USDA Forest Service personnel. In addition, its unique setting and importance as a public water supply have prompted many others to monitor and study the watershed, including the City of Portland and university researchers. Because timber harvesting was conducted on the watershed in earlier decades (primarily the 1960's and 70's), and raised significant questions and controversy (e.g., Popovich 1977), many studies focused on identifying effects of logging and road construction on water quantity and quality.

Using basic watershed and climate characteristics to estimate the local water balance (i.e., precipitation - evapotranspiration = water yield), Luchin (1973) compared actual and predicted water yields in the 68,000 acre Bull Run basin. Noting that actual water yields were considerably higher (18 inches) than estimated values, he concluded that seepage from adjacent basins through porous local bedrock in the area was primarily responsible for the discrepancy. At a smaller scale, Harr (1980) studied streamflow patterns after road construction and patch clearcutting (7-10 acre units on 25 percent of the area) with and without slash burning in two small sub-basins (Fox Creek 1 and 3, respectively). Results showed that the treatments had no obvious effect on annual water yields and peak flows, but that low flows decreased.

Because other studies of similar harvest treatments had consistently shown some flow increases, a follow-up study in one of the sub-basins (Harr 1982) evaluated the possible role of reduced "fog drip" from the temporary loss of forest canopy in logged areas. Studies in some foggy coastal and high mountain locations have shown that fog condensation and drip from vegetation canopies can add significant water to local precipitation. Over a 40-week period, measurements of net precipitation under a forest canopy were 15 inches greater than in nearby logged areas. Although this difference was not validated by statistical tests, Harr argued that they were real and explained the streamflow patterns seen in the 1980 study as well as the flow discrepancy earlier noted by Luchin (1973). Questions raised by Harr's short-term studies prompted Ingwersen (1985) to examine streamflow data from the Fox Creek sub-basins for several more years after the initial treatments. Although he found summer low flow patterns similar to Harr (1980) for the first few years after treatment (i.e., decreases on Fox Creek 1 and insignificant changes on Fox Creek 3), over the next eight years the summer flows on Fox Creek 1 were comparable to the unlogged control watershed and on Fox Creek 3 these flows had increased. These later patterns appeared to be explained by fog drip

contributed by prolific young vegetation after harvest and burning (Fox Creek 1) and by abundant unburned slash and residual vegetation (Fox Creek 3).

Harr and Fredriksen (1988) summarized water quality effects of the aforementioned road construction, timber harvest and slash treatments on the Fox Creek sub-basins. Although some effects on sediment and nutrient losses from the treatments were noted, most were relatively small and short-lived. In addition, these effects were attributable largely to activities (e.g., streamside timber harvest, high-lead yarding, in-stream machine activity during road construction, slash burning) that no longer are practiced or could have been modified to further reduce management effects. Rinella (1987) examined water quality data from downstream collection points relatively close to the Bull Run Reservoirs to help characterize both natural patterns and management influences. Although somewhat limited by the nature and extent of the water quality sampling, he found that most of the variation in the water quality measurements could be explained by natural processes and that forest management effects appeared minor.

Concerns about water quality on the Bull Run Watershed persisted, leading U.S. Representative Ron Wyden in 1988 to commission an independent team of scientists to assess the water quality monitoring program on the Bull Run for determining: a) compliance with quality standards, and b) effects of land management practices. The team found that while generally adequate to determine standards compliance, improvements in water quality monitoring could be made and would be needed to clarify management effects (Aumen and others 1989). They also noted that the available monitoring data showed no evidence of deterioration in water quality from historical levels, no violations of water quality standards, and that the water quality of the streams of the Bull Run was “extraordinary.”

Other notable studies on the Bull Run Watershed include an investigation of sediment deposits in Reservoir No. 1 (Peterson and others 1995) and some detailed analyses of stream nitrate patterns (Bakke 1993, Bakke and Pyles 1997). Findings of thin deposits in the reservoir confirmed that the watershed historically has had very low erosion and sedimentation rates, although an increase was apparent for 1964-72. This period coincides with a major natural disturbance (1964 flood) as well as peak road construction and increased logging activity. However, the study was unable to distinguish between these natural and management sources, and thus either or both could have been important. The stream nitrate analyses showed that nitrate concentrations were unrelated to suspended sediment levels, and instead were primarily explained by variations in precipitation, streamflow and air temperature.

Salem (North Santiam)

Salem’s municipal watershed was brought into the local public spotlight in February 1996, when a major storm resulted in unusually high and persistent sediment and turbidity levels in the North Santiam River system. Municipal water treatment was suspended for eight days while sediment levels exceeded the treatment system’s capacity, and the City nearly was unable to supply its residents with safe drinking water.

Responding to related concerns expressed by the City of Salem, some advocacy groups, and local agency managers, a study was initiated to assess local turbidity sources, management relationships, and potential corrective measures.

The result was a joint analysis by scientists and technical specialists from the USDA Forest Service, Oregon State University and the City of Salem (Bates and others 1998). A unique clay mineral common to the upper North Santiam watershed (i.e., smectite) was found to be the primary cause of the persistent turbidity in the water supply. And although erosion, sediment and turbidity relationships were quite complex within the watershed, the major sources of the clay sediment and turbidity problems most likely were erosion processes (e.g., slow-moving earthflows, channel erosion) and management activities (e.g., reservoir release) that were generally unrelated to logging and road construction in the upper basin.

Albany, Lebanon & Sweet Home (South Santiam)

Although designed primarily as a geologic study, some recent research by Pearch (2000) evaluated watershed erosion, sediment, and turbidity relationships that can affect the municipal water supplies for Albany, Lebanon and Sweet Home. These supplies drain from the South Santiam River watershed, whose upper portions are largely forested and have experienced a significant amount of timber harvest and road construction in recent decades. Local water quality samples and records, soil and reservoir sediment samples, and analyses of clay mineralogy of the sediments were used to help identify specific erosion and sedimentation sources and processes.

Results were similar to those seen in the North Santiam basin, i.e., sources of sediment and turbidity at the three municipal supply intakes were variable and complex. And although some land management influences were evident, erosion of slow-moving, natural earthflows clearly was the major controlling influence on suspended sediment and turbidity levels throughout the watershed. This important influence also occurs despite the fact that these active earthflows represent only a small portion of this relatively large watershed.

Seaside (South Fork Necanicum)

Taylor and Adams (1986) studied the water quality effects of leaf litter from riparian red alder stands in the City of Seaside's municipal watershed, located on the South Fork of the Necanicum River a few miles southeast of the City. City officials and others managing municipal water supplies in Oregon have seen some significant color, taste, and odor problems where riparian leaf inputs have been abundant, particularly during periods of low streamflow (State Water Resources Board 1973). In addition, chlorination of water rich in organic matter may be less effective in eliminating harmful organisms and also may create chemical byproducts that have undesirable characteristics for both the aesthetics and safety of drinking water.

Field and laboratory research showed the potential for red alder leaves to reduce the quality of municipal water supplies, although an infrequent combination of extended low flows and heavy leaf fall likely is needed to cause major problems for the Seaside water supply (Taylor and Adams 1986). Companion studies also confirmed that water samples with significant levels of red alder leaf extracts can require more chlorine for effective treatment, as well as produce undesirable trihalomethane compounds from the chlorination process (Taylor and others 1983). However, because the water quality effects in the field and laboratory were highly dependent on the relative amounts of leaves, water and soaking times, specific watershed characteristics and streamflow patterns likely will determine if leaf litter problems are a valid local concern.

Multiple Watersheds (Grizzel 1993)

To determine whether timber harvest and/or road construction had affected water quality in 13 managed watersheds in western Oregon, Grizzel (1993) studied 5-17 years of turbidity records from municipal water treatment facilities supplied by those basins. Records from the Oregon Department of Forestry provided information about the nature, extent and timing of the forest practices conducted on the watersheds. The study included three of the municipal watersheds included in the catalog portion of this report: Astoria (Bear Creek), Dallas (Rickreall Creek) and Newport (Big Creek). Because the nature of the data sets presented some limitations, two different methods were used to evaluate management effects. It is important to note that the forest practices on these watersheds were conducted between 1980-91, using both methods and equipment that may be less common under current regulations and standards of practice in Oregon.

Analyses of turbidities before, during and after logging and road construction on the 13 watersheds indicated that these practices alone did not result in sustained increases in turbidity levels at the water treatment facilities (Grizzel 1993). In some cases, forest operations appeared to exacerbate the effects of a large coastal storm in 1990, including landslides in two watersheds that led to large, but short-term increases in turbidity. A second analysis of the cumulative areas disturbed by forest operations and the observed turbidity levels revealed no significant relationships between these variables on the watersheds.

Multiple Watersheds (GAO 1998)

In February 1996, one of the worst storms in decades led to very high turbidity levels in rivers and streams supplying several major municipal systems in western Oregon. The City of Salem, which suspended water treatment for a week due to the turbidity, as well as some organized groups, raised concerns that timber harvesting and forest roads on upstream federal forest lands were a major source of the turbidity. Responding to related congressional requests, the General Accounting Office (GAO) conducted an independent review (1998) of research and other information related to the role of human activities in the high turbidity levels of 1996 and of current efforts to ensure safe water supplies during future storms. The review focused on the Cottage Grove,

Eugene, Portland, Salem and Sandy watersheds. The GAO is Congress' investigative arm, whose key activities include uniquely apolitical and objective analyses of controversial issues.

The GAO review showed that both forest practices as well as agricultural, industrial, urban, and residential development, can contribute to elevated sediment levels during large storms. Historical timber harvest and road construction practices, which originally were not designed to protect water quality, have been a notable source of erosion and sedimentation. More recent studies show that agricultural and urban/suburban areas have become major sediment sources in the Eugene and Salem watersheds. And although Eugene experienced sediment levels 20 times higher than Salem, its improved treatment system and reserve water supply allowed it to avoid the serious measures taken by Salem.

The GAO review also concluded that forest practices did not contribute significant amounts of sediment to Salem's water supply during the 1996 storm, which instead was impacted primarily by natural erosion and clay mineralogy, as well as human activities on nonfederal lands in the lower watershed. More broadly, the GAO further noted that federal and state agencies, municipalities, and private landowners have made significant progress in mitigating the impact of human activities on water quality and in ensuring safe drinking water in the region.

REGULATIONS & OTHER POLICIES AFFECTING MUNICIPAL WATERSHEDS

Water Supply

Under Oregon law, all water is publicly owned. However, to ensure consistent, legal access to water supplies, state law also provides many public and private water users with formal water rights through a permitting process (Bastach 1998). The Oregon Water Resources Department (OWRD) is the state agency that administers water rights law and permits; the Oregon Water Resources Commission is a seven member citizen body appointed by the Governor to set state water policy and to oversee OWRD activities (OWRD 1997).

Most cities and towns in Oregon hold formal water rights to one or more of the current or anticipated sources used for their domestic supplies. In many cases these water rights have been held for many years, which when combined with the unique status of a municipality, help ensure first or high priority access to the allocated supplies. Further water rights protection is provided when OWRD permitting requirements or guidelines are followed, such as filing a "Water Management Plan."

Water Quality

Municipal water supply systems in Oregon are strongly regulated by state and federal laws to promote high water quality and safety. The federal Safe Drinking Water Act (SDWA), passed in 1974 and amended in 1986 and 1996, provides the primary mandate for maintaining safe supplies of drinking water to the public (Spellman and Drinan 2000). Under the authority of the SDWA, the U.S. Environmental Protection Agency (EPA) establishes legally enforceable standards that water system administrators must comply with to limit the levels of contaminants that pose known hazards to public health. In addition to these National Primary Drinking Water Regulations (NPDWR), the EPA also sets non-enforceable guidelines for limiting contaminants that may cause cosmetic (e.g., tooth or skin discoloration) or aesthetic (e.g., taste or odor) problems.

The Oregon Drinking Water Quality Act of 1981 (ORS 448.119 to 448.285, 454.235 and 454.255, and 757.005) directs the state's efforts to implement and comply with the water quality mandates set by the SDWA and the EPA. Oregon Administrative Rules (OAR 333-061) provide the specific, detailed standards and other requirements for managing municipal water supplies, including personnel certification, water quality monitoring, maximum allowable contaminant levels (e.g., Table 1), and disinfection treatments. These Rules for Oregon's public water systems are designed to meet or exceed the federal standards, and the Oregon Health Division (OHD) of the Department of Human Resources provides primary administration and enforcement of the Rules throughout the state. If violations of safe drinking water standards occur, public notices may be required and the OHD may impose fines or other penalties on the public water system.

Forest Practices

The Oregon Forest Practices Act (ORS 527.610 to 527.770, 527.990(1), 527.992) is the primary law authorizing the regulation of management practices on forest lands to protect key resources such as water, timber, fish, and wildlife. The Act defines the fundamental policies and directives, but most of the specific requirements that forest land owners and operators must follow are found in Oregon's Forest Practice Rules (OAR Chapter 629). The first version of the Rules was implemented in 1972, when Oregon was the first state in the country to respond with forest practice regulations after a federal law was passed requiring states to develop ways to reduce water pollution. The Rules have been expanded and revised several times since 1972, reflecting both new knowledge and broader concerns about forest resource protection (Adams 1996).

Water resources are protected by many different requirements specified under the Forest Practice Rules, including various restrictions or directives for forest operations near streams and other water bodies, as well as the use of streamside vegetation buffers (ODF 1998). Table 2 lists some of the major requirements for stream protection where water is used nearby for domestic supplies, such as municipal water systems.

Many other Forest Practice Rules provide protection of other forest values such as wildlife and forest productivity (ODF 1998). For example, a minimum number of snags, down logs and green trees must be retained after timber harvest to provide wildlife habitat. Prior approval is required for any operations near critical, threatened or endangered wildlife habitat. When timber harvest reduces forest cover below specified levels, reforestation of the area must begin within 1 year of harvest and the area must have a thriving ("free-to-grow") stand of young trees within 6 years.

Other Resources & Activities

Several other policies may be important to natural resources and management activities on municipal watersheds. For example, the Division of State Lands administers Oregon's Removal-Fill law (ORS 196.800-990), as well as its Wetlands Program. Although many activities would be exempt or would be covered under the Forest Practice Rules, in some cases separate removal-fill permits or wetlands assessments may be needed or desirable. Similarly, certain mining activities (e.g., oil and gas exploration) require a permit from the Department of Geology and Mineral Industries.

Growing interest in rare, threatened, and endangered species has expanded policies and programs for species and habitat inventory and protection, as well as recovery plans and activities. The U.S. Fish and Wildlife Service (FWS) of the Department of Interior and the National Marine Fisheries Service (NMFS) of the Department of Commerce administer the federal Endangered Species Act, including species listings and recovery plans. The FWS is responsible for terrestrial and freshwater species, whereas the NMFS is responsible for marine and anadromous species.

In 1987, Oregon passed its own state Endangered Species Act to complement the federal law and direct state policies and programs. This law gave the Oregon Department of Fish and Wildlife responsibility for threatened and endangered fish and wildlife species, while the Oregon Department of Agriculture became responsible for plant species. A separate state law passed in 1979 also authorized the Oregon Natural Heritage Program, which now helps maintain a comprehensive database of the status and locations of rare, threatened and endangered species throughout the state.

Because many municipal watersheds are largely forest land, the Oregon Department of Forestry and the Forest Practice Rules provide a primary administrative and policy link to species concerns. However, if rare, threatened, or endangered species are found on or adjacent to the Watershed, the other state and federal agency policies and programs may become more directly applicable. For example, presence of an active spotted owl or marbled murrelet nest on or near a watershed may require a detailed Habitat Conservation Plan (HCP) and approval by the FWS prior to any management activities within a specified distance of the nest.

Federal Lands

Because over half of Oregon's forest lands are in federal ownership, many municipal watersheds in the state include parts of National Forests and other federal forest lands. This is more than coincidence because water supply was one of the primary purposes for which National Forests were originally established near the beginning of the 20th century (Satterlund and Adams 1992).

Federal forest lands provide most of the water for some of Oregon's largest municipal water systems, including Portland, Salem, and Corvallis. In addition to fully complying with applicable state laws, these lands are managed under a number of important federal laws and other policies that can have implications for municipal water supplies. In most cases these policies place greater restrictions on management activities such as timber harvest and road construction than is required under state law.

For example, unless watershed analysis suggests otherwise, the Northwest Forest Plan requires no-harvest riparian buffers of 150-300 feet or more along most streams on most federal forest lands in western Oregon (Record of Decision 1995). The primary objectives of these restrictions are the protection and restoration of habitat for aquatic and riparian species. In the case of Portland's Bull Run watershed, congressional amendments in 1996 (Oregon Conservation Resources Act) to Public Law 95-200 (1977 Bull Run Act) placed further restrictions on timber harvest within the watershed.

Although there is little scientific evidence to suggest that such substantial restrictions are needed to ensure the quality and quantity of municipal water supplies, in most cases they are likely to effectively minimize water resource impacts from management activities. However, such restrictive management policies may also have the unintended consequence of increasing the threat of wildfire in some locations, and

federal managers currently lack a cohesive strategy to reduce such hazards (GAO 1999).

Figure 1. Suspended sediment concentrations at various flow levels of a small stream in an undisturbed forest watershed in the Oregon Coast Range (from Brown 1985).

