ests, leading to loss of biodiversity and increase use and predation by non-native species.

Roads are a major impact on natural landscapes. Often designed to follow the lowest gradient and flattest terrain, roads often closely parallel rivers and streams for long distances. Trees and other vegetation are removed to build them. Road networks contribute sediment to streams due to surface erosion and landslides, degrading water quality and smothering gravel beds. Culverts and other road constrictions increase the erosive power of streams. Contaminants such as oil, gas, soaps and other toxins wash off roadways and can pollute adjacent streams and degrade nearby habitat. Roads also contribute to habitat fragmentation and wildlife mortality. Like other impervious surfaces, road networks can alter the natural hydrograph so that stream flows increase faster and subside faster than in areas with less impervious surface.

Manicured lawns and landscaping are another threat to natural landscapes. They often replace natural vegetation with introduced species. This is especially true along stream corridors in urban areas. By replacing the complex mix of native vegetation with lawns, biodiversity and structural complexity are reduced. Herbicides, insecticides, fungicides and fertilizers are often applied to lawns, gardens and golf courses. These chemicals can make their way into adjacent streams, degrading water quality and fish habitat.

Watersheds and aquatic ecosystems in urban areas are often modified to control flooding, divert water for recreational uses, protect private property from erosion, increase navigability and provide access for water transportation, and to expand the availability of land for development. Most anadromous and resident fish require deep pools for cover and rest; riffles for foraging; and cold, well-oxygenated, gravel-bottomed streams to spawn and reproduce. The width and composition of the riparian area are factors that assist in maintaining these various habitats for fish.

It is important to note that the effects described above can be minimized. New infrastructure development, stormwater runoff, building design and construction, stream conservation, land use measures and non-toxic materials and substances have been developed which minimize the impacts of urbanization on naturally functioning landscapes. These bear investigation by communities throughout Oregon.

Summary assessments of ecological health in six urban areas

Bend

Located in central Oregon's Cascade Mountains, Bend's 1998 population totaled 35,635, reflecting a 74 percent increase from 1990. Population in Deschutes county is expected to increase from 112,846 in 2000 to 190,697 by the year 2025. The median age for the Bend area is roughly 36 years old, well above the statewide average. Bend's per capita income in 1997 was approximately $23,000, one of the highest for Oregon's urban areas.

Major industries that drive the Bend area's economy include personal and business services, retail trade, tourism/recreation, computer software, lumber and wood products, construction, and small manufacturing. The Bend area tends to have a slightly higher unemployment rate, in comparison to statewide averages. This is due mainly to a large influx of in-migration of new residents. Bend continues to be a leader in the community visioning process in Oregon with the *Your Community 2000* project.

Table 3.10-3. Summary of potential soil and groundwater contamination in Oregon's urban areas.
Data summaries are for the number of sites in the six urban areas. For hazardous waste sites, the total number of sites for the entire state is given.

City	underground storage tanks 1755 sites	potentially harmful sites 645 sites	hazardous sites 214 sites	risks from hazardous sites				
				soil	ground-water	surface water	sediment	air
Portland	1113	389	66	49	47	6	14	1
Eugene	302	141	14	10	10	1		
Medford	164	40	0					
Coos Bay	56	26	7	1	1		4	
Bend	85	31	4					
LaGrande	35	18	1	1	1			

Water quality

Water quality in the Deschutes River at Bend is good to excellent, but water temperature is only fair to good. DEQ measures identify temperature as the most problematic aspect of otherwise good water quality at Bend.

Air quality

Limited data for Bend suggest that some pollutants are problematic, although recent sampling for conventional pollutants shows no evidence of problems. Data sets diverge in this assessment, with particulates and carbon monoxide as possible issues. Per capita vehicle miles traveled are low in comparison to other areas.

Soil and groundwater contamination

There is little evidence of hazardous surface or subsurface contamination. About 5% of urban underground storage tanks are located here, but there are few hazardous sites.

