



Population, Employment, and Housing

This chapter describes historical and current population, employment and housing characteristics in the central Puget Sound region. It then describes how these characteristics could potentially be impacted under each of the growth distribution alternatives.

5.1.1 Affected Environment

A. PHYSICAL SETTING

The region's urbanized area has developed along a (primarily) north-south axis formed by the Interstate 5, Interstate 405 and Interstate 90 highway corridors. Major population and employment centers are located in the region's historic port cities of Seattle, Tacoma, Everett, and Bremerton on the edges of the Puget Sound and in Bellevue on the east side of Lake Washington along Interstate 405.

B. CURRENT TRENDS

The central Puget Sound region continues to be one of the faster growing metropolitan areas in the U.S. This section provides an overview of its historical and forecast trends in population, employment, and housing to establish a context for exploring the potential growth impacts among the four alternatives.

The 2040 forecasts presented in Figures 5-1-1, 5-1-3, and 5-1-4 on the subsequent pages represent the current modeled¹ estimates of the projected 40-year growth in the region's population, employment, and housing stock. These should not be confused with the 2040 distributions of regional population and employment under the four alternatives discussed in *Chapter 4 – Definition of Alternatives*.

Population

The Region's Population Today. The region was home to a population of almost 3.4 million residents in 2003 and is forecast to continue to grow as people move here in pursuit of job opportunities and to enjoy the remarkable quality of life offered by the central Puget Sound area. The region has a relatively young and very well-educated labor force in comparison to the nation.

Increased in-migration from other parts of the country and the world has enriched the region's communities with a growing diversity of cultures, languages, and knowledge.

¹ The data presented in this section has been drawn from the Regional Council's 2005 Puget Sound Economic Forecaster (PSEF) model database of historical data inputs and forecast results. The PSEF is an econometric time series regional forecasting model that is driven primarily by national projections of economic growth and performance, the past performance of the region's economy relative to the nation's, and historical economic and demographic trend data for the region.



While the region's population is wealthier on average than the nation, and average wages and incomes made significant gains relative to inflation during the 1990s, poverty levels in the region have not changed appreciably since a decade ago. Many lower- and middle-income households today struggle to meet the rising costs of living, particularly for items like housing, health care, and childcare (Comprehensive Economic Development Strategy [CEDS], 2004).

Population Trends

FIGURE 5-1-1: HISTORICAL AND FORECAST REGIONAL POPULATION, CENTRAL PUGET SOUND REGION

	Actual				Forecast				
	1970	1980	1990	2000	2010	2020	2030	2040	
Pop.	1,937,000	2,254,000	2,771,000	3,285,000	3,696,000	4,149,000	4,545,000	4,988,000	
		1970-1980	1980-1990	1990-2000	2000-2010	2010-2020	2020-2030	2030-2040	2000-2040
Change		318,000	516,000	514,000	411,000	453,000	396,000	444,000	1,704,000

Note: Table reports population for July 1, as opposed to decennial census counts of population, which are for April 1; the 2000 estimates in this table are therefore slightly higher than the 2000 Census estimates used in the INDEX model's base year database.

Source: Puget Sound Regional Council, 2005 Puget Sound Economic Forecaster (PSEF) Model

Recent Historical Trends (1970-2000). The central Puget Sound region experienced substantial growth over the last three decades, increasing by over 1.3 million persons between 1970 and 2000. During this period, the region grew at an average annual rate of 1.8 percent, compared to 1.1 percent for the nation overall. The region grew at a particularly rapid pace during the 1980s, adding over half a million people at an average annual rate of 2.1 percent.

Historically, King County has, and continues to be, the central Puget Sound region's most populous county, with more than half (53 percent) of the region's total population in 2000. Pierce County is the next most populous county, with 21 percent of the region's population, closely followed by Snohomish County with 19 percent. Kitsap County is the region's smallest county, with 7 percent of the total population.

While King County received the largest share of the region's population growth over the last three decades, the region's other three counties grew at significantly faster rates, as growth pressures pushed suburban development farther out from the historic metropolitan cores. The populations of Snohomish and Kitsap counties more than doubled from 1970 to 2000, with both growing by 128 percent, at an average rate of 2.8 percent per year. Pierce County grew by 71 percent, at a rate of 1.8 percent per year. By comparison, King County grew by 50 percent, at a rate of 1.4 percent per year.