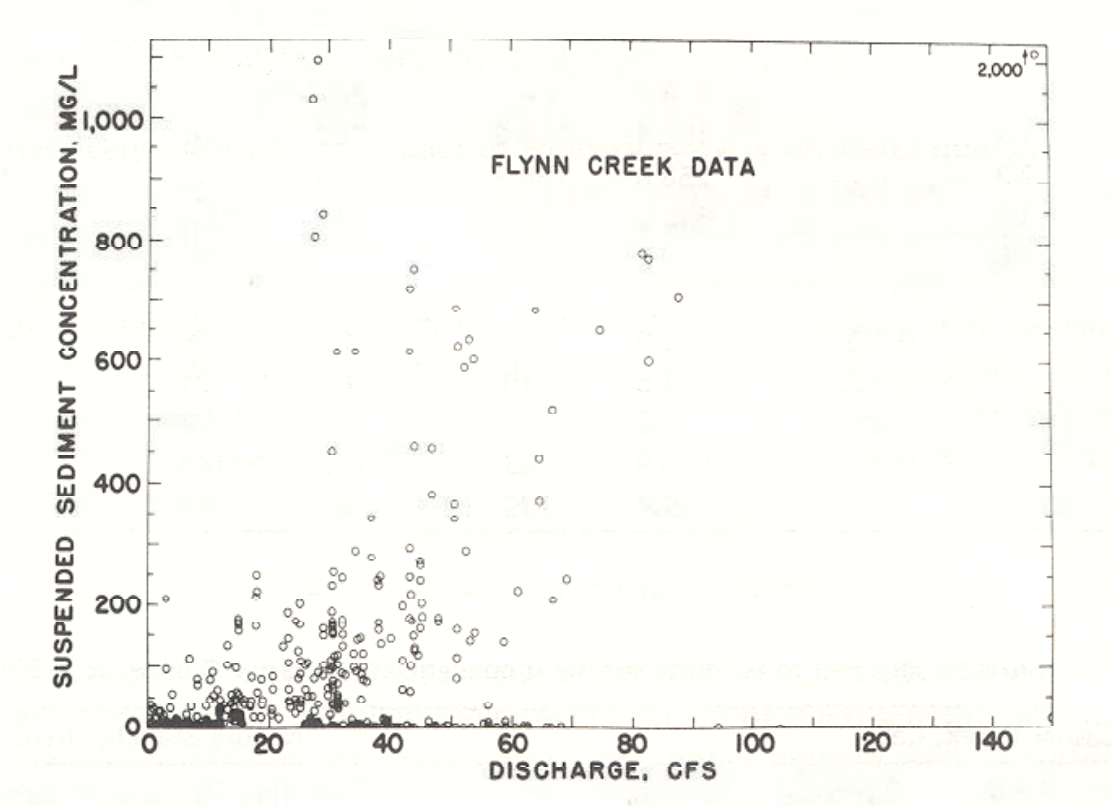

Table 1. Maximum allowable contaminant levels for inorganic chemicals for Oregon public water systems (OAR 333-061-0030).

Contaminant	Maximum Concentration (mg per liter)
antimony	0.006
arsenic	0.05
asbestos	7 million fibers (> 10um) per liter
barium	2
beryllium	0.004
cadmium	0.005
chromium	0.1
copper	1.3
cyanide	0.2
fluoride	4
lead	0.015
mercury	0.002
nitrate (as N)	10
nitrite (as N)	1
total nitrate + nitrite (as N)	10
Selenium	0.05
Thallium	0.002

Table 2. Some of Oregon's Forest Practice Rule requirements to protect water for domestic supplies or general quality.

Activity	Specific Requirements
Notification & Written Plans	The Oregon Department of Forestry must be notified at least 15 days prior to operations such as timber harvesting, road construction, site preparation, chemical applications, slash treatment & land clearing. A detailed written plan & prior approval are needed prior to any such operations within 100 feet of streams & lakes used for domestic water supply.
Road Construction Near Streams	The number of stream crossings must be minimized & they must be designed to pass a 50-year peak flow effectively. Road location, design, construction, & maintenance must minimize erosion & promote filtering of sediments from runoff. Use of large road fills (>15 feet deep) require a written plan & prior approval. Any machine activity in streams requires prior approval.
Timber Harvest Near Streams	Riparian management areas (RMA's) of 20 to70 feet wide are required on each side of streams used for domestic water supply (specific width depends on stream size; where fish also are present, the RMA widths are 50 to 100 feet). Harvest & operating restrictions within the RMA include: a) retention of all vegetation within 10 feet and all trees within 20 feet of streams, b) retention of a specific number, size, and type of trees between 20 feet & the outer RMA boundary (these depend on stream size & geographic region), c) no skid trails within 35 feet of stream except for crossings, d) prior approval required for any yarding across streams, e) full log suspension required for any cable yarding across steams, & f) written plans required for slash or other burning within 100 feet of streams and large lakes.
Chemical Application Near Streams	Community water system managers must be notified of any chemical application within 50 (ground) or 100 (aerial) feet of a stream used for domestic water supply. Mixing & staging areas for aerial spraying are not allowed within 100 feet of such streams. Aerial application is not allowed within 60 to 300 feet of such streams, depending on the type of chemical; ground application generally is allowed beyond 10 feet, but wider buffers are required for some chemicals.

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Catalog of Major Municipal Water Systems & Watersheds in Oregon

Municipal Systems Surveyed

Albany
Ashland
Astoria
Baker City
Bend
Canby
Clackamas area
Coos Bay-North Bend
Corvallis
Dallas
Eugene
Forest Grove
Grants Pass
Hermiston
Hillsboro-Beaverton
La Grande
Lake Oswego area
Lebanon
Lincoln City
McMinnville
Medford area
Newport
Ontario
Oregon City-West Linn
Portland area
Roseburg
Salem
The Dalles
Umpqua area
Warrenton

Catalog Notes

Population figures in this section come from the 2001 edition of the Oregon Blue Book, and are based on recent U.S. Census data. Numbers of water users and connections come from Oregon Health Division records. Local population and water user figures may differ due to varying assessment methods and boundaries among water districts and municipalities. Information about individual water systems and watersheds was compiled from survey responses from municipal or utility personnel (see appendix) as well as public records from agencies such as the Oregon Health Division, the Oregon Department of Environmental Quality, and the U.S. Geological Service.

Abbreviations used:

ATV	all terrain vehicle
BLM	Bureau of Land Management (U.S. Department of Interior)
CWA	Clean Water Act (federal law)
DEQ	Department of Environmental Quality (Oregon)
EIS	Environmental Impact Statement (federal assessment)
EPA	Environmental Protection Agency (U.S.)
ESA	Endangered Species Act (federal law)
GIS	geographic information system
HAA	haloacetic acids
HUC	hydrologic unit code
IOC	inorganic chemicals (primarily heavy metals)
MG & MGD	million gallons & million gallons per day
MOU	memorandum of understanding (an agreement, often between agencies)
MPA	microscopic particulate analysis
MTBE	methyl-t-butyl ether (gasoline additive)
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System (waste release permits)
NTU	nephalometric turbidity units (measure of water clarity)
ODF&W	Oregon Fish and Wildlife Department
OHD	Oregon Health Division
OWRD	Oregon Water Resources Department
pH	acidity measure (based on hydrogen concentration)
SOC	synthetic organic chemicals (primarily pesticides)
SWCD	Soil & Water Conservation District
TDS	total dissolved solids
TOC	total organic chemicals
TTHM	total trihalomethanes (chlorination by-products)
UGB	urban growth boundary
USFS	Forest Service (U.S. Department of Agriculture)
USFWS	Fish and Wildlife Service (U.S. Department of Interior)
USGS	Geological Service (U.S. Department of Interior)
VOC	volatile organic chemicals (primarily industrial solvents)

ALBANY

Albany is located in the central Willamette Valley. In 2000 its population reached 41,000, an increase of about 39% from 1990. Albany hosts several diverse industries that use water for processing, including specialty metals, paper, and frozen vegetables. Water is delivered to Albany through a canal that runs 18 miles from the South Santiam River into the water treatment plant; this canal has operated since the 1870's. The water system supplies about 43,500 users through about 14,350 water connections, including a large service district in the north Albany area.

Water Supply System:

Albany uses a mixed media rapid sand filter and a conventional water treatment plant. Treatment includes coagulation, flocculation with aluminum sulfate, settling, filtration, and disinfection. There is distribution storage up to 16.4 million gallons.

Average demand from the system is between 9 and 10 MGD, with peak demand reaching 17 MGD. There are no backup supplies to provide water to the Albany plant. The City of Albany collects water quality data beyond what is required by law. It tests for organic pesticides, VOCs, TOCs, and metals in their canal source water. The city reports that over 4000 samples are taken each year, and the water is tested for over 100 contaminants.

Watershed:

The South Santiam River is the source of water for the City of Albany. The watershed for the South Santiam River drains the western Cascade mountains between the Calapooia to the south and the Middle Santiam River to the north. The exact size of the watershed above the canal has not been calculated, but it is roughly 700 square miles in area. Annual precipitation on the watershed ranges from about 45 inches near the canal (about 250 feet elevation) to as much as 100 inches at the highest elevations (about 5000 feet). Although rain is the primary water source, snow contributes significant moisture from large portions of the upper watershed.

Water managers for the City of Albany do not have information regarding specific ownership or vegetation patterns on this watershed, but it is largely forest lands except for the developed and agricultural areas of Lebanon, Sweet Home and the Willamette valley. The upper watershed is entirely in public ownership (primarily federal lands), and the mid-elevation forests are a mixture of private and federal lands. Agricultural land is common in the valley, although the most extensive areas are below the earthen canal that supplies the city's intake.

A detailed assessment of recent and past management activities on the watershed has not been conducted, but some general patterns are evident. On the forest lands there have been significant and extensive road construction and timber harvest, although in

recent years these activities have been greatly reducted on federal lands. Recreation activities are common throughout the watershed and include fishing, reservoir boating, hunting, public road use, firewood cutting, hiking, horseback riding, and 4x4, snowmobile, and ATV use. A major state highway, OR20, passes through this watershed, and parallels the South Santiam River for some distance into the Cascades.

The lower South Santiam River has been listed as “water quality limited” (temperature and bacteria standards) under section 303(d) of the Clean Water Act, which can affect future management and land uses in the basin. ESA listings of local salmon and steelhead populations can have similar implications. Water quality for domestic use could benefit from measures to address these listings.

The South Santiam Watershed Council is active locally and has assessed portions of the watershed. Efforts to expand the assessment are continuing. Another watershed council, the Calapooia Watershed Council, is also active in the area.

Water managers for the City of Albany identified two major concerns for the watershed and water supply. First, there is concern that agricultural runoff enters the canal, with potential contamination by pesticides. Second, there are environmental contamination sites within the watershed. These include old dry cleaning business and pulp mill sites that are adjacent to the canal and have a history of impaired water listings.

Local Contacts & Information:

City of Albany, PO Box 490, 97321-0144
Phone (541) 917-7500 Fax (541) 917-7511 Web: www.ci.albany.or.us
Water Resources Coordinator: (541) 917-7629

USFS Sweet Home Ranger District: Phone (541) 367-5168
South Santiam Watershed Council, 33630 McFarland Rd., Tangent, OR 97389
Phone (541) 967-5927, ext. 120 Fax (541) 928-9345
Calapooia Watershed Council, 33679 Highway 228, Halsey, OR 97348
Phone (541) 466-5449

Water supply operator: City of Albany
Water supply source: South Santiam River, via canal from Lebanon area
Water supply capacity: 20.00 MGD
Water distribution: City limits
Water system established: 1918

ASHLAND

Ashland has a population of 20,085 and is located just a few miles from Oregon's southern border. Ashland is the home of Southern Oregon University and the widely known theatre arts center, the Oregon Shakespeare Festival. Its municipal water source is a tributary to the Rogue River known as Bear Creek (also locally referred to as Ashland Creek). The Ashland Water Department serves over 17,000 customers through over 6,700 water connections.

Water Supply System:

The Ashland Water Department maintains a conventional filtration water treatment plant. Specific details on the treatment methods used were not provided. Storage for the water system consists of concrete reservoirs that total 6.5 MG of storage capacity.

Average demand for water is 3.4 MGD. Peak demand has been as high as 7.0 MGD. If there is a need for a backup source of water, the Talent Irrigation District can supply approximately 3 to 4 MGD raw water to the intake. The water manager for Ashland reports that this backup is only used rarely, and only during extreme drought.

The water operators collect water quality data beyond what is required by law. Current monitoring includes all required tests plus Giardia, Cryptosporidia, HAAs, TOC, aluminum, iron, bromate, chlorite, and many others that may be regulated in the future.

Watershed:

The Bear Creek watershed is part of the larger Rogue River basin in southwest Oregon. The watershed exends over 14,425 acres just south of Ashland, and ranges in elevation from about 2500 feet to the peak of Mt. Ashland at 7533 feet. This elevation difference contributes to annual precipitation varying from about 25 to 65 inches, and to snow as an important part of the local hydrology. The watershed is primarily federal forest land managed by the USFS and BLM, with a small area of municipal ownership. Specific percentages of the watershed held by each entity were not identified. Vegetative cover on the watershed consists of about 2% hardwood forest, 96% conifer forest, and 2% grasses and shrubs.

Water managers for Ashland report that the only management activities that have occurred within the watershed in the past three years are slash burning and fire break construction. In the past twenty years, however, other management activities have included road maintenance, thinning and/or selective harvest, fire break construction, slash burning, and harvest of dead and dying trees using a helicopter to fly logs out of the watershed. Ashland's watershed is closed to public access throughout the year.

Some listed Threatened and Endangered species exist or have significant habitat within the watershed. Of particular interest is spotted owl habitat on 160 acres of the watershed.

Some watershed assessment work has been completed. In 1995, the USFS Ashland Ranger District completed a report entitled "Bear Creek Watershed Analysis." The DEQ will be responsible for an assessment within five years. The USFS has ortho photos and GIS data for the watershed. Although there is no local watershed council, the Ashland City Council and the USFS play a similar role in involving and serving diverse public interests.

The greatest concerns for the watershed and water supply identified by city personnel include: 1) erosion and slides in steep terrain, 2) wildfire, 3) security and 4) unauthorized human entry.

Local Contacts & Information:

City of Ashland:
20 E Main St., 97520-1849; Phone (541) 488-6002; Fax (541) 488-5311
Email: fran@ashland.or.us Web: www.ashland.or.us

USFS, Ashland Ranger District, 645 Washington St., Ashland, OR 97520-1402
Phone (541) 482-3333 Fax (541) 858-2402 Web: www.fs.fed.us/r6/rogue/

Water supply operator: City of Ashland
Water supply sources: Ashland Creek, Reeder Reservoir; Talent Irrigation District
Water supply capacity: 12.00 MGD
Water distribution: City limits
Water system established: 1908

ASTORIA

Astoria, located at the mouth of the Columbia River at the extreme northwest edge of Oregon, supports a population of 10,075. The Lewis and Clark expedition spent the winter near Astoria before their return trip east. Astoria has an ample and well-developed water supply, as early planners expected the area to support a large fishing and fish processing industry. Although such industry remains significant, Astoria's economy now includes an important tourism trade. The Bear Creek Watershed provides water to over 12,000 customers through over 3800 water connections, including some smaller water districts in the area.

Water Supply System:

The City of Astoria's water treatment plant utilizes a slow sand filter system. After initial filtration, water is chlorinated and sent several miles into town. Water rights within this watershed date back to the 1880's, and the City also holds rights for undeveloped supplies from the Youngs River if needed in the future.

Three reservoirs within the watershed provide 370 MG of raw water storage. Bear Creek Dam forms the Main Lake which stores up to 220 MG. Middle Lake has a capacity of 560 MG, and is particularly important because it can provide relatively clear water when winter storms make other sources turbid. Wickiup Lake could provide about 100 MG of storage, however its capacity currently is limited by bottom seepage. The City of Astoria is considering building an additional reservoir above Middle Lake for additional storage. Finished water is stored in three reservoirs in town. The reservoirs have capacities of 20 MG, 5.5 MG, and 23,000 gallons for a total of 25.523 MG. Because of the location of the watershed and the city, gravity is the only power needed to transmit finished water into town.

Currently, the Bear Creek Watershed provides an average of 2.6 MGD. Peak demand has been as high as 4.2 MGD. The recent addition of a fourth sand cell increased the treatment capacity from 4.2 MGD to about 5.6 MGD, although a primary objective of this installation was to sustain the base treatment capacity when an individual cell is shut down for routine maintenance.

Watershed:

Located about ten miles southeast of the City of Astoria, the Bear Creek Watershed includes not only the Bear Creek drainage, but also portions of the adjacent Cedar Creek (also known as Waterworks Creek) drainage. The total watershed area is about 3155 acres, of which about 725 acres are within the Cedar Creek Watershed. Elevations in the watershed range from about 650 feet to about 2250-2700 feet along Wickiup Ridge, which contributes to an annual precipitation level of about 100-110 inches in this wet, coastal climate.

The entire watershed is owned and actively managed by the City of Astoria. Activities within the past three years have included new road construction, road maintenance, thinning, limited clearcutting, new sand filter construction, and reservoir maintenance. Between the 1930's and 50's, the watershed was nearly entirely logged and burned by its previous private owners. Vigorous forest regrowth has allowed significant timber harvest over the past two decades. Recently, the City of Astoria took steps to develop a comprehensive, long range management plan for the watershed. This has included a detailed watershed evaluation by Oregon State University faculty and Clatsop County Extension, and plans for identifying management goals and objectives.

The Bear Creek Watershed road system has locked gates, with access given only to city staff, contractors working in the area, and maintenance personnel for the communication systems atop Wickiup Mountain. Some unauthorized recreation occurs on the watershed and the City of Astoria is reviewing such activities and its related policies. Since the primary concern for the city is to maintain needed levels of clean water, the watershed may remain closed to the public.

The City of Astoria maintains some GIS data for the watershed and has local aerial photographs from various years. Forest stand and other watershed resource data were collected and summarized by Oregon State University and should be useful for future planning. There are several watershed councils nearby in Clatsop County, but none is focused on the upper Bear Creek Watershed because it is owned entirely by the City.

City personnel note that their primary concern for the Bear Creek Watershed is the continued production of sufficient quantities of high-quality drinking water. One specific concern is the threat of landslides that add turbidity and sediment into source streams. Another issue is increasing the storage capacity of Wickiup Lake by eliminating the leakage. Of unique concern also is the stability of the Main Lake dam, which has a significant risk of failure during a moderate or large earthquake. The City of Astoria commissioned a study by a consulting firm to identify options for reducing this risk.

Local Contacts & Information:

City of Astoria, 1095 Duane St., Astoria, OR 97103
Phone (503) 325-5824; Fax (503) 325-2017
E-mail: jlampi@astoria.or.us Web: www.astoria.or.us

Water supply operator: City of Astoria
Water supply source: Bear Creek & Cedar (Waterworks) Creek
Water supply capacity: 4.2-5.6 MGD
Water distribution: City limits & nearby service districts
Water system established: 1896

BAKER CITY

Baker City is located in the Elkhorn Valley in eastern Oregon between the Wallowa Mountains to the east and the Blue Mountains to the west. Baker City was once a major center for gold mining with over 100,000 people, but now has 10,420 residents. Some of the older buildings have been remodeled to encourage tourism and to celebrate the history of the region. The water system for Baker City provides water to over 10,000 people through about 4,400 connections.