Coos Bay-North Bend

Located on the southern Oregon Coast, Coos Bay-North Bend is the largest urban area on the Oregon Coast. Total 1998 population in Coos Bay was 25,525, reflecting about a 3 percent increase since 1990 due solely to in-migration. Population in Coos County is expected to increase to 71,284 by 2025. The fastest growing age groups in this area are the middle working years (ages 45-54) and those persons 75 years of age and older, both with growth rates of 34 percent in the 1990s. Those in the younger working years age groups have declined in numbers. Compared with other urban areas of Oregon, Coos Bay-North Bend has a smaller populace that has attended college or acquired a college degree. Per capita income in 1997 for the Coos Bay area averaged approximately $19,500, which is well below the statewide average of roughly $24,000.

The basic industries of the Coos Bay-North Bend area include agriculture (e.g., cranberries, nursery stock, and dairy), fishing, timber and paper products, tourism/recreation, and health care. Secondary industries include retail and wholesale trade, business and personal services, and government. The basic industries for this area (and their employment levels) are heavily influenced by seasonal fluctuations. The Coos Bay-North Bend area has a relatively high unemployment rate, in comparison to other Oregon regions. A downturn in the number of jobs in the basic industries coupled with a decline in wage-earner portion of the population accounts for the slow growth in total employment for this area. The Coos Bay area recently completed a community visioning project titled *Visions 2010*.

Water quality

The South Fork of the Coos River shows stable, good to excellent quality for the pollutants assessed. As discussed in the Estuarine chapter of this Report, low dissolved oxygen in the Coos Bay estuary approaches anoxic conditions in late summer and has high to moderate fecal coliform concentrations.

Air quality

Coos Bay is not in a mandatory attainment area. Few data are available on which to assess air quality. However, per capita vehicle miles traveled are high in comparison to population, with only Portland posting a higher figure.

Soil and groundwater contamination

About 3% of the state's contaminated sites are in the Coos Bay area. Of these, a small number (7) are hazardous and in various stages of remediation.

Eugene/Springfield

Located in the Willamette Valley, the 1998 population for Eugene-Springfield was 185,160. This reflected a growth rate from 16-18% in the period between 1990 and 1998. Population is Lane County is expected to increase to 442,338 by 2025. The age distribution of this urban area mirrors that of national averages with a slightly higher proportion of young adults (ages 18-29). Eugene-Springfield's population also tends to be highly educated with a high percentage of professional and technical employment in the area. Per capita income for the Eugene-Springfield area is second only to the Portland metro area. After adjusting for inflation, incomes and wages have been increasing in Eugene-Springfield during the 1990s.

Eugene-Springfield's economy is dependent on three major sectors: professional services (health care, business/professional, and social services), wholesale and retail trade, and manufacturing (lumber and wood products, transportation equipment, high tech, and food processing). The education and government sector (University of Oregon) as well as agriculture still continues to employ thousands of Eugene-Springfield residents.

Current trends that affect the Eugene-Springfield urban area include a housing affordability problem, strong job growth (increased growth in services-producing sectors with less growth in the manufacturing sector), and moderate population growth. A community visioning process was recently completed that focused on the north end of downtown Eugene.

Water quality

Water quality in the Willamette River at Eugene is stable and generally good. Some evidence points to phosphorus as a problem at low flow. Phosphorus is a common problem in Oregon waters.

Air quality

Air quality in the Eugene-Springfield area is good to excellent. Per capita vehicle miles traveled are about

40% lower than in Portland. Exceedence days are rare.

Soil and groundwater contamination

The Eugene-Springfield area ranks below only Portland in the number of contaminated sites, although the number of hazardous sites is small. Several sites have the potential to adversely affect soil and groundwater.