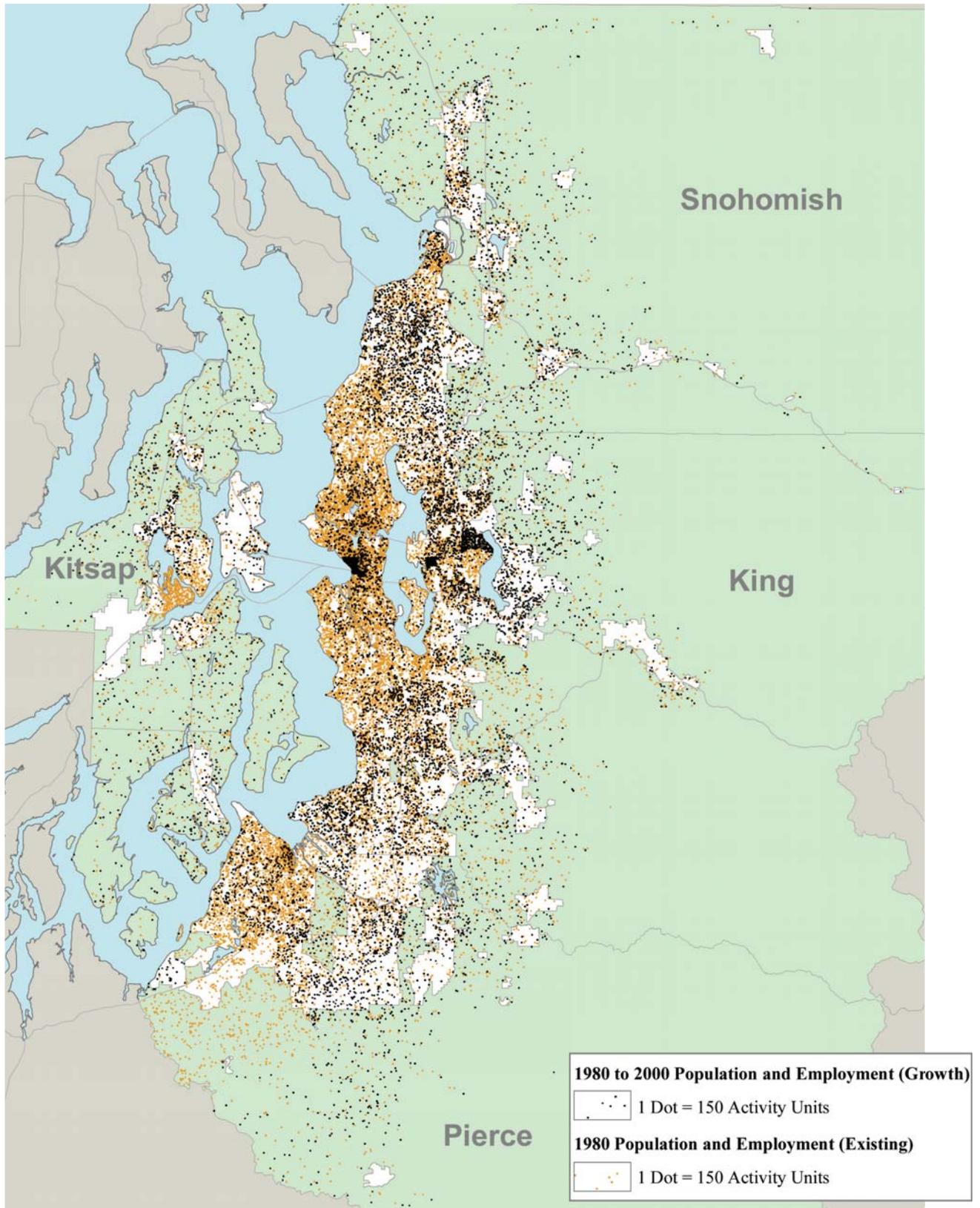
The last 30 years also witnessed some major demographic shifts that substantially affected the average number of persons living per household, both nationally and locally. Average household size declined significantly from the 1970s to the 1980s. The region's average household size dropped from 2.96 persons in 1970, to 2.58 in 1980, and 2.50 in 1990. As household size has declined, the number of single-person households has been increasing in the region. Within King County, for example, 2000 Census data indicates that single-person households increased by 21 percent between 1990 and 2000.

These trends stabilized during the 1990s, with regional household size dropping very slightly to 2.49 in 2000. This was due, in part, to the rise in minority and immigrant populations that tend to have higher-than-average family sizes. Average household size can vary considerably from place to place. Among the region's cities, average household size in 2000 ranged from a low of 2.08 in Seattle to a high of 3.13 in Covington.