Water Supply System:

The water supply for Baker City is one of the few municipal water systems in Oregon that is exempt from filtration requirements. Raw water is stored in the 210 MG High Mountain Reservoir at the head of Goodrich Creek. There are also eleven intake sources from streams or springs. This raw water is delivered by gravity to the reservoir site. From the reservoir, the water flows through a channel that is monitored for flow and turbidity. While the water is traveling in this channel, chlorine is added. The channel flows into a 4.5 MG chlorine contact reservoir that has baffles to ensure sufficient contact time for disinfection. Finished water that leaves the 4.5 MG chlorine contact reservoir is directed to two other reservoirs with 3.0 MG and 0.91 MG storage capacities.

Average demand is quite variable through the year. In winter, average demand is 1.4 MGD. Average demand increases to between 6 and 7 MGD in summer, with peak demand as high as 8 or 9 MGD. There is a single backup well at the reservoir site. This 800 foot deep well can provide up to 2.5 MGD to supplement the system during turbidity events or when flows are insufficient to meet demand.

Because this surface water supply is unfiltered, significant effort goes into monitoring water quality. Some parameters are monitored at levels above those required by law. Turbidity is monitored continuously, and an alarm system alerts water managers if it increases above a threshold level. Raw water is sampled four times a week. Finished water is sampled ten times per month. All other tests meet minimum standards.

Watershed:

The Baker City Watershed is about 10,000 acres and is located about six miles west of the City on the eastern slope of the Elkhorn Ridge of the Blue Mountain Range. Elevation ranges from about 4,000 feet to 8,934 feet at the summit of Elkhorn Peak. Snowfall is a major water source, and annual precipitation ranges from about 15 to 40 inches. Nearly all of the watershed is federal forest land managed by the USFS. Baker City does own and manage a small portion (about 1%) of the watershed. Vegetation on the watershed consists of conifer forest with some grass and shrubs.

The only management activities on the watershed reported by city personnel are road maintenance and thinning/selective harvest. There have been no recent changes to management activities on the watershed. There is some limited seasonal access to the watershed by special permit, but otherwise there is no public access. The only other activities reported for the watershed are hiking and hunting by permit.

Some Threatened and Endangered species occur or have habitat within the watershed. Bull Trout have been identified in some of the lower drainages of Salmon Creek. There have been sightings of Bald Eagles in the Marble Creek and Salmon Creek areas.

A watershed assessment has been completed for the Washington Gulch area and north to Rock Creek. This assessment was performed by the USFS. There is also GIS data for the watershed available through the County Watermaster's office. The Powder Basin Watershed Council covers the area that encompasses the Baker City watershed. City personnel listed wildfire hazard as the number one concern for the watershed, with all other concerns relatively insignificant.

Local Contacts & Information:

Baker City, PO Box 650, 97814-0650
Phone (541) 523-6541 Fax (541) 523-2049
Email: gzimmerman@bakercity.com Web: bakercity.com

USFS Baker Ranger District, 3165 10th Street, Baker City, OR 97814
Phone (541) 523-4476 Web: www.fs.fed.us/r6/w-w/brd.htm
Powder Basin Watershed Council, SWCD, 3990 Midway, Baker City, OR 97814
Phone (541) 523-7121 ext. 119.

Water supply operator: City of Baker City
Water supply source: Baker City Watershed, City wells
Water supply capacity: 5.00 MGD
Water distribution: City limits
Water system established: 1876

BEND

Bend has been one of Oregon's fastest growing cities, expanding from 20,447 in 1990 to 53,040 in 2000. It is now the largest community east of the Cascades in Oregon. Although originally a center for local forest products and ranching enterprises, Bend now supports major leisure and tourism industries, as well as diverse businesses. The Bend Water Department serves well over 31,000 customers through about 13,000 water connections.

Water Supply System:

The Bend Water Department supplies water to city residents and businesses, and it is among the few major systems in Oregon with an exemption from filtration requirements. Bend has significant groundwater resources, and in a typical year, about half the water supply will come from surface water and half from groundwater. The Water Department supplies an average of 9.31 MGD, with peak demand as high as 21.8 MGD. There is also a 12 MGD backup supply from wells approximately 700 to 1000 ft deep. The Water Department maintains 22 MG of storage capacity. 10 MG of storage is supplied by an underground concrete reservoir, and 12 MG is stored in steel tanks.

Because the water supply is not filtered, Bend is very active in taking water quality samples. City personnel report that they have started taking more samples of the surface water supply to check for long term changes in water quality. They further report that "At least 98.5+% of all surface water samples contain less than 100 CFU per 100 ml. We also collect and analyze about 30% more raw water samples than required by regulation. The creek is so pure that there are no fish in the 4+ miles of watershed."

Watershed:

Surface water for Bend comes from Bridge Creek, a tributary to Tumalo Creek located about 11 miles west of the city. Upper elevations of the watershed reach about 7,000 feet, so snow is an important moisture source. The Bridge Creek watershed is about 3,200 acres, but the watershed administrative unit totals 7,000 acres due to a buffer zone around the watershed proper. It is reported that low snow years have no effect on local flows, which suggests the importance of springs from deep aquifers and perhaps a source area larger than the surface terrain indicates. Such complex geologic and hydrologic influences are not uncommon in this region. Vegetation on the watershed consists almost entirely of conifer forest.

The entire watershed is federal land managed by the Deschutes National Forest. The City of Bend has agreements with the Forest Service dating back to 1926 that describe how the watershed is to be managed. Further, the city has an MOU with the Forest Service that handles the day-to-day operations. Basically, the agreement says that neither party can do anything without direct communication and agreement of the other. Relations between the City and the Forest Service are reported as excellent, with clear

lines of communications. There is an annual “watershed walk-around” when the public is invited to tour the watershed.

In the past three years, no management activities have occurred on the watershed. Within the past twenty years, less than 10% of the watershed area was logged in a helicopter salvage operation after a major fire. An intake keeper who lives in a city-owned house at the eastern edge of the watershed performs local patrols. During winter, access is restricted to snow machines.

Public access to the watershed is allowed only by special permit, and limited to hiking and permit hunting. There are no roads, buildings, or other constructed features in the watershed except for a small diversion dam and short canal. Access is by foot only, and no camping allowed. Domestic animals and fires are prohibited, as are wheeled vehicles. There is a short corridor upon which the city allows snowmobile traffic during the winter. City personnel report that this special access has caused no measurable impact on water quality or forest health. It is estimated that about 300-400 people visit the watershed each year, mostly hunters and day hikers. The City has found no evidence of visitors impacting water quality.

Some local watershed assessment work for the Tumalo Creek basin has been completed by the Deschutes National Forest. The Forest Service also has GIS data available. There are several watershed groups in the area, including the Upper Deschutes Watershed Council.

City personnel report that the greatest two concerns for the watershed are wildfire and geological processes. Limited access and management within the watershed limit other concerns.

Local Contacts & Information:

City of Bend, PO Box 431, Bend, OR 97709
Phone (541) 388-5505 Fax (541) 388-5519
Email: pstell@ci.bend.or.us Web: www.ci.bend.or.us

USFS Bend/Ft. Rock Ranger District, 1230 NE 3rd St., Suite A-262, Bend, OR 97701
Phone (541) 383-4000 Fax (541) 383-4700
Web: www.fs.fed.us/r6/centraloregon/index.html
Upper Deschutes Watershed Council, P.O. Box 1812, Bend, OR 97709
Phone (541) 383-7146, ext. 422 Fax (541) 383-7638

Water supply operator: City of Bend
Water supply source: Bridge Creek and several groundwater wells
Water supply capacity: 20.00 MGD
Water distribution: City limits

CANBY

Canby is located south of the Portland metropolitan area in the northern part of the Willamette Valley. While retaining rural enterprises and character, the community now includes many residents who work in the metropolitan area. Canby's population grew rapidly in the past decade, from 8,990 in 1990 to 13,170 in 2000. Situated at the confluence of the Molalla and the Willamette Rivers, Canby uses water from the Molalla for its municipal supplies. The Canby Utility Board serves over 12,000 customers through over 3,200 connections.

Water Supply System:

The Canby Utility Board operates two water filtration systems. The primary system is a direct filtration system that uses dual media filters. This treatment system has a capacity of 4 MGD. The other system has a capacity of 2 MGD and includes upflow clarifiers followed by mixed-media filtration (aluminum chlorhydroxide with cationic polymer). Storage of finished water is provided by a 2.4 MG steel tank at the treatment plant, as well as a 0.5 MG steel tank and 2.0 MG concrete tank within the distribution system. Pump and tank configuration allow a total storage capacity of 3.92 MG.

Average water demand is about 1.5 MGD in winter and about 3.5 MGD in summer. Peak demand has been as high as 4.7 MGD, and the instantaneous peak during the summer can exceed 8 MG.

Although the Molalla River is the main water source for the treatment plant, water from “gallery springs” can be blended with river flow when taste and odor are a problem. This springs source can produce over 1.3 MGD when the water table is high, but only yields around 1.0 MGD in the summer.

Water quality is monitored using lab instruments and portable testing devices. Tests include alkalinity, hardness, specific conductance, and total dissolved solids.

Watershed:

Water supplies from the Molalla River come from a large watershed (over 300 square miles) with diverse activities and ownerships. Watershed elevation ranges from about 100 at the intake to 4000 feet at the upper basin, with local annual precipitation (primarily rainfall) increasing from about 45 to over 100 inches over this distance. Utility personnel do not have specific information on the basin size, ownership and vegetation patterns, and management activities on the watershed. The area does include significant federal and private forest lands in the uppper watershed as well as agricultural and developed areas nearer the city’s water intake. The City of Canby owns 25 acres within the watershed.

Listed Threatened and Endangered species (winter steelhead and spring chinook salmon) present some management issues within the watershed. Currently, the Canby Utility Board is working with the ODF&W, USGS, Army Corps of Engineers, OWRD, USFS and DEQ is in the process of obtaining a NPDES permit for the gallery springs.

Some local assessment work has been completed by the OHD, including a water system plant evaluation in January 1998. Detailed delineation of the the Molalla River watershed by the DEQ is expected to be completed in the near future. The Canby Utility Board currently does not have GIS information for the watershed, but the DEQ used some GIS data to assist in location of the watershed boundaries and the water intakes. A local watershed group, Molalla River Watch, is active in the area.

Personnel for the Canby Utility Board identified two major areas of concern for their water system and watershed. First, as Canby continues to grow, there is concern that water supply may not be able to meet demand. Second, concern exists about the water intake relative to the current NPDES permit.

Local Contacts & Information:

City of Canby, PO Box 930, Canby, OR 97013
Phone (503) 266-4021 Fax (503) 266-7961
Email: adcockm@ci.canby.or.us Web: www.ci.canby.or.us

DEQ Portland (watershed delineation): Sharee Stewart, (503) 229-5413
OHD (plant evaluation& sanitary survey): Mike Grimm, (503) 731-4317
Molalla River Watch, PO Box 867, Molalla, OR 97038, (503) 829-2195.

Water supply operator: Canby Utility Board, City of Canby
Water supply source: Molalla River & groundwater springs
Water supply capacity: 6.00 MGD

CLACKAMAS AREA

The Clackamas River Water system is a major water supplier in the eastern Portland metropolitan area, using water from the Clackamas River. This system has two primary service areas that supply over 51,000 water users through over 16,000 connections. Like most of the region surrounding Portland, the areas served by the Clackamas River Water system grew significantly in the 1990's.

Water Supply System:

The Clackamas River Water system uses a conventional treatment plant that includes sedimentation, coagulation, filtration, and disinfection. Storage for the system is divided between the two service areas. There is 20 MG of storage for the North Service Area, and 10 MG for the South Service Area. Information on water demand was only provided for the North Service Area. Average demand is 14 MGD, and peak demand has been 32 MGD.

There are no backup wells. However, the system is interconnected with other local water districts and cities, which provides an emergency backup source. Water quality data includes TOC, nutrients, SOC, VOC, and IOC for both raw and finished water.

Watershed:

At 972 square miles, the Clackamas River watershed is among the larger drainages providing municipal water in Oregon. It extends from about 50 feet elevation near the intake to about 5,000 feet at the eastern boundary along the Cascades divide. Local precipitation ranges similarly from about 45 to 100 inches annually, with snow an important water source at the upper elevations.

Reported ownership patterns for the watershed are about 2% local and state, 25% private and 73% federal. Although the watershed is largely forested, agricultural and developed areas are significant near the system intake. Recent and past activities have included road construction and maintenance, clearcutting, and thinning/selective harvest. However, in recent years, road building and logging have been very limited on federal forest lands. Nursery and Christmas tree production, other agricultural land use, and aggregate/gravel mining have been significant on private lands in the lower watershed. Public lands are the focus of substantial recreational activities, including fishing, hiking, road use, horseback riding, firewood cutting, limited permit and open access hunting, bicycle riding, and 4x4, ATV and snowmobile travel.

Some assessments of various watershed characteristics and resources have been completed. Clackamas River Water personnel have completed a nutrient analysis. Data are being gathered currently for most of the USFS and BLM lands within the watershed. Detailed assessments are expected for Clear Creek, Rock and Richardson Creek, Deep Creek, and Clackamas River drainages. GIS data for the watershed are

available from various sources, including Portland Metro, USGS, USFS, DEQ, and Clackamas County. Threatened and Endangered species occur or have habitat on the watershed; listed species include salmonids and cutthroat trout. The Clackamas River Basin Council is the only local watershed council reported by water system personnel.

Water system personnel shared many primary concerns for this watershed, including:

Limitations on water quantity. Specific concerns include: increased number of point and non-point source pollution sources, increased urbanization, increased impervious surfaces, open access in most of the watershed, maintaining diverse land uses and economic bases, and increased ESA listings.

Limitations on water quality. Specific concerns include: turbidity, logging, road maintenance, temperature, reservoirs, underground storage tanks, and septic tanks.

Local Contacts & Information:

Clackamas River Water, P.O. Box 2439, Clackamas, OR 97015
Phone (503) 722-9241

USDA Forest Service, Clackamas River Ranger District, Estacada Ranger Station
595 NW Industrial Way, Estacada, OR 97023
Phone (503) 630-6861

Clackamas River Basin Council, PO Box 1869, Clackamas, OR 97015
Phone (503) 650-1256 Fax (503) 657-8955 email: crbc@teleport.com

Water supply operator: Clackamas River Water
Water supply source: Clackamas River, about 3 miles upstream from Willamette River

COOS BAY-NORTH BEND

Coos Bay and North Bend are adjacent cities located on the southern Oregon coast. The two cities have a combined population of 26,265. The Coos Bay-North Bend Water Board serves both cities plus the nearby communities of Charleston and Empire, with a total of about 37,000 customers through over 12,000 connections. Personnel from the Coos Bay-North Bend Water Board did not complete the written survey, but provided some recent reports that contained some of the information presented here.

Water Supply System:

The Coos Bay-North Bend water supply system uses conventional filtration to treat its raw water supplies. The primary water sources are Pony Creek and Joe Ney Creek, which drain into three major storage reservoirs that currently have a total capacity of 860 MG. Groundwater sources (North Spit wells) also are used. The treatment plant at Pony Creek (water from the Joe Ney Creek reservoir is pumped to the adjacent Pony Creek drainage) has a capacity of 8 MGD; the North Spit plant 1 MGD. In recent years, average daily demand has been about 6 MGD, with peak demand about 9.6 MGD. Some of this demand is from industrial uses that do not require treated water. However, because peak demand remains close to the total system capacity, an expansion of the water storage facilities is underway. This includes raising the height of one of the Pony Creek dams, which will increase reservoir capacity by one-third.

Watershed:

The Pony Creek and Joe Ney watersheds are located immediately south and west of the City of Coos Bay. The two adjacent watersheds are similar in size and total about 8 square miles in area. At this coastal location, annual precipitation averages about 60-65 inches even though the terrain is relatively gentle and elevations are generally under 500 feet. The watersheds are largely forested and some forest management activities (timber harvest, tree planting, etc.) have occurred. Recent management activities have been conducted with assistance from a professional forestry consultant in the area. Access to the watersheds is restricted by locked gates, although a public right-of-way crosses a portion of the divide between the Pony Creek and Joe Ney Creek drainages.

Local Contacts & Information:

Coos Bay-North Bend Water Board, PO Box 539, Coos Bay, OR 97420
Phone (541) 267-3128

City of Coos Bay, 500 Central Ave., Coos Bay, OR 97420-1895
Phone (541) 269-1181 Fax (541) 267-5615
Email: bgrile@coosbay.org Web: www.coosbay.org

City of North Bend, PO Box B, North Bend, OR 97459-0014

Phone: (541) 756-8500 Fax: (541) 756-8527
Email: combs@mail.coos.or.us Web: www.coos.or.us/~nbend

Water supply operator: Coos Bay - North Bend Water Board
Water supply district: Greater Bay Area
Water supply source: Pony Creek, Joe Ney Creek & Oregon Dunes (North Spit) Aquifer
Water supply capacity: 9.0 MGD (treated water)
Water distribution: Coos Bay, North Bend, Charleston, Empire and surrounding areas
Water system established: 1905

CORVALLIS

Corvallis is located along the Willamette River in the central portion of the valley. It is the home of Oregon State University, as well as some notable technology businesses. Corvallis grew significantly in the 1990's, and in 2000 its population reached 52,215 residents. Corvallis' water system serves over 50,000 users through 13700 connections. The city relies on two major water sources, both surface supplies. One intake is on the Rock Creek watershed on the east slope of Marys Peak. The City of Corvallis owns a portion of the land in the Rock Creek drainage, but the current intakes are above the city's property. The other intake is on the Willamette River, south (upstream) of the city center.