LaGrande

Located between eastern Oregon's Blue and Wallowa mountain ranges, LaGrande's 1998 population totaled 12,795, a slight increase from 1990 due mainly to natural increase. Population in Union County is projected to increase to 27, 512 by 2025. The LaGrande area has a relatively higher percentage of residents age 65 and older, compared to the statewide averages. The residents of the LaGrande area are less likely to have post-high school education, compared to other, larger urban areas of Oregon. Per capita income in 1997 for this area (approximately $17,600) lagged far behind the national and statewide averages.

The LaGrande area has a higher unemployment rate than the state average. The economy for this area is less diverse than that of the state as a whole. Despite that, the LaGrande area has experienced slow but steady job growth. The primary industries for this area are government and education (federal, state, and local), wholesale and retail trade, services (business, personal, health care), manufacturing (lumber and wood products), and construction and mining.

Water quality

Analyses of the Grande Ronde River at LaGrande are mixed, but suggest that water temperature may be a concern.

Air quality

Air quality data show some concern about particulates in the LaGrande area, although recent quality attainment investigations show no current problems. Per capita vehicle use is low.

Soil and groundwater contamination

There is only isolated evidence of surface and subsurface contamination in LaGrande. Only a small number of underground storage tanks exist and a single hazardous site has been identified.

Medford

Located in southern Oregon, Medford's 1998 population was 58,895, reflecting a 25.4% increase from 1990 (mostly due to in-migration). Population in Jackson county is projected to increase to 233,081 by 2025. Medford's population has a higher median age (approx. 39 years) than the 1998 state average of 36.5 years. This area has a relatively large cohort in the retirement age (75+ years of age) population with a 34% increase from 1990 to 1998. Regionally, this area has not acquired the level of education that other, more urbanized areas of the state have achieved. Less than 12 percent of the Medford regional population has 4 or more years of college. Per capita income in 1997 for the Medford area was roughly $22,000, nearly 92% of Oregon's $23,920.

The primary industries for the Medford area include agriculture (e.g., fruit orchards, nursery stock, grapes, livestock, and dairy), manufacturing (e.g., lumber and wood products and food processing), and services (e.g., tourism/recreation, education, and health care). Secondary industries include wholesale and retail trade.

Water quality

The quality of Bear Creek in Medford is poor with each of the conventional pollutants indicating limited quality. Data trends are mixed and the stream is classified as water quality limited.

Air quality

Air quality assessments for Medford show historical poor quality in terms of particulates (PM10) and carbon monoxide, although the number of exceedences has fallen dramatically to acceptable levels. Hazardous air pollutants rank second only to Portland.

Soil and groundwater contamination

Risks to soil and groundwater are small. The number of underground storage tanks is less than 10% of those in the urban areas assessed. There are no hazardous sites and a comparatively small number of potentially contaminated sites.

Portland Metropolitan Area

The Portland metro area consists of parts of six urbanized counties: Clackamas, Columbia, Multnomah, Washington, Yamhill, and Clark County in Washington state. While we acknowledge, from a socioeconomic standpoint, the important role that Clark County, WA plays in the region, this report does not include Clark County in its environmental analysis. The Portland metro area is Oregon's most populous urbanized area as it includes four of the state's six largest cities. In 1998, the population for this area (excluding Clark County) totaled 1,487,300 residents, roughly 46% of Oregon's total population.

The Portland metro area's population is relatively young and well educated, in comparison to other urbanized areas of the state. Per capita income in the Portland metro area is 32 percent higher than per capita income for the rest of the state. In 1998, over two-thirds of the employment in the Portland metro area centered in three areas: professional services, such as business and health care (27.8%), wholesale and retail trade (24.9%), and manufacturing (15.8%).

Some key trends that affect the Portland metropolitan area include continued population growth (with most of the recent growth in Clark County, WA and Washington County), labor shortages (especially in skilled occupations), slowing job growth rate, emphasis on high tech employment, and housing prices that outpace income levels.

Although several cities in the Portland metro area have conducted community visioning projects two of the best known are Portland's Future Focus I and II as well as the Envision Gresham project. Other visioning projects have been conducted in Beaverton, Milwaukie, West Linn, and Forest Grove.