Forecasts (2000-2040). The region is forecast to grow by an additional 1.7 million persons between 2000 and 2040, increasing 52 percent to reach a population of nearly 5 million by 2040. King County is expected to receive the largest share of the forecast growth, but, consistent with trends over the last 30 years, an increasing share of the growth could likely be absorbed by the region's other counties, with Snohomish County showing the fastest overall growth rate.

Average household size is expected to continue declining, albeit at a much slower pace, due to downward pressure from an aging population, combined with some upward pressure from growing minority populations and the continued arrival of new immigrant households. The regional average household size is forecast at 2.22 persons in 2040. Smaller household size means that more housing units might be needed to accommodate the forecast growth in population relative to historic growth.

FIGURE 5-1-2: SPATIAL DISTRIBUTION OF 1980 POPULATION AND 1980 TO 2000 POPULATION INCREASE



Note: See note accompanying Figure 5-1-6, which explains the term "activity units."
 Source: Puget Sound Regional Council, 2005



Another significant demographic shift that is anticipated to occur over the next 40 years is the aging of the baby boomer population. The population age 65 and older, which represented 10 percent of the region's population in 2000, is expected to grow by nearly 150 percent over the next 40 years to constitute 17 percent of total population by 2040. The forthcoming expansion of the senior population is expected to place new and unique demands on the region's services and socio-economic infrastructure. The workforce population age 20-64, which represented 63 percent of the region's population in 2000, is forecast to drop to 58 percent of total population by 2040. The population under age 20 is also forecast to show a proportional decline. In the past two decades, efforts to contain growth have had some success, as can be seen in Figure 5-1-2. While some level of growth has occurred throughout the region, a significant amount of the development occurred inside what is now designated as the region's Urban Growth Area.

Employment

The Region's Economy Today. Many of the region's traditionally strong employment sectors, such as forestry, fishing, agriculture, manufacturing, and aerospace, have declined in the past years. Forestry and fishing may decline further, while other new industries might emerge. Ongoing efforts to diversify the economic base have borne fruit, however, and have helped the region to better weather economic recessions.

Some new industries, such as biotechnology and life sciences, have grown particularly well in the past few years. New opportunities and markets have been opened with the rise of local companies gaining international prominence, such as Boeing, Microsoft, Amazon, Paccar, and Starbucks.

Each county has a different, albeit similar, set of leading businesses and employers.

- Kitsap County's major businesses and employers include: the Puget Sound Naval Shipyard, the Navel Base Kitsap; the school districts and Olympic College; private businesses such as Harrison Memorial Hospital, Johnson Controls World Services, TeleTech; and retail businesses such as Wal-Mart, Safeway, Albertsons, and Fred Meyer.
- King County's major business and employers include: the University of Washington; local governments such as Seattle, King County, and others; private sector businesses such as the Boeing Company, Microsoft, Washington Mutual, and Swedish Hospital. In addition, a number of Fortune 500 companies are located in King County, including Costco, Nordstrom, Paccar, Safeco, and Weyerhaeuser.
- Pierce County's major businesses and employers include: the U.S. Army Fort Lewis, McChord Air Force base; the school districts and colleges such as University of Puget Sound, University of Washington-Tacoma, and Pacific Lutheran University; local and state government offices; and private businesses such as Multicare, Franciscan Health Systems, and Good Samaritan Hospitals; retail establishments such as Fred Meyer and the Emerald Queen Casino, and manufacturing establishments such as Intel-DuPont, and Milgard.
- Snohomish County's major business and employers include: Boeing; Premera health systems and Providence medical centers; the Tulalip Tribe's casino and administrative offices; the Naval Station Everett; the local and state governments; and the school districts and community colleges.

The region is also home to a very strong and growing small- and medium-sized business sector. As of 2003, 82 percent of all establishments in the region had 10 or fewer employees (almost 14 percent of total covered employment), with over 16 percent of the remaining establishments falling into the 10 to 99 employees range (almost 35 percent of total covered employment). These percentages are almost exactly the same in each county (CEDS, 2004).