Water Supply System:

The City of Corvallis has two major water treatment facilities, one for its Rock Creek source and one for its Willamette source. About 40 percent of Corvallis' water comes from the Rock Creek watershed east of Marys Peak. Water treatment at the Rock Creek plant consists of conventional methods, i.e., flocculation using aluminum sulfate, sedimentation, multimedia filtration, and chlorination. Before distribution, fluoride is added.

The balance of Corvallis' water supply (highest in summer when flow from Rock Creek is relatively low and demand is greatest) comes from the Willamette River, with treatment at the H.D. Taylor plant. At this location, lime is added for pH adjustment, then aluminum sulfate for flocculation, and sodium hypochlorite for pre-disinfection. Water then moves to flocculation tanks. Fluoride is then added, as is a filter aid polymer. After filtration, more sodium hypochlorite is added, and the water is stored.

Corvallis has several storage locations for both treated and untreated water. There are two concrete "clearwells" for treated water. One is 10,000 gallons, and the other is 100,000 gallons. There is also one reservoir for untreated water in the Rock Creek watershed that holds 100 million gallons. Additional storage is supplied by nine steel reservoirs located on hills throughout Corvallis. This provides 21 million gallons of stored water that is distributed through the system via gravity.

The average demand for Rock Creek water is 3.2 MGD. Although this plant has a capacity of 7 MGD, only 3.5 MGD can be delivered because of limitations due to the diameter of the transmission lines. Peak demand from Rock Creek has been 3.4 MGD, close to the supply capacity. The Taylor Plant has a capacity of 21 MGD. Average demand from this source is between 2 and 16 MGD, depending on season, with peak use at the upper end of this range occuring in summer. There are no other backup water sources.

The City of Corvallis collects water quality data beyond what is required by law. Each week, stream water samples are collected and tested for *E. coli*. Turbidity, pH, alkalinity, temperature and dissolved oxygen are sampled monthly.

Watershed:

The Rock Creek Watershed is located on the eastern flank of Marys Peak, about 12 miles west of Corvallis. Marys Peak is the highest point in the Oregon Coast Range, so both elevations and precipitation amounts vary widely within the watershed (i.e., about 500-4000 feet and 60-120 inches, respectively). Significant precipitation falls as snow during winter at the upper elevations, and a seasonal snowpack near the summit is not unusual.

The total area of the Rock Creek Watershed is about 10,000 acres. Of this, the City of Corvallis owns 2,500 acres, or 25% of the watershed. Most of the remaining 75% of the watershed is federal land managed by the USFS, however, some small properties are owned by the state (Oregon State University) and some private owners. City personnel estimate that vegetation on the watershed consists of 8% hardwood forest, 60% conifer forest, 30% mixed forest, and 2% grass and shrub. The hardwoods are located primarily in the riparian zones.

Management activities on the watershed currently is limited. Timber harvesting generally is excluded from the area, both because the City has an agreement with the USFS and because of the presence of Northern Spotted Owl nests. Habitat or evidence of other threatened and endangered species, i.e., marbled murrelet and bald eagles, also are present. In the past three years, the only management activity reported for the watershed is road maintenance. In the past twenty years, however, there were more numerous activities including both clearcutting and thinning/selective harvest, and new road construction. The discovery of owls was reported as the primary reason that these activities were curtailed greatly.

Public access to the watershed is limited. Occasionally there are supervised tours of the watershed, and forestry and environmental research and teaching are allowed by permit. Some hunting is allowed, but is restricted to deer hunting primarily to protect young forest reproduction. There is no overnight camping, and fires are prohibited. Vehicles are prohibited; hunting is walk-in only, and gates remain locked. During hunting season, there are increased patrols by watershed personnel.

Some assessments of the watershed and its surroundings have been completed, including summaries by Oregon State University, the Siuslaw National Forest, and the Marys River Watershed Council. The City of Corvallis has a GIS department, and much pertinent information for the watershed has been entered into their data base.

Day to day management of the watershed is provided by the Water Operations Supervisor, whereas long term management is directed by the Water/Wastewater Operations Supervisor, with guidance from an advisory committee of local citizens.

Primary concerns identified by the Water/Wastewater Operations Supervisor are:

1. Protection of the quality water source by maintaining a closed watershed.
2. Working with adjoining property owners to prevent problems from trespass or chemical contamination.
3. Using natural resources (i.e., timber) when possible.
4. Maintaining access for fire prevention and suppression.

Local Contacts & Information:

City of Corvallis, Public Works Department:, P.O. Box 1083, Corvallis, OR 97339-1083
Phone: (541) 766-6916 Email: Public.Works@ci.corvallis.or.us
Web: www.ci.corvallis.or.us/pw/

USFS Siuslaw National Forest, 4077 SW Research Way, P.O. Box 1148, Corvallis, OR 97339
Phone (541) 750-7000 FAX: (541) 750-7234
Marys River Watershed Council, P.O. Box 1041, Corvallis OR 97339
Phone: (541) 758-7597 Email: mrwc@peak.org
Web: http://www.marys-river-wc.peak.org/

Water supply operator: City of Corvallis
Water supply source: Mary's Peak (Rock Creek) Watershed & Willamette River
Water supply capacity: 23.5 MGD
Water distribution: city limits

DALLAS

Located about 15 miles west of Salem near the eastern foothills of the Coast Range, Dallas has a population of 12,967. Despite its proximity to Salem, the area surrounding Dallas remains rural in character with both agricultural and forest lands. The water system for the City of Dallas serves nearly all of the City's residents through over 4,000 water connections.

Water Supply System:

The water treatment plant for Dallas is a conventional filtration system, consisting of four 36-inch mixed media filters. This system has a capacity to treat up to 8.6 MGD. Average seasonal demand ranges from 2.32 MGD in winter to 3.60 MGD in summer. In recent years, peak demand has ranged from 5.14 MGD (1999) to 6.39 MGD (1998). The supply does not include any backup wells or alternate sources, and there is interest in expanding supply capacity through construction of a new dam.

The storage capacity for finished water in the system is 6.14 MGD. This storage is provided by one 2 MG steel tank, one 135,000 gallon steel tank, and four ground level concrete reservoirs that have a combined capacity of about 4 MG. Water managers monitor water quality parameters beyond those required by law. Measurements include TOC for both raw and finished water, specific conductance, alkalinity, calcium, hardness, total solids dissolved, and Langliers Index.

Watershed:

Dallas draws its water supply from the Rickreal Creek watershed, located only a few miles west of the city on the eastern edge of the Oregon Coast Range. The watershed is moderately large, encompassing about 20,500 acres that range in elevation from about 500 to 3500 feet. Local precipitation is similarly variable from about 50 to 75 inches annually.

The City of Dallas owns a very small portion of the watershed, only 0.1% of the total area. Federal and state lands each represent about 2% of the watershed area. The remaining 95.9% of the area is in private ownership. Vegetation on the watershed is primarily conifer forest, which covers about 80 % of the watershed. Mixed forest and grass-shrub types each occupy about 10% of the watershed.

Management activities occurring within the past three years have not differed significantly from those over the past twenty years. These include road maintenance, clearcutting, thinning & selective harvests, new road construction, herbicide application, and fertilizer application. Public access to the watershed is limited. During most of the year, access is limited to those holding special permits. The City of Dallas enforces a "no motor vehicles without permit" regulation. There is seasonal access during rifle elk hunting season.

According to the water manager for Dallas, no threatened or endangered species have been identified on the watershed. Although no watershed assessments have yet been completed, at the time of the survey the Rickreall Watershed Council was arranging a contract for an assessment. Some GIS data for the watershed is available through Polk County. It is likely that there is also some GIS data in existence for the private land, however, access to this data is uncertain.

The greatest concerns identified by the water manager are water storage capacity, water quality, and fire. Turbidity is the primary water quality concern. In late 1987, when the watershed was open to the public, there was a major fire in the watershed that required major measures to reduce erosion and sedimentation. Since that time, the watershed has been closed to motorized vehicles to prevent future problems.

Local Contacts & Information:

City of Dallas, Public Works Dept., City Hall Bldg, 187 SE Court St., Dallas, OR 97338
Phone: (503) 831-3571 Fax: (503) 623-2339
Email: pw.dir@ci.dallas.or.us Web: http://www.open.org/~dallas

Rickreall Watershed Council, 289 E. Ellendale, Suite 702, Dallas, OR 97338
Phone (503) 623-9680, x110 Fax: (503) 623-6335 Email: rickreallwc@hotmail.com
Ecosystems Northwest (503) 926-2591, contractors for watershed assessment.

Water supply operator: City of Dallas
Water supply source: Rickreall Creek
Water supply capacity: 4.90 MGD
Water distribution: City limits

EUGENE

Located at the southern end of the Willamette Valley, Eugene is Oregon's second largest city (population 136,806). Eugene's municipal water supply comes from the McKenzie River watershed, a large basin that extends to the crest of the Cascades. The water supply system is managed by the Eugene Water and Electric Board (EWEB), one of the oldest and largest customer owned utilities in the Pacific Northwest. EWEB serves about 161,000 customers through about 53,000 connections, including some areas beyond the city limits.

Water Supply System:

EWEB operates the largest full-treatment water supply facility in Oregon. Prior to entering the distribution system, water supplies undergo chlorination, coagulation, sedimentation, filtration, pH adjustment, and dichlorination. The water supply system has a capacity to treat 72 MGD. Multiple (24) covered reservoirs provide a storage capacity of 78 MG. Average water demand is about 30 MGD, or about 11 billion gallons annually. Reported peak demand has reached nearly 72 MGD. EWEB has water rights to nearly 200 MGD from the McKenzie River, so there is little current need for alternate water sources.

According to EWEB, water quality testing and other data collection exceed those required by law, with over 85,000 water quality tests conducted each year. These water quality tests include: TOC, Giardia, Cryptosporidium, MTBE, radon, taste and odor, and Bacillus bacteria.

Watershed:

Eugene gets its water directly from the McKenzie River near the City of Springfield. The McKenzie watershed has an estimated size of 1156 square miles (739,840 acres) and extends about 60 miles east to the scenic "Three Sisters" peaks at the Cascade Mountains divide. Elevation and precipitation both rise dramatically from about 500 feet and 40 inches, respectively, near Springfield to over 10,000 feet and 150 inches on the peaks. Although rainfall is the primary water source in most of the watershed, snow is very important at elevations above about 4000 feet.

Most of the watershed area (88%) is publicly owned, primarily federal forest lands managed by the USFS and BLM. Only about 1% of the watershed area is in municipal ownership, and about 10% is in private ownership. Approximately 34,000 acres (4.6%) of the watershed is in agricultural use, 9,000 acres (1.2%) is in residential use and 1,000 acres (0.1%) is in industrial use. Although these uses represent a relatively small total area, they are heavily concentrated in the lower watershed. The majority of the remaining 800,000 acres is in forest uses, including private and public land and about 225,000 acres of federally designated wilderness.

Diverse activities and uses occur on the forest lands in the watershed, although in recent years management activities have declined significantly on the federal lands. Types of forest management activities are similar to those that occurred in the past, and include clearcutting, thinning/selective harvest, road maintenance, and new road construction. With the exception of the wilderness areas at the upper elevations, the extensive public lands on the watershed are widely accessible to a large population via roads and trails. As a result, this scenic area receives heavy recreational use, including driving, boating, hiking, fishing, biking, and hunting.

Established in 1991, the McKenzie Watershed Council (MWC) is among the larger and more active watershed-based groups in Oregon. The group includes 21 members representing diverse organizations and the broad public. A detailed assessment has been completed for the watershed and the MWC provides extensive information from this and other sources at its web site listed below. EWEB also has access to GIS data for this watershed.

Primary concerns identified by EWEB personnel include various pollution sources including: stormwater inputs, increasing urbanization, industrial discharges (more specifically, pulp mill discharges), and forest practices (specifically those believed to increase turbidity).

Local Contacts & Information:

Eugene Water and Electric Board:
500 East 4th Ave., P.O. Box 10148, Eugene OR 97440-2148
Phone: (541) 484-2411 Email: askus@eweb.org Web: http://www.eweb.org/

McKenzie River Watershed Council, P.O. Box 53, Springfield, OR 97477
Phone: (541) 687-9076 Email: mwc@pond.net Web: http://www.pond.net/~mwc/
Watershed Assessment: GEM Consulting, Inc., P.O. Box 23635, Eugene, OR 97402.

Water supply operator: Eugene Water and Electric Board
Water supply source: McKenzie River near Springfield
Water supply capacity: 4.90 MGD
Water distribution: City limits and Glenwood, Santa Clara, and River Road districts

FOREST GROVE

Located about 24 miles west of Portland near the foothills of the northern Coast Range, Forest Grove (population 17,130) represents a blend of rural and suburban influences. While still a center for agricultural and forest products, a significant number of residents now also work in local and nearby technology and other businesses that have developed in the western metropolitan area in recent years. The Forest Grove water system delivers water to over 16,000 customers through over 4,000 connections.

Water Supply System:

The City of Forest Grove operates a conventional water treatment plant that uses a rapid sand filtration system with a capacity of 2.66 MGD. Two ground storage tanks (5 MG and 1 MG) provide 6 MG of total storage capacity. Average demand on the water system is 2.3 MGD with peak demand reaching 3.5 MGD in summer. There are no backup wells or additional storage points, but the City can access water supplies from a jointly owned treatment plant (see section on Hillsboro-Beaverton-Forest Grove) that uses water from the Tualatin River. Forest Grove conducts all water quality tests and data collection as required by law.

Watershed:

Forest Grove draws its water supply near the confluence of Clear Creek and Roaring Creek, about 8 miles west of the City. The watershed for these streams extends about 4,500 acres, and ranges in elevation from about 400 to nearly 2400 feet. Annual precipitation in this area is about 50-60 inches. City personnel estimate that Forest Grove owns about 80-85% of the watershed, about 10-15% is in private ownership, and about 6% is part of the Tillamook State Forest. The vegetation on the watershed is almost entirely conifer forest, but some hardwoods are found in the riparian areas.

Within the past three years, management activities have been very limited within the watershed. In 1994, the Forest Grove City Council authorized that only minimal timber harvest would be allowed on city property, i.e., only that necessary for forest health and moderate revenue ($200,000 per year). No cutting has occurred on city land since this authorization. In the past twenty years, management activities have included road maintenance, clearcutting, thinning or selective harvest, and new road construction. There is no public access to the watershed and all the roads into it are gated. The City maintains five water diversion structures within the watershed.

The City of Forest Grove has considered ESA species listings in its management, and in its 1994 Watershed Resource Management Plan included an assessment of habitat for spotted owls and marbled murrelets. Areas ranging from no probability to high probability for suitable habitat were identified in the watershed. Stream surveys have been conducted on major drainages and fish habitat features have been identified. The City also maintains GIS data for the watershed.

Clear Creek and Roaring Creek are headwaters of the Tualatin River. Although a detailed assessment of the municipal watershed has not been conducted, the larger Tualatin basin in recent years has been the focus of substantial concern and study regarding water quality issues. The Tualatin River Watershed Council is active in the area and maintains an office and web site (see contact information below).

City personnel stated that Forest Grove is fortunate to own and control most of the land within the municipal watershed. The City's highest priority is maintaining water quality. Other concerns include forest health and wildlife habitat. Management of city lands within the watershed is intended to maximize these three goals.

Local Contacts & Information:

City of Forest Grove, Public Works Dept., 1928 Council Street, PO Box 326, Forest Grove, OR 97116
Phone (503) 992-3228 FAX: (503) 992-3203 Web: www.ci.forest-grove.or.us

Tualatin Watershed Council, 1080 SW Baseline Rd., Suite B, Hillsboro, OR 97123
Phone (503) 681-3174, ext. 116 Fax (503) 681-9771
Email: tualatinwc@yahoo.com Web: http://www.trwc.org/

Water supply operator: City of Forest Grove
Water supply source: Clear Creek & Roaring Creek; Tualatin River (joint area supply)
Water supply capacity: 2.66 MGD to 5.20 MGD
Water distribution: City limits, plus area north of Gales Creek Road

GRANTS PASS

Grants Pass (population 21,775) is located in southwest Oregon along the Rogue River where it flows between the Siskyou and Cascade Mountains. Like the nearby communities of Medford, Jacksonville and Ashland, the Grants Pass area has a unique landscape and drier climate that resembles the interior of northern California more than most other areas of western Oregon. The City of Grants Pass supplies water to over 20,000 customers through about 7,500 water connections.

Water Supply System:

Grants Pass takes its water from the Rogue River, with coventional treatment using a mixed-media filtration system. Because of the general quality and quantity of the Rogue supply, there are no backup wells or other sources for raw water. Storage is provided by an 8 MG reservoir. Average water demand is 4.5 MGD, with peak demand as high as 10 MGD. Current supply capacity (18.2 MGD) significantly exceeds peak demands.

Watershed:

Above the Grants Pass intake, the Rogue River Watershed is a very large and diverse area that encompasses over a million acres. Elevations range from about 950 feet near the City intake to 9,495 feet at the summit of Mt. McLoughlin in the Cascades. Precipitation varies widely in amount and form, from about 25 inches in Grants Pass to over 60 inches in the upper Cascades, where a seasonal snowpack is common.

The upper Rogue River watershed is described in some detail in the information about Medford's water supply. Activities within the extensive Rogue River basin include those common to forest lands that dominate the area, i.e., timber harvest, road maintenance and construction, and recreation. However, diverse agricultural and urban/suburban activities also occur in the valley locations surrounding Medford and other communities.

There have been no major changes in the types of activities in the watershed in recent years, although population growth in this region over the last decade has increased the intensity of urban and suburban activities. During the same period, the intensity of forest management activities has decreased markedly on the federal forest lands that dominate much of the region.

Several watershed councils are active in this extensive river basin, including one based in Grants Pass (Middle Rogue). Those recently identified by the Oregon Watershed Enhancement Board are the Bear Creek, Little Butte Creek, Middle Rogue and Upper Rogue Watershed Councils. Watershed assessments also have been completed for some portions of the basin by various organizations.

City personnel did not identify any specific areas of concern regarding the water supply or watershed for Grants Pass.