Water quality

Overall, water quality in streams of the Portland metropolitan area ranges from poor to good (but not excellent) for conventional pollutants. In Portland streams, temperature, nitrate, and dissolved oxygen were ranked most frequently as good, while phosphorus was almost evenly split between poor and good rankings. Water quality is generally stable or improving, although comparisons of DEQ values with EPA estimates of water quality show several instances of disagreement about status and trends, especially for stream temperature and dissolved oxygen. Many of the streams and rivers in the Portland area are considered to be water quality limited with respect to temperature and dissolved oxygen.

Fanno Creek flows from the west hills into the Tualatic river. Today, some high quality natural areas exist but many stretches are highly degraded. Fanno Creek is on DEQ's 303d list due to high temperatures, coliform bacteria, dissolved oxygen and chlorophyll. Tryon Creek, flows through both the Portland and Lake Oswego urban service boundaries. It is one of the few remaining free flowing streams in the Portland metro area, but still carries silty soils and is modified by urbanization.

Johnson Creek originates in the hills near Cotrell and flows about 25 miles to its confluence with the Willamette River. It is also on DEQ's 303d list due to high summer temperatures and fecal coliform bacteria found year round. For the Columbia Slough however, convergent trends indicate that nitrogen is getting worse. Johnson Creek and the Columbia Slough have the poorest water quality in the metropolitan region.

For the Clackamas River, EPA Basins data and DEQ averages converged on temperature as getting worse, but oxygen levels and nitrogen pollutants are good to excellent. Similarly, the Sandy River has generally good water quality and has the highest water quality index rating of streams in the metropolitan region. However, even the Sandy River has only fair temperature values at low flow.

Endangered Fish and Wildlife

The Sandy and Clackamas rivers and Johnson and Tryon creeks are among the many Portland watersheds affected by the National Marine Fisheries Service listing of lower Columbia steelhead as threatened under the Endangered Species Act. Lower Columbia River chinook salmon, chum salmon, upper Willamette River spring chinook salmon and upper Willamette steelhead are also listed as threatened under the ESA and affect the Portland metro area. Riparian corridors in the Portland Metro area have been degraded by the cumulative impacts of human activities such as building in riparian corridors and stream channelization.

Air quality

Air quality in Oregon's urban areas meets all currently mandated levels at the state and federal levels; but conventional air pollutants such as particulates and oxides of nitrogen and sulfur are typically only fair and hazardous air pollutants are an area of rising concern. Current air quality conditions for the six urban areas are determined using number of exceedences of the current EPA ambient air quality standards and represented in Table 3.10-2. The Portland metropolitan area has had ozone concentrations above allowable levels several times in 1996 and 1998; additional violations in 2000 would lead to mandatory enactment of contingency plans to reduce ozone formation. These plans include tightening of controls on industrial emissions, and reducing vehicle emissions and area sources.

While air quality concerns have been reduced, Portland air quality remains at risk. Per capita vehicle usage is the highest in the state (over 4,000 miles per person per year), a figure that is likely to increase with expansion of the urban area and growth of the urban population. Portland has the highest risk factor in the state for hazardous air pollutants. Regional transportation plans focusing on increased public transportation, employee trip reduction, and enhanced vehicle testing may aid in mitigating these impacts, although hazardous pollutants are more likely to be related to industrial and commercial sources rather than mobile (truck and automobile) sources.

Soil and groundwater contamination

Contamination risks for soil and groundwater are highest in the Portland area. Over 1,000 petroleum storage tanks with past or current problems exist in the metropolitan area, and nearly one-third of the state's inventory of hazardous sites is found here. Nearly 50 sites potentially affect soil and groundwater, although the Portland area is also the center of much of remediation and clean-up activities.

What data were used and how reliable were they?