Employment Trends

FIGURE 5-1-3: HISTORICAL AND FORECAST REGIONAL EMPLOYMENT BY MAJOR SECTOR, CENTRAL PUGET SOUND REGION

TOTAL EMPLOYMENT	Actual					Forecast				
	1970	1980	1990	2000	% of Total	2010	2020	2030	2040	% of Total
Const & Resource	40,000	64,000	97,000	131,000	7%	157,000	198,000	234,000	280,000	9%
FIRE *	46,000	70,000	89,000	112,000	6%	127,000	143,000	152,000	156,000	5%
Manufacturing	146,000	194,000	236,000	218,000	11%	191,000	179,000	167,000	159,000	5%
Retail	82,000	111,000	161,000	202,000	11%	214,000	233,000	250,000	267,000	9%
Services	168,000	319,000	527,000	774,000	41%	920,000	1,151,000	1,388,000	1,644,000	53%
WTCU *	70,000	98,000	136,000	158,000	8%	164,000	180,000	193,000	205,000	7%
Govt & Educ	137,000	178,000	219,000	262,000	14%	299,000	325,000	343,000	362,000	12%
Subtotal:	688,000	1,033,000	1,465,000	1,856,000	-	2,072,000	2,409,000	2,726,000	3,072,000	-
Military	71,000	50,000	57,000	52,000	3%	54,000	54,000	54,000	54,000	2%
Total:	759,000	1,083,000	1,522,000	1,908,000		2,126,000	2,463,000	2,780,000	3,126,000	
CHANGE	1970-1980	1980-1990	1990-2000	2000-2010	2010-2020	2020-2030	2030-2040	2000-2040		
Const & Resource	24,000	33,000	33,000	26,000	41,000	36,000	46,000	149,000		
FIRE *	24,000	20,000	23,000	15,000	16,000	9,000	4,000	44,000		
Manufacturing	48,000	43,000	-19,000	-27,000	-12,000	-11,000	-9,000	-59,000		
Retail	28,000	51,000	41,000	11,000	20,000	17,000	17,000	65,000		
Services	152,000	208,000	247,000	146,000	231,000	237,000	257,000	870,000		
WTCU *	27,000	38,000	22,000	6,000	16,000	13,000	13,000	47,000		
Govt & Educ	41,000	41,000	44,000	37,000	26,000	18,000	19,000	100,000		
Subtotal:	345,000	432,000	391,000	215,000	337,000	317,000	347,000	1,216,000		
Military	-21,000	7,000	-5,000	3,000	0	0	0	3,000		
Total:	324,000	439,000	386,000	218,000	337,000	317,000	347,000	1,218,000		

Notes: * FIRE stands for "Finance, insurance, and real estate" sectors, and WTCU stands for "wholesale, transportation, communications and utilities" sectors. Table reports "Total Employment," which estimates all jobs, including those held by proprietors, self-employed persons, and active enlisted military personnel that are otherwise not included in the Bureau of Labor Statistics' estimates of covered employment and wage and salary employment. The 2000 estimates of total employment reported in this table differ slightly from those used in the INDEX model's base year database; this is due to a transition made from the former Standard Industrial Classification to the current North American Industrial Classification System, and the resulting change in the adjustment factors used to estimate total employment.

Source: Puget Sound Regional Council, 2005 Puget Sound Economic Forecaster (PSEF) Model

Recent Historical Trends (1970-2000). Total employment estimates for 1970 and 2000 reveal that the region's jobs base more than doubled over the last 30 years, rising from about 760,000 jobs to 1.9 million. The regional job growth rate for this period, for all employment, including military, which averaged 3.1 percent per year, is a full percentage point higher than that of the nation, which grew at 2.1 percent per year on average. A strong regional economy acts as a magnet for in-migration job seekers. As such, the growth in jobs was a major reason that the region experienced robust population growth during this period, at 1.8 percent per year compared to 1.1 percent for the nation.

Consistent with trends in the national economy, the central Puget Sound region made a structural shift away from its traditional manufacturing, industrial, and resources base toward a services base during the latter part of the 20th century. Historically the region relied heavily on its manufacturing sector, most notably on the aerospace industry, which is dominated by Boeing. Historical employment trends are characterized by dramatic fluctuations, brought on by upswings and downturns in manufacturing. While the aerospace industry continues to go through significant hiring and lay-off cycles, its impacts on the regional economy have become less severe. The growth and emergence of other industries resulted in the expansion and diversification of the economy, primarily in the services sector, leading to greater overall stability in the region.