Local Contacts & Information:

City of Grants Pass, Utilities Dept., 101 NW "A" Street, Grants Pass, OR 97526
Phone: (541) 474-6360 Fax: (541) 479-0812 Web: www.ci.grants-pass.or.us

Bear Creek Watershed Council, RVCOG, P.O. Box 3275, Central Point, OR 97502
Phone (541) 664-6676 Fax (541) 664-7927 Email: bill@rv.cog.or.us
Little Butte Creek Watershed Council, 1094 Stevens Rd., Eagle Point, OR 97524;
Phone & Fax: (541) 826-2908 Email: luanthony@earthlink.net
Middle Rogue Watershed Council, 576 NE “E” Street, Grants Pass, OR 97526
Phone (541) 476-5856 Fax (541) 995-9574 Email: mrwa@cdsnet.net
Upper Rogue Watershed Council, P.O. Box1128, Shady Cove, OR 97539
Phone & Fax: (541) 878-7647 Email: msfish@mind.net

USFS Rogue River National Forest, 333 W. 8th St., PO Box 520, Medford, OR 97501
Phone (541) 858-2200 Fax: (541) 858-2220 Web: www.fs.fed.us/r6/rogue/

Bureau of Land Management, Medford District, 3040 Biddle Road, Medford, OR 97504
Phone (541) 618-2200 Fax: (541) 618-2400 Email: or110mb@or.blm.gov
Web: www.or.blm.gov/Medford/

Water supply operator: City of Grants Pass
Water supply source: Rogue River
Water supply capacity: 18 MGD
Water system established: 1931

HERMISTON

Hermiston is a community of 12,425 located about six miles south of the Columbia River near McNary Dam in northeast Oregon. Hermiston is an important agricultural and transportation center for this area. The City's supply system provides water to about 12,400 customers through about 3,200 connections.

Water Supply System:

Hermiston's municipal water supply is drawn from shallow and deep groundwater sources and the Columbia River. The City has water rights to a total 20.6 MGD supply, including 14 MGD from groundwater, 2.1 MGD from the Columbia and 4.5 MGD from Minnehaha Springs. However, the latter is a undeveloped source with no current connection, so functional water rights using the existing system is about 16 MGD.

Surface water from the Columbia is delivered to Hermiston via a regional supply system that maintains an intake at the McNary Pool at the Port of Umatilla. Raw water is pumped from the Columbia to the regional water treatment facility located south of Hermiston, which provides conventional treatment. This includes including filtration, although specifics were not given by City personnel.

Hermiston has a system of four storage reservoirs with a total capacity of 5.5 MGD. Average water demand in Hermiston is 2 MGD, with peak demand reaching 4 MGD in summer. These demand levels are well within the system capacity of 12 MGD. Hermiston monitors water quality levels and system conditions as required by law.

Watershed:

The Columbia River watershed above Hermiston and the Umatilla intake is extraordinarily large and diverse, extending into Canada, Nevada and Wyoming. Thus, it is very difficult to briefly characterize the patterns of ownership and vegetation. Similarly, land uses and management activities within the watershed vary widely from remote wilderness to surface mining to urban development. Because salmon are an important Columbia River resource, ESA listings can affect local management activities and land and water use within the watershed.

Many watershed councils likely operate in the interior Columbia River watershed, and a variety and abundance of GIS data and other information also can be expected. For example, federal agencies recently completed a major assessment and management strategy for this region (i.e., the Interior Columbia Basin Ecosystem Management Project), which includes water resources and influences.

City personnel indicated that their greatest concern is maintenance of the quality of their water supplies, with pollution sources presenting the greatest threat to the both surface and groundwater supplies. Potential sources include sediment from roads, fuel from

roads and shipping, radioactive contamination from Hanford Nuclear Reservation, and agricultural chemicals.

Contacts:

City of Hermiston, Water Dept., 180 NE 2nd Street, Hermiston, OR 97838
Phone: (541) 567-5521 Fax: (541) 567-5537
Email: city@hermiston.or.us Web: www.hermiston.or.us/city/waterdept.htm

Interior Columbia Basin Ecosystem Management Project:
Phone: (208) 334-1770 Fax: (208) 334-1769 Web: www.icbemp.gov/

Water supply operator: City of Hermiston
Water supply source: groundwater wells, Columbia River
Water supply capacity: 12.00 MGD
Water distribution: City limits

HILLSBORO, FOREST GROVE, BEAVERTON JOINT WATER COMMISSION

The communities of Beaverton, Hillsboro, and Forest Grove extend westward in Washington County from the city limits of Portland, thus including diverse urban, suburban and rural environments. Their collective size (159,990 people) places this area among the largest population centers in Oregon. The joint water system has about 16,700 connections, which includes the Beaverton and Forest Grove systems that have an additional 18,100 connections. Forest Grove, however, has its own primary supply (see summary earlier in this section) and currently does not place a large demand on the joint system relative to its larger partners.

Water Supply System:

The Joint Water Commission has two treatment facilities in its water supply system, which uses water from the Tualatin River. One is operated by the City of Hillsboro, and consists of a slow sand filtration plant with a capacity of 3 MGD. The Joint Water Commission also operates its own treatment plant, which has a capacity of 60 MGD. This conventional facility uses standard coagulation, flocculation, filtration, and chlorination methods for water treatment. There are no backup wells or other water sources within this system, except for Forest Grove's primary supply from its watershed west of the City. However, substantial raw water storage is provided at Hagg Lake and Barney Reservoir, located southwest of Forest Grove.

The Joint Water Commission has 20 MG of storage capacity for treated water from its large plant. Each municipal partner within the Commission also has its own storage facilities. For example, Beaverton has four reservoirs with a total capacity of 27 MG. Average water demand on the joint system during 1999 was 24 MGD, with peak demand the same year reaching 46 MGD. Personnel of the Joint Water Commission reports that they maintain a substantial data base for both raw and finished water. Of primary interest are water quality parameters proposed for regulation, those linked to issues in the news (e.g., MTBE), and those with potential problems.

Watershed:

The Joint Water Commission draws water from two locations on the Tualatin River, i.e., near Haines Falls west of Cherry Grove (Hillsboro treatment plant) and about a mile east of Dilley (Joint Commission plant). The watersheds for the River at these source points are very large, i.e., about 20,000 acres at Haines Falls and over 100,000 acres near Dilley. Local elevation ranges from about 150 feet near Dilley to over 3000 feet on Saddle Mountain above Sunday and Lee Creeks. Annual precipitation extends from about 45 inches at the lower elevations to perhaps 100 inches near the summit of Saddle Mountain.

Specific ownership patterns, vegetation and management activities in this watershed were not known by personnel of the Joint Water Commission, but may be found in

reports and other information sources identified by the Tualatin River Watershed Council (see contact information below). Many diverse, recent and past management activities undoubtedly have occurred in the area, including logging and road construction on forest lands in the upper basin, as well as agriculture and residential construction and other development in the valleys near Forest Grove and other local communities.

There are some current regulatory concerns on this watershed that were identified by Commission personnel. Species of salmon and steelhead trout that are listed under the ESA are present within the watershed. Tualatin River also is listed as a 303(d) water body under the Clean Water Act, which can affect land use practices and other activities on the watershed.

There are several watershed groups operating in the area. The Tualatin River Watershed Council is very active and maintains an office and web site (see contact information below) with substantial background about the watershed, as well as many links to other organizations and information sources. Other watershed groups include Tualatin Riverkeepers and Friends of Gales Creek.

The greatest concerns noted by personnel of the Joint Water Commission focus on water quality and water pollution. More specific concerns included road and rail crossings, industrial discharges, agricultural/nursery non-point pollution, forest fire & fire retardants, forest practices and chemical application, erosion and sediment loading, recreational use and abuse. There was concern also about water quality and quantity in dry years.

Local Contacts & Information:

Joint Water Commission Treatment Plant, 4475 SW Fern Hill Road, Forest Grove, OR 97116
Phone (503) 615-6670 Fax (503) 615-6675

Tualatin Watershed Council, 1080 SW Baseline Rd., Suite B, Hillsboro, OR 97123
Phone (503) 681-3174, ext. 116 Fax (503) 681-9771
Email: tualatinwc@yahoo.com Web: http://www.trwc.org/

Water supply operator: Hillsboro, Forest Grove, Beaverton Joint Water Commission
Water supply source: Tualatin River, intakes near Haines Falls and Dilley
Water supply capacity: 63 MGD
Water distribution: Cities of Hillsboro, Beaverton, Forest Grove (secondary source) and some small service areas

LA GRANDE

La Grande is located in the Grande Ronde River valley between the Blue and Wallowa Mountains in northeast Oregon. La Grande has a population of 12,555, and is a regional center for agricultural and forest products, manufacturing, and higher education (Eastern Oregon University). The La Grande water system provides water to about 12,700 customers through about 4800 water connections, primarily within the City limits.

Water Supply System:

City of La Grande personnel did not return the written survey, but did provide some comments and information via telephone; available public records provided further information. Currently, the City of La Grande relies on several groundwater wells at various locations in the City for its entire municipal water supply. These supplies are of sufficient quality that filtration treatment is not needed and only chlorination is required. Supply capacity of the system is 8.20 MGD, with average use up to about 7.0 MGD.

Watershed:

The City recognizes the limitations of its groundwater supplies, and thus maintains a reservoir and water rights for additional surface water supplies from the upper Beaver Creek drainage southwest of the City. As the City increases in population, it is expected that water from Beaver Creek eventually will be used. This watershed is located entirely within the Wallowa-Whitman National Forest, and the City has an agreement with the U.S. Forest Service regarding management activities on the watershed. Public access is effectively controlled by a gated and very limited road system within the watershed boundaries.

The upper Beaver Creek watershed ranges in elevation from about 5400 to 6500 feet. At these elevations annual precipitation reaches about 25 inches and primarily falls as snow. The watershed is covered primarily by mixed conifer forest, with some grass, shrub, and scab areas (exposed rock, etc.) mixed in. Recent management activities on the watershed have been limited, and there are concerns that large accumulations of dead and down wood on the watershed increase the risk of catastrophic wildfire.

The Blue Mountains Natural Resources Institute, in cooperation with the USFS, Oregon State University and other organizations, sponsored a major multidisciplinary research project on fuels management operations in forested areas bordering the Beaver Creek watershed. Federal agencies also completed a major assessment and management strategy for this region (i.e., the Interior Columbia Basin Ecosystem Management Project), which includes water resources and influences. In addition, the Grande Ronde basin where the Beaver Creek drainage is located is the focus of the Grande Ronde Model Watershed Program. Established in 1992, this is one of the original and most active watershed management partnerships in Oregon.

Local Contacts & Information:

City of La Grande, Public Works, PO Box 670, La Grande, OR 97850
Phone (541) 962-1325 Fax (541) 963-3608
email: danchev@uwtc.net Web: www.ci.la-grande.or.us

USFS La Grande Ranger District, 3502 Hwy. 30, La Grande, OR 97850
Phone (541) 963-7186
USFS La Grande Forestry & Range Sciences Lab (Blue Mountains Institute info), 1401 Gekeler Lane, La Grande, OR 97850
Phone (541) 963-7122 Fax (541) 962-6504 Web: www.fs.fed.us/pnw/bmnri
Interior Columbia Basin Ecosystem Management Project:
Phone (208) 334-1770 Fax (208) 334-1769 Web: www.icbemp.gov/

Grande Ronde Model Watershed Program, 10901 Island Ave., La Grande, OR 97850
Phone (541) 962-6590 Fax (541)962-6593
Email: joveson@eou.edu Web: www.fs.fed.us/pnw/modelwatershed

Water supply operator: City of La Grande
Water supply source: wells, water rights on Beaver Creek
Water supply capacity: 8.20 MGD
Water distribution: city limits

LAKE OSWEGO AREA

Lake Oswego is among the many communities in the north Willamette Valley that are found within the bustling Portland metropolitan area. Although Lake Oswego is home to several electronic and other manufacturing businesses, the community retains a residential emphasis, with a population of 35,305. The Lake Oswego municipal water system serves serves these residents and many other users through about 11,000 individual connections. The system provides water to several other cities and special service districts located adjacent to or within the City's Urban Services Boundary. The major source of water for the system is the Clackamas River.

Water Supply System:

Lake Oswego's water treatment plant is actually located in a neighboring community, West Linn. This treatment facility was built in 1967 and currently uses a tri-media direct filtration system. Prior to filtration, raw water is subjected to pre-chlorination, coagulation, and flocculation. After filtration, the finished water is disinfected with liquid chlorine. In 1980 the plant's treatment capacity was increased substantially to the current level of 16 MGD.

Storage for the system consists of surface and underground reservoirs totaling 25 MG. Average demand for water is 5 MGD in the winter and 16 MGD during the peak summer period. The City operates one additional well that can provide 0.25 MGD, and the system maintains connections with other water districts in case of emergencies. The treatment plant capacity allows surplus water to be distributed to several nearby cities and service districts.

The treatment system operator takes water quality readings for turbidity, pH, residual chlorine and conductivity every two hours. Every four hours, analyses of alkalinity and color of raw river water and finished water are conducted. City personnel assure customers that the system produces water quality consistently superior to the drinking water standards set by the 1996 amendments to the Safe Drinking Water Act.

Watershed:

Water for Lake Oswego originates on the 622,000 acre (972 square miles) Clackamas River watershed, one the largest drainages providing munipal water in the state. Elevation ranges from about 50 feet elevation near the City intake to about 5,000 feet at the Cascades divide. Annual precipitation also increases with elevation from about 45 to 100 inches, with snow an important water source above about 3,000 feet. The City does not own any property in the watershed, which is reported to be 66% federal land, 22% state land and 12% private.

City personnel indicate that a variety of management activities occur over the diverse ownerships of this watershed. Urban and suburban activities and development are

common near the City intake, but agriculture and forest land uses are dominant over extensive areas upstream. Some of the activities occurring within the past three years on the forest lands include road maintenance, timber harvest, and removal of existing logging roads. In the past 20 years, road maintenance, clearcutting, thinning/selective harvest, new road construction have occurred on the forest lands. Logging and road building have been greatly reduced in recent years on federal lands, whereas recreational activities have increased substantially.

The City of Lake Oswego does not have GIS data for this watershed, but such data are likely to be available from other sources. Various watershed studies and assessments have been completed or are expected. For example, the USGS recently released a report on "Water quality and algal conditions in the Clackamas River Basin, Oregon, 1996-98, and their relations to land and water management." The Clackamas River Basin Council is the primary watershed council that is active in the area.

Species found within the watershed that are listed as threatened and endangered include local runs of salmon, steelhead and cutthroat trout, and Northern Spotted Owls and American Bald Eagles. The greatest water resource concerns identified by City personnel are pollution sources that affect water quality and the ability to produce potable water.

Local Contacts & Information:

City of Lake Oswego, Engineering Dept., 380 A Avenue, P.O. Box 369, Lake Oswego, OR 97034
Phone (503) 635-0290 Phone (treatment plant) (503) 635-0393
email: engr@ci.oswego.or.us email (treatment plant): hthomson@ci.oswego.or.us.
Web: www.ci.oswego.or.us/engineer/Environ/wtp.htm

USDA Forest Service, Clackamas River Ranger District: (503) 630-6861
Clackamas River Basin Council: Michael Carlson, PO Box 1869, Clackamas, OR 97015
Phone (503) 650-1256 Fax (503) 657-8955 email: crbc@teleport.com

Water supply operator: Lake Oswego Municipal Water
Water supply source: Clackamas River, about 0.75 miles upstream from Willamette
Water distribution: Lake Oswego, Lake Grove and other service districts
Water supply capacity: 16 MGD

LEBANON

Lebanon is located along the South Santiam River in the eastern part of the central Willamette Valley. Lebanon has 12,895 residents and an economic base that blends rural and urban influences, including forest products, medical services, manufacturing and retail businesses. Lebanon's water system supplies about 11,000 customers through over 4,000 connections.

Water Supply System:

Lebanon's raw water originates from the South Santiam River. However, the intake for this water actually is located in the Albany Canal, which diverts water from the Santiam for several miles to the City of Albany's water treatment plant. Lebanon removes water from the Canal under an agreement with the City of Albany. To treat this raw water, Lebanon uses a conventional system that includes coagulation, sedimentation (solids contact clarifier) and filtration.

Lebanon's treatment plant, which is operated by an independent contractor, can provide up to 5 MGD of finished water. Average water demand is about 2.0 MGD, with peak demand as high as 3.7 MGD. Lebanon has storage for 4 MG of finished water, in two 2 MG reservoirs. The City has no backup wells or alternate water sources. In addition to mandated water quality testing, personnel at the treatment plant monitor the water supply for residual chlorine, alkalinity, pH, and turbidity to verify process control.

Watershed:

Although Lebanon's water comes from the Albany Canal, the intake is a short distance from the primary source, i.e., the South Santiam River just southeast of the city center. The watershed for the River at this point is quite large (about 450,000 acres or 700 square miles), and drains the western Cascade mountains between the Calapooia to the south and the Middle Santiam River to the north. Annual precipitation ranges from about 45 inches near the intake in Lebanon (about 350 feet elevation) to as much as 100 inches at the highest elevations (about 5000 feet). Water is supplied primarily as rain, but snow provides significant moisture in large areas of the upper watershed.

City personnel did not have data on specific ownership or vegetation patterns on the South Santiam watershed, but it is primarily forest lands except for some developed and agricultural areas of around and between Lebanon and Sweet Home. The upper watershed is nearly all federal land, whereas the mid-elevation areas are primarily a mix of private and federal forest lands. There are two large reservoirs (Foster and Green Peter) in the watershed that are managed by the U.S. Army Corps of Engineers.

Recent and past management activities on the watershed have not been assessed in detail, but some general patterns are visible. Significant and extensive road construction and timber harvest are evident on much of the forest lands, although in

recent years these activities have been greatly reducted on the federal lands in the area. The watershed is regional center for recreational activities, including fishing, reservoir boating, hunting, public road use, firewood cutting, hiking, horseback riding, and 4x4, snowmobile, and ATV use. A major state highway, OR20, traverses the watershed, and parallels the South Santiam River for many miles into the Cascades.

The South Santiam Watershed Council is active locally and has sponsored some assessments of portions of the watershed. The group is continuing efforts to expand these assessments. The watershed also has been the focus of some recent technical studies of water quality patterns and influences.