Water Quality

In assessing water quality for the six urban areas, we looked for reports of similar status and trends using different datasets: Oregon Department of Environmental Quality (DEQ) Water Quality Index data (WQI) during low flow, DEQ raw data and averages during low flow, and Environmental Protection Agency Basins data (Basins) during low flow. Four common indicators were used: phosphorous (P), temperature, nitrogen (N), and dissolved oxygen (DO). When datasets showed similar status and trends, we considered this "convergence" of reports. When there was a lack of similarity in reported data, we reported this "divergence." Most, but not all, of the datasets show similar status and trends for water quality in the six urban areas.

Oregon Department of Environmental Quality Water Quality Index (WQI). DEQ uses an index to determine water quality. This index integrates various types of data to develop a single number which reflects the overall status of general water quality per river. DEQ uses this index because raw water quality data can be misleading and confusing.

The overall water quality index is based on seven variables (sub-indices), phosphorous, dissolved oxygen, fecal coliforrn, biochemical oxygen demand, dissolved total solids, pH and nitrogen levels. These stream water-quality indicators are used by DEQ to ensure the integrity of aquatic ecosystems and organisms. The use of certain target levels indicate concentrations above or below which fish or other organisms cannot survive. In order to assess current conditions, trends and future projections, quality ratings were assigned and based on the following scale: 0-59 very poor, 60-79 poor, 80-84 fair, 85-89 good, 90-100 excellent (DEQ, 1999).

Environmental Protection Agency (EPA) Basins data (Basins). The EPA compiles information regarding the distribution of conventional toxic pollutants, physical habitat, and conventional constituents in stream waters to evaluate water quality. Basins is a compilation of many datasets which contains average values and standard deviations for specified dates.

Air Quality

Four different datasets were used to evaluate air quality: ODEQ air quality data and averages, Environmental Protection Agency (EPA) Airs data, ODEQ Air Pollution Index (API), and EPA Hazardous Air Pollutants. Each data set was gathered, the units were converted where necessary, and then summarized by pollutant and year. Depending on EPA allowable emissions limits for each pollutant and the number of times that ambient air quality standards were exceeded, urban areas were ranked across cities And within data set, then within criteria pollutant, and finally across the agencies.

ODEQ Air Quality Data and Averages. DEQ's air quality surveillance network collects data throughout the state for a number of pollutants and meteorological parameters. The Department uses air sampling methods to judge attainment with air quality standards. Air quality data summaries for particulate and gaseous pollutants are tabulated to indicate the annual statistical summary as well as the number of days the pollutant level exceeded the value established as the ambient air quality standard. Raw data and their averages for various criterial pollutants for nine years (1988-1997) are used as a dataset in this assessment.

ODEQ Air Pollution Index (API). ODEQ uses an air pollution index (API) to integrate carbon monoxide, particulate matter, ozone, nitrogen oxides, sulfur dioxide, lead, and particulates into a single value reflecting overall status of general air quality. Computer and reported twice a day, the API values are then ranked as good (0-50) days), moderate (51-150 days), unhealthy (151-420 days), hazardous (421-600 days), or very hazardous (601 days and beyond) (IDEQ, 1999).

EPA Airs Data. EPA's Aeormatic Information Retrieval System reports data either as the estimated annual emission of air pollutants with compliance information as an annual summary of air pollution measurements at individual monitoring stations. Both information systems are updated monthly and include the years 1980-1990. EPA reports emissions for VOCs and other pollutants within the six urban areas.

EPA Hazardous Air Pollutants. The EPA Hazardous Air Pollutants (HAP) database includes 189 chemicals that are not regulated in Oregon unless an industry is determined to be a large quantity polluter (producing more than 100 tons/year or 25 tons/year of a HAP). The air pollutants chosen are included for their association with cancer, neurological, respiratory, reproductive and developmental or adverse effects on human health. HAPs detected at concentrations that warrant public health concern are assigned estimated cancer risk values (the estimated individual risk of getting cancer due to a lifetime exposure to outdoor hazardous air pollutants) (EPA, 1999). Very little monitoring for HAP's takes place in the U.S., much less than for the criteria pollutants listed through DEQ. However, new estimates by EPA, using emissions data from 1990 and extensive modeling, show the concentration of HAPs by census track and county in the continental U.S.