Of the 1.15 million jobs added to the region from 1970 to 2000, more than half were added by firms classified under the services sector category. Correspondingly, the proportion of the region's jobs in services grew from 24 percent to 42 percent. The shift toward services mainly came at the expense of the manufacturing (-9 percent) and military (-6 percent) sectors. It is notable though, that while manufacturing declined in terms of its share of the region's total employment, the sector still added over 72,000 jobs in 30 years, despite a national trend of declining manufacturing jobs.



King County serves as the core of the region's jobs base, with 69 percent of total non-military employment, or seven out of every 10 of the region's jobs in 2000. Pierce County had 14 percent of the region's non-military employment, followed by Snohomish County with 13 percent, and Kitsap County with 4 percent. (Note: The employment shares for Kitsap and Pierce counties would increase with the inclusion of active enlisted military personnel.)

From 1970 to 2000, the region's growth in total non-military employment averaged 3.4 percent per year. King County's jobs base expanded at a rate in line with the regional average. Snohomish County recorded the highest growth rate at 3.9 percent per year, while Kitsap County posted slightly below the regional average at 3.2 percent, and Pierce County showed the lowest rate at 2.9 percent.

Most recently, the region, along with the nation, experienced a significant economic boom during the late 1990s that was uniquely characterized by the rise of technology industries and firms. "High tech"² industry sectors accounted for roughly one out of every five jobs created in the region from 1995 to 2001, with Seattle and east King County emerging as major centers of such activity. A series of economic shocks during 2000 and 2001, including the "dot-com bust," subsequent NASDAQ crash and stock market decline, as well as the September 2001 terrorist attacks, dealt a particularly severe blow to the central Puget Sound economy, sending the region into a recession that was deeper and longer than the nation's. The region has succeeded in the past few years in making its economic recovery, with current job growth rates now surpassing the national average.

Industry Clusters. In 2004-2005, the central Puget Sound region engaged in a process, called the Prosperity Partnership, to develop a Regional Economic Strategy. The Strategy, which was adopted in September 2005, is meant to guide economic development priorities and efforts, and serves as the functional economic plan for VISION 2020. The Strategy focuses on reinforcing six economic foundation areas that are key to the health of the region's economy: education, technology commercialization, new and small businesses, tax structure, transportation, and social capital and quality of life. It also focuses on supporting 15 identified regionally significant industry clusters, with five prioritized for the first phase of activities — aerospace, clean technology, information technology, life sciences, and international trade and logistics. The following table presents data on these clusters and the trends for each over the past decade.

Forecast data do not exist for the industry clusters. Over the past decade, these clusters have grown by 8 percent across the region, however, some counties have grown faster than this rates and others have actually declined. Of all the clusters, at the regional level and during this time period, the fastest growing cluster has been Electronic Shopping, and the clusters experiencing the greatest declines seem to be Sound Recording and Aerospace. Data suppression requirements, however, prevent further analysis at the county level.

Forecasts (2000-2040). Current forecasts of regional employment show the central Puget Sound region adding another 1.2 million jobs between 2000 and 2040, bringing the regional jobs base to over 3.1 million, an increase of 64 percent during the period, at an average rate of 1.2 percent per year. The projected rate of job growth is lower than what was recorded between 1970 and 2000, which is consistent with national economic and demographic trends. Causes for the slower growth likely could include increased foreign business competition and a proportional decrease in the available labor force due to the aging of the population and the leveling off of the number of women entering the workforce.

However, in terms of absolute job growth, the forecast shows between 300,000 and 350,000 jobs being added each decade, a figure comparable to the 324,000 jobs added during 1970-1980 and the 386,000 jobs added during 1990-2000. (Note: The current regional forecast recognizes the impacts of the economic recession that occurred in the early part of the 2000-2010 time frame, showing an increase of only 218,000 jobs during that span.)

The current forecast expects the services sector to play an even more prominent role in regional job growth in the future, compared to the last 30 years. The services sector is projected to produce more than 70 percent, or over 870,000, of the 1.2 million jobs that are forecasted to be added to the region over the next 40 years. By 2040, the forecast shows over one of every two jobs in the region belonging in the services sector. It is important to note that the Services sector includes a wide variety of industry types — each with differing land use impacts and characteristics — and includes information and communications technology businesses.