Future management and land uses in the area may be affected by the recent listing of the lower South Santiam River as a “water quality limited” (temperature and bacteria standards) body under section 303(d) of the Clean Water Act. Local salmon and steelhead listings under the ESA may have similar implications. Measures to address these listings could provide some benefits for water quality for domestic use.

The greatest concerns identified by City of Lebanon personnel are general water quality, consistency of water quality, and the prevention of catastrophic pollution near the City intake (e.g., oil truck crashing into the canal).

Local Contacts & Information:

City of Lebanon, Public Works, 925 Main Street, Lebanon, OR 97355
Phone (541) 451-7433 Fax (541) 451-1260
Web site: www.ci.lebanon.or.us

USFS Sweet Home Ranger District, 3225 Highway 20, Sweet Home, OR 97386
Phone (541) 367-5168 Fax (541) 367-5506
South Santiam Watershed Council, 33630 McFarland Rd., Tangent, OR 97389
Phone (541) 967-5927, ext. 120 Fax (541) 928-9345
Email: meg-shaughnessy@or.nacdnet.org

Water supply operator: City of Lebanon (Operations Management Intl., contractor)
Water supply source: South Santiam River (intake on Albany Canal)
Water supply capacity: 5.00 MGD
Water distribution: City limits
Water system established: 1971

LINCOLN CITY

Located on the central Oregon Coast, Lincoln City has a population of 7,045 residents. Its well-developed tourist facilities and proximity to population centers in the Willamette Valley make Lincoln City an important destination for coastal recreation activities. Lincoln City provides drinking water to over 13,500 customers through about 4,800 connections that span a large service area.

Water Supply System:

Lincoln City has a conventional water treatment plant that incorporates coagulation, flocculation, sedimentation, and filtration. Storage for finished water is provided by three reservoirs with a total capacity of 5 MG. Two reservoirs hold 2 MG each, and the third holds 1 MG. Average demand for water is 2.0 MGD, with peak demand as high as 3.8 MGD. Lincoln City does not have any backup wells or alternate sources, although applications for additional water rights and a diversion are pending approval by the State. Lincoln City does not conduct water quality tests other than those required by law, but it does perform some analyses more frequently than required.

Watershed:

Lincoln City gets its water from Schooner Creek, which drains a 12,800 acre watershed east of the City. The watershed ranges in elevation from about 100 feet at the City intake to over 1800 feet on Cougar Mountain. The moist, coastal climate produces about 80 inches of precipitation at the lower elevations to over 100 inches in the upper watershed. Rainfall is dominant, but winter storms occasionally leave a short-lived snowpack at the higher elevations. This watershed is primarily forested, and city personnel estimate that 77% of the area is Siuslaw National Forest lands, and the other 23% in private and USDI Bureau of Land Management ownerships.

City personnel report that, within the past three years, forest management activities in portions of the watershed have included road maintenance and some timber harvest. Both clearcutting and selective harvesting have occurred. Within the past twenty years, mining has also occurred in addition to these other management activities. As has been common throughout Oregon, the scope of forest mangement activities on federal lands has been very limited in recent years.

Management activities within the watershed are affected some major issues related to threatened and endangered species. Timber harvest, particularly on federal lands, is limited by presence of Marbled Murrelets and salmonid species. The latter also limit Instream work on the City water intake due to fish migration concerns.

City personnel are not aware of any local watershed assessment work that has been completed or expected. There are, however, GIS data available for the watershed. At the time of the survey, a local group was getting organized into a watershed council.

Local Contacts & Information:

City of Lincoln City, Water Department, P.O. Box 50, Lincoln City, OR 97367
Phone (541) 996-2152 Web: www.ci.lincoln-city.or.us

USFS Hebo Ranger District, 31525 Hwy. 22, P.O. Box 324, Hebo, OR 97122
Phone (503) 392-3161 Fax (503) 392-4203

Water supply operator: City of Lincoln City
Water supply source: Schooner Creek
Water supply capacity: 4.00 MGD
Water system established: 1983

McMINNVILLE

Located in the northwest Willamette Valley, McMinnville (population 25,250) was among Oregon's fastest growing communities during the 1990's. Working residents are employed in diverse enterprises, including manufacturing, transportation, insurance, higher education, and food products. McMinnville Water and Light utility provides water to about 25,000 customers through about 8,000 service connections.

Water Supply System:

McMinnville Water and Light uses a dual media treatment plant for their water supply. Water is filtered, disinfected and fluoridated before it is distributed. The plant has a capacity of 13.3 MGD. Raw water storage is provided by two large impoundments, Haskins Reservoir (230 MG) and McGuire Reservoir (1,230 MG). Finished water is stored in four covered concrete reservoirs. These reservoirs have capacities of 2.1, 3.1, 7.1 and 10.5 MG, for a total of 22.8 MG.

Average demand from the system is 5.38 MGD, and peak demand about 10.6 MGD. There are no backup sources to the Haskins and McGuire Reservoir supplies, but there is a backup water diversion system. Water quality tests beyond those required by law are performed occasionally and all water quality data is on file.

Watershed:

McMinnville's two primary water sources are located in adjacent watersheds in the Coast Range about 10 miles northwest of the City. Interestingly, Haskins Creek is a tributary to the Yamhill River that drains east into the Willamette, whereas the Upper Nestucca River (McGuire Reservoir) drains west to the Pacific. The Haskins Reservoir watershed is 4,384 acres, and the McGuire Reservoir watershed is 1,824 acres. Elevations in these drainages range from about 900 to 2,800 feet, with precipitation varying from about 55 to 80 inches.

The Haskins watershed is owned entirely by the City of McMinnville, which also owns about 60% of the McGuire watershed. The remaining 40% of the McGuire watershed is split between about 33% federal ownership (Bureau of Land Management) and 7% private ownership. McMinnville Water and Light personnel estimate that vegetation on the watersheds consists of about 3% hardwood forest, 2% mixed forest, and 95% conifer forest.

Forest management activities within the watersheds have not changed significantly in recent years. In the past three years as well as the last twenty years, activities have included road maintenance, clearcutting, thinning/selective harvest, and new road construction. McMinnville has a forester who oversees specific management activities on the City's watershed properties. Long term management guidance is provided by the McMinnville Water and Light Commission.

There is no public access on any watershed lands owned by McMinnville. Most of the other property in the watersheds, however, has relatively open access. Likely activities that occur on these lands include public road use, fire wood cutting, open access hunting, and 4x4, snowmobile, and ATV riding. The primary threatened or endangered species that currently impacts management in the watersheds is the Northern Spotted Owl, which has an activity center identified within the Haskins watershed.

Some watershed assessment work has been completed. A "source water assessment" has been performed by the DEQ, but is not ready for publication. McMinnville Water and Light personnel were not aware of any GIS data available for the watersheds, although some are likely for the BLM lands. Watershed councils in the area include the Nestucca-Neskowin and Yamhill councils.

Water quality is the primary management concern identified by McMinnville Water and Light personnel, and the City's watershed properties are managed with that priority. However, sustained yield of timber resources is also very important to McMinnville Water and Light and its ratepayers.

Local Contacts & Information:

McMinnville Water and Light, 855 NE Marsh Lane, P.O. Box 638, McMinnville, OR 97128
Phone (503) 472-6158 Fax (503) 472-5211
Email: VanceG@mc-power.com Web: www.mc-power.com/n_Water.htm

Bureau of Land Management, Salem District, 1717 Fabry Rd. SE, Salem, OR 97306
Phone (503) 375-5646 Fax: (503) 375-5622
Nestucca-Neskowin Watershed Council, P.O. Box 255, Hebo, OR 97122
Phone (503) 392-3161 Email: nnws@oregoncoast.com
Yamhill Watershed Council, 2200 W. 2nd St., McMinnville, OR 97128
Phone (503) 472-6403 Fax (503) 472-2459 Email: Melissa-Leoni@or.nacdnet.org

Water supply operator: City of McMinnville, McMinnville Water & Light
Water supply source: McGuire & Haskins Reservoirs (Upper Nestucca & Haskins Cr.)
Water supply capacity: 13.3 MGD
Water distribution: City limits
Water system established: 1889

MEDFORD AREA

With a population of 62,030, Medford is southwest Oregon's largest residential and commercial center. Although population growth and development activity have been significant in recent years, producers of agricultural and forest products continue to be Medford's primary employers. The Medford Water Commission is a major regional utility that supplies not only the residents of Medford, but also the neighboring communities of Jacksonville, Central Point, Phoenix, Eagle Point and White City. The system thus serves over 90,000 customers through over 20,000 individual and service area connections. The primary water source for the Medford system is a major springs supply (Big Butte Springs), although the Rogue River provides substantial amounts of supplemental water to meet seasonal demands.

Water Supply System:

The primary supply from the Big Butte Springs source provides raw water of unique quality and quantity. High quality water captured by concrete collection boxes allows direct use of unfiltered water following simple chlorine disinfection. Although fed primarily by groundwater, year round flows from the Springs are substantial and relatively constant, averaging 26.4 MGD annually. The average system demand from the Springs is about 23 MGD. In the winter months, when demand is low, the Commission reduces withdrawals from the springs to 19.8 MGD

Because both seasonal and peak (53 MGD) system demands exceed the amount available from the Big Butte Springs source, the Medford Water Commission also operates a treatment plant that uses Rogue River water for several months each year (usually May to September). The Duff Water Treatment Plant is a conventional filtration facility with a treatment capacity of 45 MGD. Average volume treated at the Duff Plant is 14 MGD, with peak levels about 27 MGD. Because the Commission has rights to 65 MGD of Rogue River water and the excess capacity of the Duff Plant, this source and treatment facility could provide significant backup or supplemental supplies if needed.

The overall supply system provides approximately 33.5 MGD storage for finished water, consisting of 10 small (0.10 MG) to large (10 MG) concrete covered reservoirs. There is 10,000 acre-feet of raw water storage capacity available in the Lost Creek Reservoir, but this is not used currently.

Commission personnel report that water system data collection exceeds that required by law. For example, parameters required to be monitored every 3 years for groundwater sources are monitored annually. In addition, there is regular monitoring of crytosporidium, giardia, and microscopic particulates (MPA). Samples are collected weekly for total coliforms and HPC, and water quality in streams and springs are monitored throughout the watershed on a monthly basis. The latter analyses include temperature, pH, conductivity, total dissolved solids, and dissolved oxygen. Nitrates and phosphates are monitored on a quarterly basis. Full chemical analyses are

performed on select water samples every two years, and include HCO3, CO3, As, B, Ca, Fl, Fe, Mg, Mn, NO3, NO2, pH, PO4, K, Si, conductivity, SO4, TDS, and Zn. Selected monitoring wells are sampled for the same parameters.

Watersheds:

Big Butte Springs

The watershed that feeds the Big Butte Springs is about 56,000 acres. Vegetation is diverse in this watershed, and is estimated to be about 60% conifer forest, 25% grass and shrubs, 5% hardwood forest and 7-10% of other vegetation (e.g., wetlands, meadows, and riparian areas). The City of Medford owns about 6% of the watershed, 76% is under federal ownership, and about 18% is owned privately.

Forest management activities on the watershed generally have not changed over the past 20 years, and include road maintenance, thinning/selective harvest, clearcutting, and new road construction (very limited in past three years). Both day-to-day and long term oversight is shared among the City of Medford, the US Forest Service, and private timber companies, which work cooperatively despite their distinct ownerships. Listed threatened and endangered species (e.g. Northern Spotted Owl, salmonids), may affect management activities on the watershed. Fisheries concerns may water releases or diversion, and any activity that affects water temperature may be impacted.

Most of the Big Butte Springs watershed is open to public access due to federal ownership, but the Medford Water Commissions lands surrounding Big Butte Springs are closed to the public. Willow Lake, which is owned by the Commission but leased to Jackson County, is open for recreational use. Likely activities in areas open to public access areas include fishing, hiking and/or walking, public road use, horse riding, fire wood cutting, hunting, boating, bicycle riding, snowmobile/ATV riding.

The Rouge River National Forest completed an assessment of the Big Butte Springs Watershed in 1995. The Medford Water Commission also completed a Drinking Water Protection Plan for the Big Butte Springs Watershed following Oregon Drinking Water Protection Program guidelines, including participation by major stakeholders. The Medford Water Commission also has a GIS for the watershed and has access to additional GIS data from the US Forest Service and Jackson County. The Upper Rogue Watershed Association is active in the area that includes the Big Butte Creek Watershed. The Medford Water Commission is a current member of the association some funding for administrative purposes.

The greatest concerns regarding the Big Butte Springs watershed noted by Medford Water Commission personnel focus on the use of chemicals, both herbicides for forestry, and petroleum products. Regardless of requirements, the Commission tests regularly for SOCs and VOCs, as detection could impact consumer confidence, initiate new monitoring requirements and possibly require construction of expensive treatment facilities. There is also concern that the watershed remain in active management for

multiple use, as long as risk is minimized and watershed health and water quality are maintained.

Rogue River

The watershed at the Medford intake on the Rogue River encompasses about 1,000,000 acres (over 1500 square miles). About 70% is federal land (National Forest and BLM), 28% is privately owned and 2% is in local public ownership. Vegetation cover is estimated to be about 40% conifer forest, 20% mixed forest, 15% hardwood forest, 25% grasses or shrubs (including pasture and agricultural lands).

Public access depends on ownership, and varies from very open access on most of the extensive public lands to restricted access on private lands. Activities in areas of open access include fishing, hiking/walking, public road use, horse riding, fire wood cutting, hunting (both open and by limited access), boating, bicycle riding, 4x4, snowmobile and ATV riding. Forest management activities within the past three years include road maintenance, a very small amount of new road construction, clearcutting, selective harvest/thinning, and grazing. Similar activities occurred over the past twenty years, road construction and timber harvest were more common. Federally listed species (salmonids, Bald Eagle, etc.) occur in several areas within this large watershed, and can affect management activities

The Medford Water Commission expects to develop a Drinking Water Protection Plan for its Rogue River source within the next two years. The Commission has GIS data and access to additional data from Jackson County, Rogue River National Forest, BLM, and other sources such as the Southwest Oregon Province Project. Several watershed analyses on smaller drainages within the Rogue basin have been completed by the Rogue River National Forest, the Bureau of Land Management, and a private contractor for Boise Cascade. These include the Upper and Lower Big Butte, Elk Creek and North Fork Rogue watersheds. Local watershed councils active in the area include the Little Butte Creek and Bear Creek councils and the Upper Rogue Watershed Association.

The greatest concern related to the Rogue River water source is drastic changes in water quality over short periods, because of the time needed to adjust filtration processes at the treatment plant. Nutrient loads and high temperatures that cause taste and odor problems also are of concern. Commission personnel recognize that communication, cooperation and education among land managers and users are very important for maintaining or improving water quality and minimizing risks.

Local Contacts & Information:

Medford Water Commission, Room 177, 200 South Ivy Street, Medford, OR 97501
Phone (541) 774-2440 Fax (541) 774-2555
Email: wtrcom@ci.medford.or.us Web: www.medfordwater.org

Bear Creek Watershed Council, RVCOG, P.O. Box 3275, Central Point, OR 97502
Phone: (541) 664-6676 Fax: (541) 664-7927 Email: bill@rv.cog.or.us
Little Butte Creek Watershed Council, 1094 Stevens Rd., Eagle Point, OR 97524 Phone & Fax: (541) 826-2908 Email: luanthony@earthlink.net
Upper Rogue Watershed Council, P.O. Box1128, Shady Cove, OR 97539
Phone & Fax: (541) 878-7647 Email: msfish@mind.net

USFS Rogue River National Forest, 333 W. 8th St., P.O. Box 520, Medford, OR 97501
Phone: (541) 858-2200 Fax: (541) 858-2220 Web: www.fs.fed.us/r6/rogue/

Bureau of Land Management, Medford District, 3040 Biddle Rd., Medford, OR 97504
Phone: (541) 618-2200 Fax: (541) 618-2400
Email: or110mb@or.blm.gov Web: www.or.blm.gov/Medford/

Water supply operator: Medford Water Commission
Water distribution: Medford & regional service, including Jacksonville, Central Point, Phoenix, Eagle Point & White City
Water supply source: Big Butte Springs & Rogue River
Water supply capacity: 91.40 MGD

NEWPORT

Newport (population 10,715) is the largest community on the central Oregon Coast, and it serves as a regional center for commercial and many other activities. Fishing, seafood processing, tourism, and forest products are among the important enterprises that employ local residents. In addition, the Hatfield Marine Science Center and the Oregon Coast Aquarium are widely known for their high quality programs in research and education. The water system for Newport serves over 10,000 customers through about 3,900 connections.

Water Supply System:

The City of Newport's water treatment facility uses a relatively conventional regimen that includes coagulation, flocculation, sedimentation, filtration, fluoridation, and chlorine disinfection. Average production from the water system is 2.5 MGD. Peak demand has been as high as 3.8 MGD.

Significant storage of raw water is provided by a 416 MG reservoir on the primary source on Big Creek. There is also about 8 MG of storage for finished water. There are no backup wells or other sources for the treatment plant. Some water quality parameters are monitored beyond those required by law, including inorganic chemicals, organic chemicals, metals, and bacteriological contamination.

Watershed:

Water for Newport’s supply system originates from Big Creek, just northeast of the City. Big Creek’s watershed encompasses about 2,000 acres, about 10% of which is owned by the City. The remaining 90% is in private ownership. Vegetation on the watershed consists primarily of mixed conifer and hardwood forests. Elevations within the watershed range from about 100 to 750 feet, and annual precipitation averages about 75 inches.

Forest management activities on the Big Creek watershed have been diverse. In the past three years, City personnel report that management activities have been limited to road maintenance and thinning/selective harvest. In the past twenty years, however, activities have included both clearcutting and new road construction.

Given its ownership pattern and size, Newport's watershed is somewhat unique in that it is relatively open to public access. City personnel report that activities occurring in the watershed include fishing, public road use, open access hunting, bicycling, hiking and walking, horse riding, 4x4/ATV/snowmobile use and boating. However, boating in the watershed is limited to non-motorized use.