Data are incomplete or missing for all six urban areas, greatly restricting the comprehensiveness of any evaluation.

Soil and Groundwater Contamination

Three sources of data were used to determine this measure of ecological health: ODEQ Underground Storage Tank List (UST) (DEQ, 1999a), the Environmental Cleanup Site Information System (ECSI) (DEQ, 1999b), and Oregon's Inventory of Hazardous Substances Sites (IHSS) (DEQ, 1999c).

The ODEQ Underground Storage Tank List (UST). The UST is part of the Department's Waste Management and Cleanup Division. The UST program handles issues related to regulated tank registration and compliance, and cleanup of releases of leaking petroleum USTs including releases from home heating oil tanks.

Environmental Cleanup Site Information System (ECSI). The ECSI is a DEQ-maintained electronic database containing information on sites with suspected or known releases of hazardous substances.

Oregon's Inventory of Hazardous Substances Sites (IHSS). Oregon's Inventory of Hazardous Substances Sites (IHSS) is a subset of the ECSI and lists sites of known hazardous substances. To be added to the listing, a site must have had a release of a hazardous substance that is confirmed by meeting both of the following two criteria: 1) the release has been documented by qualified observation, report, or laboratory data; and 2) the release is not excluded from listing by virtue of being insignificant in quantity or hazard, regulated by another program, having been adequately cleaned up or otherwise requiring no further action. Indicators used in the datasets for this report are: a) petroleum storage tanks with leakage potentially-harmful substances storage sites hazardous chemical sites inventory; b) Hazardous sites within each city are organized in four categories based on status of cleanup (Phase 1, 11, HI, or IV) (See SOER Appendix for definitions: www.econ.state.or.us/opb), and specific program in which the site is active (VCS, SRS, or SAS) (See Appendix for definitions).

Phase IV is considered the most progressive of the four phases. A VCS program indicates that responsible parties have entered into an agreement with DEQ to voluntarily address contamination associated with their property under the oversight of the DEQ Voluntary Cleanup Program. All three datasets are complete for all six urban areas.

Data needs

Water Quality

Water quality data sets are among the most complete and available for evaluating urban ecosystems. Nevertheless, high variability in the number of sampling stations employed as well as a relatively small number of common indicators restrict the strength of any evaluation of water quality.

Ranking water quality by the analysis found within a column of water may or may not be adequate to determine biological health or the overall health of an aquatic ecosystem. For example, sediment constituents may or may not be found within the water column. Additionally, the Oregon Water Quality Index is designed to permit spatial comparison of water quality among different reaches of rivers or between different watersheds. This is accomplished in part because pH and total solids function within the index to remove the effects of geological variability. Ultimately however, this aggregate value affects the relative variability of water quality in water.

A better understanding of water quality health relies primarily on improved data; current limitations of sampling and data aggregation fail to adequately recognize linkages between water quality and other environmental factors. Examining the sediment, instream, or bank qualities as well as the water may be a more comprehensive part of an effective assessment.

Air Quality

The most pressing issue is the lack of complete datasets. Second, Federal pollution guidelines must take into account local issues and mitigating factors (see case study in Appendix). Hydrocarbons are currently measured only as a point source pollutant; more monitoring stations and data collecting of area emissions are required.

A more complete measure of air quality health within urban regions may require an urban airshed model; showing locations where air pollutants may be a problem due to air movement and highlighting areas for additional monitoring. In addition, NO and VOCs should be more frequently monitored.

Soil and Groundwater Contamination

Better assessment of the dangers posed by soil and groundwater contamination will provide a more accurate reflection of their role in the urban ecosystem. An increase in the number and type of monitoring devices will also provide a more comprehensive picture of both soil and groundwater health.

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Water Quality

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