At the time of the survey, no assessment work had been completed specifically for the Big Creek watershed. It is expected that some analysis by the Oregon Health

Department will be completed at some point in the near future. City personnel were unsure about the existence of GIS data for the watershed, but doubts that there is any. There are no threatened or endangered species known to be present within the watershed. The MidCoast Watersheds Council operates in the general area that includes the Big Creek Watershed, and thus may offer some relevant information from nearby basins and other sources.

City personnel identified two issues of primary concern regarding Newport's water supply and watershed. The reservoir currently is overrun with Brazilian Elodia (Eqera densa), a noxious weed that causes elevated taste and odor problems in the water system. It also causes elevated TTHMs and HAAs. The other major concern is that the quantity of water provided by the watershed is barely sufficient to supply the current demand. As the City of Newport grows, this will become an increasing problem. The City is seeking new sources, but recognizes this is a long process.

Local Contacts & Information:

City of Newport, Public Works, 845 NE 3rd St., Newport OR 97365
Phone (541)265-4291 Fax (541)265-3301
Email: newptpubwrks@actionnet.net Web: www.ci.newport.or.us

MidCoast Watersheds Council, 157 NW 15th St., Newport, OR 97365
Phone (541) 265-9195
Email: midcoast@newportnet.com Web: www.midcoastwatershedcouncil.org

Water supply operator: City of Newport
Water supply source: Big Creek
Water supply capacity: 2.00 MGD
Water distribution: City limits
Water system established: 1953

ONTARIO

Ontario (population 10,680) is Oregon's easternmost city. Located across the Snake River from Idaho, Ontario residents are among those who set their clocks with the Mountain Time Zone. With several major food and forest products processors, Ontario's economy is strongly linked to the agricultural and forest lands of the region. Ontario's water comes from the Snake River, and its supply system serves about 10,500 customers through about 3,400 connections.

Water Supply System:

Water drawn from the Snake River undergoes conventional surface water treatment, which includes coagulation, flocculation, settling, and mixed media filtration. Chlorine gas is added for final disinfection. The treatment plant has a capacity to produce 11 MGD of finished water. A total of 12 MG of storage for finished water is provided by one elevated tank, three concrete reservoirs, and three steel reservoirs.

Average water demand from Ontario's system is about 6.0 MGD, with peak demand as high as 9.8 MGD. As a backup water source, Ontario has several shallow, low volume wells. In addition to water quality monitoring required by law, the City of Ontario collects and monitors further samples for bacterial contamination.

Watershed:

The Snake River drains a very large watershed that includes portions of western Montana as well as much of Idaho and parts of southeast Oregon. As such, patterns of vegetation, ownership, management activities, and public access are very diverse. For example, land uses and management activities within the watershed range from remote wilderness to surface mining to urban development. Because salmon are an important regional resource, ESA listings can affect local management activities and land and water use within the watershed.

Many watershed councils likely operate in the Snake River watershed, and a variety and abundance of GIS data and other information also can be expected. For example, federal agencies recently completed a major assessment and management strategy for this region (i.e., the Interior Columbia Basin Ecosystem Management Project), which includes water resources and influences. The Malheur Watershed Council is based in Ontario. The Snake River - Hells Canyon TMDL project and Public Advisory Team (PAT) were also identified as potential sources of information about area watersheds and their uses and management.

City of Ontario personnel identified several major concerns related to their water suppy and watershed: organic loading, high turbidity, inorganic chemical contamination, synthetic organic chemicals, and metals.

Local Contacts & Information:

City of Ontario, Public Works Dept. 444 SW 4th Street, Ontario, OR 97914
Phone (541) 881-3231 Email: ontario@cyberhighway.net Web: www.ontario.or.us

Malheur-Owyhee Watershed Council, 2925 SW 6th Ave., Suite 2, Ontario, OR 97914
Phone (541) 889-2588, ext. 5 Fax (541) 889-4304

Snake River - Hells Canyon TMDL Project web site: www.srhctmdl.org
Interior Columbia Basin Ecosystem Management Project
Phone: (208) 334-1770 Fax: (208) 334-1769 Web: www.icbemp.gov/

Water supply operator: City of Ontario
Water supply source: Snake River, 8 wells
Water supply capacity: 13.00 MGD
Water distribution: City limits
Water system established: 1910

OREGON CITY-WEST LINN

Known for its pioneer history as the first incorporated city west of the Mississippi, Oregon City is located in the northern Willamette valley near the confluence of the Clackamas and Willamette Rivers. West Linn is found directly across the Willamette from Oregon City. Both cities are at the southern edge of the Portland metropolitan area and have grown rapidly in recent years, Oregon City to a population of 24,940 and West Linn to 23,380. Local government services (Clackamas County and school districts) and paper, paint, steel and plastic manufacturing are major employers. The water supply for the two cities is managed by the South Fork Water Board, using water drawn from the Clackamas River. The collective water system serves about 49,000 customers through about 14,000 connections.

Water Supply System:

Water for the South Fork treatment plant is drawn directly from the Clackamas River just east of the Interstate-205 bridge. There are no primary backup sources, although the Health Division lists the Lake Oswego system as a potential secondary source for West Linn. Raw water is treated with conventional processes using a high-rate, mixed media filtration system that can produce up to 20 MGD. There are underground storage tanks at the plant site providing a total of 1 MG of storage, as well as 10 MG storage in above ground tanks located at the end of the main transmission line from the plant. In 1999, average daily demand for the system was 7.2 MGD and peak demand was 18 MGD.

Water quality data are collected beyond what is required by law. Water quality samples are taken from three major distribution systems served by the water source, as well as on the watershed. Total organic content (TOC) is sampled monthly on both raw and finished water. Alkalinity and hardness samples are taken daily on finished water. Other raw and finished water samples are taken every two hours while the plant is operating, including pH, temperature, turbidity, and residual chlorine.

Watershed:

The source of raw water for the South Fork system encompasses nearly all of the Clackamas River drainage, which is 972 square miles (about 626,000 acres) in area. This large watershed extends from about 50 feet elevation near the treatment plant intake to about 5,000 feet at its eastern boundary along the Cascade Range divide. Annual precipitation generally increases from about 45 to 100 inches with this elevation change, as does the importance of snowpack water.

Water system personnel estimate that Oregon City and West Linn own less than 1% of the watershed, as does the State of Oregon. Most of the watershed is federal land (72%) or in private ownership (25%). These diverse ownerships result in diverse land use activities. In the past three years, reported activities have included road maintenance, thinning/selective harvest, clearcutting, gravel mining, pesticide

application, Christmas tree farming, nursery stock raising, and other farm use. Within the past 20 years, only road maintenance, thinning/selective harvest, and clearcutting were reported, perhaps reflecting some increase in nonforest activities. Management activities may be limited by threatened and endangered species that are found within the watershed, including adadromous salmonids and cutthroat trout.

Because of the dominance of federal lands and a well-developed road system, access to the watershed is relatively widespread and open. Water personnel report that likely recreational activities on the watershed include fishing, hiking and walking, public road use, horse riding, fire wood cutting, open access hunting, boating, bicycle riding, and some limited 4x4, snowmobile, and ATV use.

Significant assessment work has been completed on the watershed, particularly on the USDA Forest Service lands and most of the BLM lands. Studies of nutrients and algae in the drainage also have been conducted. A cooperative watershed assessment will be completed soon for the balance of the private and public lands, including Deep and Clear Creeks and the lower Clackamas River basin. GIS data for the watershed currently are available from various sources, including Portland Metro, USGS, USDA Forest Service, DEQ, and Clackamas County. The Clackamas River Basin Council is the primary watershed council that operates in the area.

Water system personnel identified water quality and quantity as the most important concerns for the water supply and watershed. More specific concerns include turbidity, point and nonpoint pollution sources, logging practices, road maintenance, reservoirs, temperature, increased urbanization, open access to the watershed, increased ESA listings, maintenance of diversity of land uses, and USTs and septic tanks.

Local Contacts & Information:

Oregon City, PO Box 351, 320 Warner Milne Rd., Oregon City, OR 97045
Phone (503) 657-0891 Web: www.ci.oregon-city.or.us/
City of West Linn, 22500 Salamo Rd, West Linn, OR 97068
Phone 503-657-0331 Web: www.ci.west-linn.or.us/ Email: jatkins@ci.west-linn.or.us

USDA Forest Service, Clackamas River Ranger District, 595 NW Industrial Way, Estacada, OR 97023 Phone (503) 630-6861
Clackamas River Basin Council, PO Box 1869, Clackamas, OR 97015
Phone (503) 650-1256 Fax (503) 657-8955 email: crbc@teleport.com

Water supply operator: South Fork Water Board
Water supply source: Clackamas River, about 1.5 miles upstream from Willamette
Water distribution: Lake Oswego and West Linn
Water supply capacity: 20.00 MGD
Water system established: 1958

PORTLAND AREA

Located at the confluence of the Willamette and Columbia Rivers, Portland is by far Oregon's largest municipality (population 513,325). The Bull Run watershed has been Portland's primary water source since the 1890's. Initially, city leaders were apprehensive about using water from this area because of fears of sedimentation from the slopes of Mt. Hood. Shortly thereafter, it was found that the Bull Run was actually a distinct basin and did not receive cloudy outwash from the glaciers on Mt. Hood. The Portland Water Bureau supplies over 875,000 people in both the City of Portland and several nearby communities and service districts, including Gresham andTualatin.

Water Supply System:

Raw water is stored within the Bull Run watershed in two large reservoirs and in Bull Run Lake, a natural lake in the upper basin that has been augmented with a small dike. Storage capacity in these impoundments totals about 13 billion gallons. Water from the lowest reservoir (Reservoir No. 2) enters the Headworks treatment plant, usually passing first through a power generating plant. Electricity generation, however, is a secondary priority to water supply.

Water from the Bull Run watershed currently is exempt from filtration treatment, but a 1/4 inch mesh screen keeps out most animals, leaves, sticks, and other large debris. Although the water is very clear most of the year, storms that result in high turbidity (>5 NTU) require use of alternate raw and finished water sources in wells and storage reservoirs. This backup supply consists of 24 production wells in the Columbia South Shore Wellfield with a capacity of 85 MGD. This backup system is also used to supplement the Bull Run supply during the peak demand season.

After entering the Headworks plant intake, water is disinfected with chlorine. After an initial fixed contact time with the chlorine, ammonium hydroxide is added to maintain disinfection effectiveness as it enters and moves through the distribution system. Sodium hydroxide also is added for corrosion control within the transmission lines, which carry the finished water to several urban storage tanks and reservoirs. Total storage capacity of finished water is about 250 MG. Average demand from the water system is 118 MGD, with peak demand as high as 210 MGD.

The Portland Water Bureau collects water quality data beyond that required by law, and maintains a data base for many characteristics of both raw and finished water.

Watershed:

The Bull Run watershed is located near Mt. Hood just northeast of Sandy, about 25 miles east of Portland. Most of the watershed's 65,500 acres (102 square miles) is National Forest land (96%), with the rest Portland Water Bureau property. Local elevations (750 to 4,150 feet) and a favorable aspect toward moving weather systems

contribute abundant precipitation throughout the basin (80 to over 150 inches). Snow is an important water source at the upper elevations, and significant “fog drip” also has been measured in a portion of the basin. Conifer forests dominate the landscape (about 95%), with some hardwoods found primarily riparian areas.

Public access to the Bull Run watershed has been restricted for nearly a century, beginning with the “Trespass Act” signed by Teddy Roosevelt in 1904. Between the late 1950’s and early 1990’s, timber harvesting and road construction occurred on about 22 percent of the watershed under National Forest multiple-use mandates as well as Public Law 95-200 of 1977, which also required primary concern for local water quality. However, in 1996 Public Law 95-200 was amended to greatly restrict timber harvest on the Bull Run, and thus in recent years the only land management activities reported by the City personnel have been road maintenance and road obliteration.

A watershed analysis has been completed by the Zigzag Ranger District of the Mt. Hood National Forest. In addition, the Portland Water Bureau has compiled a fairly extensive GIS database of the Bull Run watershed. The Bull Run River is part of Sandy River drainage, where the Sandy River Basin Watershed Council also operates. A watershed assessment for the Sandy basin was recently completed for the Council.

Because of existing habitat for the Northern Spotted Owl, the federal Northwest Forest Plan has identified most of the Bull Run watershed as “Late Successional Reserve,” which further restricts management activities. Local Threatened and Endangered fish listings (steelhead and chinook salmon) also have prompted the Bureau to voluntarily begin releasing reservoir water to help maintain minimum flows, and to initiate a regulatory compliance planning process with NMFS, USFS, and several other state and federal agencies. The lower Bull Run is on the state 303(d) list of impaired water bodies due to excess temperature. The regulatory compliance plan will address both ESA and CWA issues.

Portland Water Bureau personnel noted several primary concerns about their water supply and watershed resource:

Turbidity events. Infrequent (> 5-10 years) heavy runoff events (e.g., rain-on-snow) can temporarily shut down the Bull Run supply. Maximum legal turbidity at a raw water intake is 5 NTU, and the Water Bureau's operating policy is to shut down the Bull Run supply and rely on its alternate source (Columbia South Shore wellfield) when turbidity approaches 5 NTUs.

Water quantity. Summer drawdown in the two Bull Run reservoirs is limited to about 60% of the total storage capacity because of the risk of high turbidity during fall storms.

Road maintenance. Limited funding has led to substandard maintenance on roads needed for long-term access, and slow progress in decommissioning about 70 to 80 miles of old logging roads. Ditches and culverts not being maintained to recommended standards pose a threat to water quality during winter storms.

Wildfire. The Bull Run watershed generally has a low risk of catastrophic wildfire due to high rainfall and low occurrence of natural (lightning) and other ignition sources. Although local fires remain uncommon and the natural fire cycle appears to have been infrequent (e.g., every 350 years), there is concern that these historical fires were very severe and destructive. There is concern also about reduced local fire control resources and increased reliance on regional, aerial systems for major wildfire control.

Local Contacts & Information:

Portland Bureau of Water Works, 1120 SW 5th Ave., Room 600, Portland, OR 97204
Phone (503) 823-7404 Web: www.water.ci.portland.or.us/

USFS Zigzag Ranger Station, 70220 E. Highway 26, Zigzag, OR 97049
Phone (503) 622-3191 Web: www.fs.fed.us/r6/mthood/
Sandy River Basin Watershed Council, P.O. Box 868, Sandy, OR 97055
Phone (503) 668-1646 Fax (503) 668-1641
Web: www.columbia-center.org/SRBWC/MAIN.HTM

Water supply operator: City of Portland, Bureau of Water Works
Water supply source: Bull Run River & reservoir system
Water supply capacity: 210.00 MGD
Water distribution: Portland City limits, other cities & local supply districts
Water system established: 1895

ROSEBURG

Roseburg straddles the South Umpqua River in southwest Oregon, between the Cascades (east), Coast Range (west) and Klamath (south) Mountains. Roseburg (population 20,955) is the largest city in Douglas County, and is a regional center for forest products manufacturing and government services. The Water Division of the City of Roseburg supplies over 30,000 users through about 10,000 connections in the area. City personnel did not complete the written survey, thus the information here was compiled from other sources. This includes survey responses from the Umpqua Basin Water Association, which also uses water from the North Umpqua River and supplies water for a portion of northwest Roseburg.

Water Supply System:

Roseburg uses a conventional filtration plant to treat its raw water supply, and it maintains a distribution system with 126 miles of transmission lines. Public records indicate that Roseburg's water system has a capacity to supply 12 MGD. Average water use is reported at 6 MGD.

Watershed:

Raw water for Roseburg is drawn from the North Umpqua River as it flows through Winchester, a small community just north of the City. The watershed for the North Umpqua near this point is 1344 square miles (about 860,000 acres), and elevations in this large basin range from about 375 feet near the City's intake to 9,182 feet at the summit of Mt. Thielsen in the Cascades. Precipitation also varies widely, from about 35 inches near the intake to 75-100 inches at the higher elevations, where snow can be an important water source.

Information provided by Umpqua Basin Water Association personnel indicate that most of the watershed is in federal ownership, with USFS managing about 60% of the area, and the BLM about 10%. About 30% of the watershed is in private ownership and there is also a small amount of state land. Local vegetation consists of about 70% conifer forest, 5% mixed forest, 15% grass and shrub cover, and about 5% residential and municipal areas.

Diverse ownership supports an array of management activities. For both the past three and past twenty years, reported activities include road maintenance, clearcutting, selective harvest, new road construction, and farming. Much of the watershed is public land where access is relatively unrestricted, whereas private lands have areas of special permit access, limited seasonal access, and closed access. Recreational activities include fishing, hiking and walking, public road use, horse riding, firewood cutting, hunting, boating, bicycle riding, 4x4, snowmobile, and ATV riding.

Management on portions of the watershed is limited by the presence of Threatened and Endangered species, including Northern Spotted Owl, Umpqua cutthroat trout, and coho salmon. The North Umpqua River is on the state's 303(d) list of impaired water bodies (i.e., temperature) for several reaches and tributaries, which also has implications for management.

Some watershed assessment work has been completed by the USFS and the BLM, including the middle portion of the North Umpqua drainage. The USFS and BLM are likely to have GIS data for the watershed. The Umpqua Basin Watershed Council also operates in the area, and is undertaking a watershed assessment in a drainage (Deer Cr.) adjacent to the lower North Umpqua.

Local Contacts & Information:

City of Roseburg, Water Division, 900 SE Douglas, Roseburg, Oregon 97470
Phone (541) 672-7701 Web: members.rosenet.net/roseburg/

USFS Umpqua National Forest, 2900 NW Stewart Pkwy, PO Box 1008, Roseburg, OR 97470 Phone (541) 672-6601 Fax (541) 957-3495 Web: www.fs.fed.us/r6/umpqua/

Umpqua Basin Watershed Council, 1758 NE Airport Rd., Roseburg, OR 97470
Phone (541) 673-5756 Fax: (541) 673-5790
Web: www.ibissoftware.com/umpqua/index.html

Water supply operator: City of Roseburg, Water Division
Water supply source: North Umpqua River at Winchester
Water supply capacity (MGD): 12.00 MGD
Water distribution: most areas within Roseburg's urban growth boundary, other areas
Water system established: 1936

SALEM

Oregon's capitol and third largest city (population 131,385), Salem is located in the central Willamette Valley. The Salem water system has been operating since 1870, and currently serves about 155,000 people through approximately 41,000 connections. Like most other major cities in Oregon, Salem's water supply comes from a relatively large watershed, the North Santiam.

Water Supply System:

The City of Salem is among Oregon's few larger municipalities to use slow sand filtration for initial purification of its raw water supply. One of the oldest methods of water treatment, slow sand systems use microbial activity to eliminate organic matter and pathogenic organisms. Although this purification method normally works quite well, it is a relatively slow and extensive process; large or multiple filter cells must be used and maintained to provide large volumes of water. Salem thus operates three 5-acre slow sand filter cells at its Geren Island facility, which can deliver up to 66 MGD.

After slow sand treatment and chlorination, Salem's finished water is stored in a system of 15 reservoirs and 4 aquifer storage and recovery wells. The latter are important for maintaining river flows during peak summer demand, and in emergencies if surface waters become very turbid (e.g., as in the 1996 flood) or contaminated. Reservoir capacity is 131 MG and the aquifer holds 440 MG, providing a total storage capacity of 571 MG. Average and peak system demand are 30 MGD and 59.5 MGD, respectively.

In addition to required water quality monitoring, the City of Salem collects water quality samples from their watershed, and tests include MPAs (microscopic particulate analysis). The City also collects supplemental samples at the treatment plant. Water quality monitoring information and current test results are available at the City's drinking water web site.

Watershed:

The large watershed that supplies Salem extends east from the Stayton area to the crest of the Cascade Mountains, covering about 690 square miles (over 440,000 acres). Local elevations range from about 450 feet near Stayton to over 10,000 feet at the summit of Mt. Jefferson. Precipitation also varies widely between these locations, from about 50 to over 150 inches, with snow an increasingly important water source at the highest elevations.

City personnel report that land ownership in the upper North Santiam basin is primarily federal (76%) and State of Oregon (12%). Important management units include Willamette National Forest (Detroit Ranger District and Mt. Jefferson Wilderness), Bureau of Land Management lands, and Santiam State Forest. The City of Salem owns

8% of the watershed, and the remaining 4% is owned privately. Private lands become increasingly important in the lower watershed near the City intake.

Many different land uses and management activities are found on this large watershed. Those reported by City personnel include road maintenance, new road construction, timber harvest (both clearcutting and thinning/selective), stream restoration (restoration for fish habitat is specifically identified), wastewater plants with no discharge, housing, and municipal development. Since this large watershed is primarily in federal ownership, diverse access and activities are reported, including fishing, use of public roads, fire wood cutting, open access hunting, bicycle riding, hiking/walking, horse riding, boating, and 4x4/snowmobile/ATV riding.

City of Salem personnel report that there are endangered species present within the watershed that may affect management. Known listed species include Northern Spotted Owl, bull trout, salmon, and voles. Local listings and restrictions related to the Clean Water Act provisions (turbidity limits, temperature, etc.) also were noted.

Some watershed assessments have been performed in the watershed. City personnel report that the USFS has completed some sub-basin assessments. The watershed also has been evaluated under the DEQ Source Water Protection Assessment Program. In addition, the North Santiam Watershed Council has contracted for a watershed assessment, which is near completion. Both the City and the federal agencies maintain GIS data bases for lands in the watershed.

City personnel noted two major concerns regarding Salem's water supply and watershed: sediment and turbidity.

Local Contacts & Information:

City of Salem Public Works, Water Division
1410 20th Street SE, Bldg. #2, Salem, OR 97302
Phone & Fax (503) 361-2224 Web: www.open.org/~swater/

USFS Detroit Ranger District, HC73, Box 320, Mill City, OR 97360
Phone (503) 854-3366 Fax (503) 854-4239 Web: www.fs.fed.us/r6/willamette/

North Santiam Watershed Council
Email: nsantiam@open.org Web: www.open.org/~nsantiam/
City of Salem member: Tina Schweickert, phone (503) 588-6211 x7358

Water supply operator: City of Salem
Water supply source: North Santiam River near Stayton (primary), wells (emergency)
Water supply capacity: 66.00 MGD
Water system established: 1870

THE DALLES

Located on the south bank of the Columbia River east of the Columbia Gorge and the Cascade Range, The Dalles (population 12,175) is the site of one of the major hydroelectric dams along the Columbia. Two major industies in the The Dalles also supply (natural gas distribution) and use (aluminum foundry) large amounts of energy. The water system for the City of The Dalles supplies over 11,000 customers through about 5000 water connections.

Water Supply System:

The Dalles uses a conventional filtration plant with chlorine disinfection. Corrosion control is provided by phosphate inhibitors and pH adjustment. Water undergoes fluoridation before it enters the distribution system. Treated water is stored in above ground steel reservoirs with a combined capacity of 16 MG.

Water demand in The Dalles has decreased in recent years from nearly 4.0 MGD to about 3.0 MGD. This decrease occurred after residential water meters were installed and consumption based billing was implemented. Prior to that time, water was not metered. Peak demand currently is 6.0 MGD. The water system can provide up to 12.9 MGD. Three backup wells supplement the surface water supply to The Dalles during the summer. The backup wells also provide emergency water sources surface if water quality is compromised, as occurred during the 1996 floods.

In addition to water quality monitoring required by law, The Dalles conducts further sampling and testing of its water supply. Within the watershed, samples are collected to identify bacteriological, physical, chemical, and algal contaminants. At the water treatment plant, samples are taken for process control. These tests include pH, alkalinity, hardness, bacteriological contamination, TOC, UU254. There is some concern about uranium because of the proximity of the Hanford Nuclear Reservation. Within the water distribution system, additional samples are monitored. Water system operators collect about twice the required number of samples each month and also test for chemicals such as iron, manganese, and aluminum.

Watershed:

Although The Dalles is located on the banks of one of the largest rivers in the world, its water supply comes from the Mill Creek watershed southwest of the city. This basin is about 22,000 acres in size (34 square miles) and has mixed ownership. The Dalles owns and manages about 22% of the watershed. Most of drainage (66%) is in federal ownership and part of the Mt. Hood National Forest. About 1% of the watershed is State of Oregon land, and 11% is in private ownership. Vegetative cover is primarily conifer forest (about 75-80%), with the remaining 20-25% in grasses and shrubs. City personnel report that in the past three years, the new road construction has been limited to temporary spur roads for forest harvest. Other activities in this period include

road maintenance and thinning/selective harvest. Management activities over the past twenty years were generally similar to those occurring within the past three years. The watershed has restricted public access and use. Some people are allowed to enter under a limited special permit basis. There is a limited amount of fire wood cutting and a limited amount of permit hunting. There is a very limited amount of 4-wheel-drive, ATV, and/or snowmobile use on the watershed.

There are ESA concerns within the watershed. Northern Spotted Owl sites and habitat have been surveyed and mapped on both USFS and City lands. The City has developed a Habitat Conservation Plan for spotted owls in cooperation with the USFS and USFWS. Additionally, steelhead are listed as threatened on streams that supply city water. The NMFS will promulgate ESA sections 4(d) rules to protect these populations. Streams within this watershed are not 303(d) listed for water quality.

Some watershed assessment work has been completed. The USFS has complete assessments of federal lands on the watershed, and the Hood River Watershed Council addressed the Dog River portion in their Hood River Watershed Assessment. There are also plans for continued assessment work. The Dalles Watershed Council is scheduled for formation and is expected to assess the South Fork Mill Creek portion of the watershed. While some GIS data exists for the watershed, it is very limited.

City personnel identified four major concerns for the water supply and watershed:
1. Maintaining municipal water rights (undeveloped) for future growth.
2. Maintaining ability to operate and maintain water diversions and structures on streams with ESA-listed species without risk of "take."
3. Compliance with new and stricter drinking water quality standards.
4. Providing adequate financial resources to operate, maintain, and develop the water system while protecting the affordability of water for customers.

Local Contacts & Information:

City of The Dalles, 313 Court Street, The Dalles, OR 97058
Phone (541) 296–5481

USFS Dufur Ranger Station, 780 NE Court St., Dufur, OR 97021, Ph. (541) 467-2291
Hood River Watershed Council, 2990 Experiment Station Dr., Hood River, OR 97031
Phone (541) 386-2275 Fax (541) 386-1867 Email: hcoccoli@aol.com

Water supply operator & district: City of The Dalles, Chenowith Irrigation
Water supply source: Surface (Mill Creek) 80%, groundwater 20%
Water supply capacity: 12.90 MGD
Water distribution: City limits
Water system established: 1947

UMPQUA AREA

The Umpqua Basin Water Association operates in Douglas County in southwest Oregon. The Association serves residential areas outside the city limits of Roseburg along the South Umpqua River near its confluence with the North Umpqua River. The City of Roseburg also purchases water from the Association to serve a northwest section of the City. The Umpqua Basin Water Association provides water to about 8,500 customers through about 2,675 connections.

Water Supply System:

The Umpqua Basin Water Association operates a conventional water treatment plant, including flocculation, sedimentation, filtration, and chlorine disinfection. Storage for the system includes 17 above ground reservoirs that provide 3.35 MG storage. Average water output is 1.4 MGD, while peak demand is as high as 2.4 MGD.

As a backup system to its Umpqua River source, the Umpqua Basin Water Association has a tie with the City of Roseburg's system that is available for use in emergencies. In addition to required water quality testing, the Association monitors for Cryptosporidia, Giardia, halocetic acids, and TOCs.

Watershed:

The Umpqua Basin Water Association draws its raw water supply from the North Umpqua River near Riversdale, northwest of Roseburg. The watershed for the North Umpqua near this point is over 1344 square miles (about 860,000 acres) in area, and elevations in this extensive basin range from about 350 feet near the intake to over 9,000 feet at the summit of Mt. Thielsen in the Cascades. Precipitation also varies widely, from about 35 inches near the intake to 75-100 inches at the higher elevations, where snow can be an important water source.

Water Association personnel report that most of the watershed is in federal ownership, with the USFS managing about 60% of the area, and the BLM about 10%. About 30% of the watershed is in private ownership and there is also a small amount of state land. Local vegetation consists of about 70% conifer forest, 5% mixed forest, 15% grass and shrub cover, and about 5% residential and municipal areas.

Diverse management activities are found on these ownerships. For both the past three and past twenty years, reported activities include road maintenance, clearcutting, selective harvest, new road construction, and farming. Much of the watershed is public land where access is relatively unrestricted, whereas private lands have areas of special permit access, limited seasonal access, and closed access. Recreational activities include fishing, hiking and walking, public road use, horse riding, firewood cutting, hunting, boating, bicycle riding, 4x4, snowmobile, and ATV riding and "just about any other public use and abuse you can imagine."

The presence of Threatened and Endangered species limits management activities on portions of the watershed. These species include Northern Spotted Owl, Umpqua cutthroat trout, and coho salmon. In additon, several reaches and tributaries of the North Umpqua River are on the state's 303(d) list of impaired waters (i.e., temperature), which also has implications for management.

The USFS and the BLM have completed some watershed assessment work in the area, including the middle portion of the North Umpqua drainage. The USFS and BLM also are expected to have GIS data for the watershed. The Umpqua Basin Watershed Council also operates in the area, and is conducting a watershed assessment in a drainage (Deer Creek) adjacent to the lower North Umpqua.

Water Association personnel expressed several major concerns for their water system and watershed:
Maintaining water rights. The primacy of municipal rights is now being challenged by the Governor's Office and the Oregon Water Resources Department.
Municipal activities. Always a concern, especially sewage discharges during locally heavy rain events.
Highway accidents. The North Umpqua Highway runs next to the North Umpqua River for about 50 miles, and accidents could cause pollution problems.
Watershed management. Decisions about federal land management are not made locally but in Washington, DC and Federal District Courts. The Association thus has been unable to have a meaningful impact on federal watershed management.

Local Contacts & Information:

Umpqua Basin Water Association, 4972 Garden Valley Road, Roseburg, OR 97470
Phone (541) 672-5559

Umpqua National Forest, 2900 NW Stewart Pkwy, PO Box 1008, Roseburg, OR 97470
Phone (541) 672-6601 Fax (541) 957-3495 Web: www.fs.fed.us/r6/umpqua/

Umpqua Basin Watershed Council, 1758 NE Airport Rd., Roseburg, OR 97470
Phone (541) 673-5756 Fax: (541) 673-5790
Web: www.ibissoftware.com/umpqua/index.html

Water supply operator: Umpqua Basin Water Association
Water supply source: North Umpqua River near Riversdale
Water distribution: local areas, northwest portion of Roseburg

WARRENTON

Located between the Pacific Ocean and Youngs Bay in the most northwest portion of Oregon, Warrenton has a population of 4,310. Community enterprises include fishing, forest products, and a growing tourism industry. The Warrenton Water System serves both City residents as well as surrounding areas, supplying water to over 9,000 customers through about 2,000 connections.

Water Supply System:

Raw water for Warrenton's Water System goes through basic sedimentation and disinfection treatment, and does not include filtration. Treatment capacity of this system is 4.5 MGD.

A 16 MG reservoir provides most of the raw water storage for the Warrenton Water System. Finished water storage is provided by a 1.6 MG reservoir and a 250,000 gallon tank. Average demand from the water system is 2.5 MGD. Peak demand has been as high as 6.5 MGD. Warrenton has no backup source of raw water. The Warrenton Water System routinely monitors its water quality as required by law.

Watershed:

Water for the Warrenton Water System comes from multiple intakes (main Lewis and Clark, Big South Fork, Little South Fork, Camp C Creek) located in the southern portion of the Lewis and Clark River basin east of Seaside. The total watershed area for these sources is over 175,000 acres (275 square miles), and extends in elevation from about 500 feet at lower Camp C Creek to 3,283 feet at the summit of Saddle Mountain. Precipitation is abundant throughout the watershed, ranging from about 90 inches at the lower elevations to as much as 150 inches annually on Saddle Mountain.

The primary landowner in the south Lewis and Clark watershed is Willamette Industries, although much of Saddle Mountain State Park (about 2600 acres total) also is within the watershed. The City of Warrenton owns 18 acres in the watershed. Vegetation on the watershed is almost entirely conifer forest. There is GIS data available for this watershed.

Management activities reported for this watershed have not changed significantly in the recent past. City of Warrenton personnel report that local activities include road maintenance, clearcutting and thinning/selective harvest. There is some limited seasonal access to the watershed. Activities likely to occur include fishing, bicycling, hiking and walking, and some limited permit hunting. Hunting is only during rifle season, and is limited to foot access only.

No significant water supply or watershed concerns were identified by Warrenton Water System personnel. They report that the watershed is a well controlled and managed forest land operation.

Local Contacts & Information:

City of Warrenton, Water System, 147 S. Main Ave., PO Box 250, Warrenton, OR 97146
City Phone (503) 861-2233 Water System Phone (503) 861-0917

Water supply operator: City of Warrenton
Water supply source: Lewis & Clark River, Big S. Fork, Little S. Fork, Camp Creek
Water supply capacity: 4.50 MGD
Water system established: 1914

Appendix 1

Survey sent to city personnel about their municipal water system and watershed

Information About the Watershed & Water Supply System

If you need additional space, please attach sheets and be sure to include the number of the question. Please remember to fill out both sides of this survey. Thank you!

Water Supply System

1. What kind of water quality treatment (facility) is used for the water supply?

2. What type of storage is used & what is the storage capacity (MGD) for the water system?

3. What is the average volume (MGD) supplied by the system?

4. What is the peak volume (MGD) supplied?

5. Are there other water source for this water system (e.g., are there backup wells)?

6. Do you collect water quality data beyond what is required by law? If so, what type?

The Watershed

7. How large is the watershed that provides water to your system intake (approximate number of acres)?

8. What kind of ownership patterns exist within the watershed? Please estimate the percent of the watershed area that is owned by the following:

Municipality	_____	State	_____
Federal	_____	Private	_____
Don't know/unsure	_____	Other (explain):	_____

9. Regardless of ownership, what types of forest and land management activities have occurred *in the past 3 years* on your watershed? Check all that apply:

Road maintenance	____	Thinning or selective harvest	____
Clearcutting	____	New road construction	____
Don't know/unsure	____	Other (explain) _____	

10. Regardless of ownership, what forest and land management activities have been practiced *in the past 20 years* on the watershed? Check all that apply:

Road maintenance	____	Thinning or selective harvest	____
Clearcutting	____	New road construction	____
Don't know/unsure	____	Other (explain) _____	

If your municipality owns or controls a significant portion of the watershed (e.g., 20% or more of the total watershed area or key land near intake), please answer

questions #11 through #15. If not, you may skip to question #16, or complete #11 through #15 if you can respond with reasonable accuracy.

11. Who oversees and directs day-to-day activities on the watershed?
    Name _____ Title _____

12. Who plans and directs long term land management on the watershed?
    Name _____ Title _____

13. What kind of public access is allowed on the watershed? Check all that apply:

Open access	____	Limited (seasonal) access	____
Special permit access	____	No public access	____
Don't know/unsure	____	Other (explain) _____	

14. If there is public access, what type of activities do people engage in on the watershed? Check all that apply:

Fishing	____	Hiking/walking	____
Public Roads	____	Horse riding	____
Fire wood cutting	____	Limited permit hunting	____
Open access hunting	___	Boating	____
Bicycle riding	____	4x4, snowmobile, or ATV riding	____
Don't know/unsure	____	Other (explain) _____	

15. What is the approximate percent of the following types of predominant vegetation on the watershed?

Hardwood forest	____	Conifer forest	____
Mixed forest	____	Grasses and shrubs	____
Don't know/ unsure	____	Other (explain) _____	

16. Do any threatened or endangered species listings or Clean Water Act listings potentially limit the management of the watershed? If yes, please explain.

17. Has a watershed assessment been performed on the watershed or surrounding area? Please provide location(s) and responsible organization(s):

18. If not, is one expected to be performed soon? Where and by whom?

19. Do you have any or have access to GIS data for your watershed?

20. Are there any locally led watershed councils operating in the area of your watershed, or that encompass your watershed? Please provide contact names:

21. What are some of the greatest concerns for your watershed and water supply system? Please be specific (e.g., water quantity, pollution sources, wildfire):