² The term "high-tech" encompasses those industries that directly advance technology. The Regional Council's definition of high-tech industries began with the definition developed by the U.S. Department of Labor. This definition compares the proportion of technology-oriented workers and relative amount of research and development expenditures for a given industry, to the average for all industries. The Regional Council further refined this definition to tailor it to the central Puget Sound economy as including aerospace (non-Boeing), biotechnology, chemicals and allied products, computer-related, electronic equipment, instruments and related products, software, and telecommunications. Although Boeing is clearly a high-tech firm, it is excluded from the Regional Council's definition to allow for analysis of the high-tech industry independent of Boeing-specific characteristics and trends.

Consistent with historical trends, there might be a continued reduction in the proportion of regional employment seen in the manufacturing sector, as the forecast shows a loss of nearly 60,000 manufacturing jobs from 2000 to 2040, lowering its share of regional employment to 5 percent.

FIGURE 5-1-4: EMPLOYMENT BY REGIONAL ECONOMIC STRATEGY INDUSTRY CLUSTER

Cluster	King			Kitsap			Pierce			Snohomish			Region Total		
	1995	2004	% Change	1995	2004	% Change	1995	2004	% Change	1995	2004	% Change	1995	2004	% Change
Aerospace	58,795	39,251	-33%	*	*	*	*	*	*	30,296	21,618	-29%	90,457	62,101	-31%
Boat Building	2,169	2,031	-6%	*	239	*	469	355	-24%	*	1,138	*	3,693	3,763	2%
Business Services															
Architectural & Engineering	10,043	12,804	27%	1,159	1,673	44%	1,098	1,227	12%	1,051	1,451	38%	13,351	17,155	28%
Marketing, Advertising & PR	4,123	5,170	25%	66	118	79%	239	222	-7%	148	358	142%	4,576	5,868	28%
Insurance	11,862	10,970	-8%	293	334	14%	1,142	1,991	74%	685	4,000	484%	13,982	17,295	24%
Clean Technology	1,352	1,570	16%	35	175	400%	98	234	139%	68	182	168%	1,553	2,161	39%
Electronic Shopping	*	3,104	*	0	*	*	*	*	*	*	25	*	547	3,426	526%
Information Technology	43,911	75,652	72%	1,096	2,095	91%	1,923	2,946	53%	4,533	4,169	-8%	51,463	84,862	65%
Life Sciences	12,481	14,423	16%	507	469	-7%	502	1,011	101%	2,885	4,786	66%	16,375	20,689	26%
Logistics & International Trade	32,182	30,843	-4%	330	233	-29%	5,169	6,594	28%	1,989	1,495	-25%	39,670	39,165	-1%
Long-Term Care	5,458	10,301	89%	664	1,389	109%	2,713	2,734	1%	1,293	1,984	53%	10,128	16,408	62%
Sound Recording	*	525	*	7	*	*	*	*	*	347	150	-57%	1,125	721	-36%
Specialty Food	11,870	8,577	-28%	30	29	-3%	696	1,057	52%	903	965	7%	13,499	10,628	-21%
Wood Products	4,422	2,753	-38%	328	229	-30%	3,852	4,211	9%	3,548	3,532	0%	12,150	10,725	-12%
Total	199,775	217,974	9%	4,612	7,011	52%	19,467	24,129	24%	48,715	45,853	-6%	272,569	294,967	8%

Note: Asterisks indicate data that is suppressed by the state Economic Security Department. Because of suppression, the figures may differ from the totals.

Housing

The Region's Housing Today. The economic boom of the late 1990s generated a significant rise in demand for housing across the region, particularly around its major employment centers. Housing demand, buoyed by in-migration, wealth creation, and decreasing mortgage loan rates, intersected with a tight housing supply to produce rapid increases in housing prices. From 1997 to 2003, average rents in the region's four counties rose between 20 to 33 percent, and median home resale prices increased between 36 to 55 percent. However, rent increases have slowed in recent years.

Historically low mortgage and refinancing rates helped to mitigate rising prices and resulted in expanded homeownership opportunities for many households. On the other hand, low- and medium-income renters and potential first-time home buyers whose salaries and wages have lagged behind the market have found it increasingly difficult to find affordable housing near their jobs.

Construction of affordable housing involves the use of many tools. Increasing the number of units built on existing lots, near employment centers and transit, could likely be important in order to meet the region's housing needs. Options like townhouses, apartment buildings, small lot single-family homes, as well as shared lot cottage- or cluster-housing developments, can offer affordable homeownership opportunities. Many local land use regulations also allow for accessory (mother-in-law) dwelling units. Transit-oriented development (TOD) provides housing in walkable neighborhoods near transit, which encourages residents to give up one or more motor vehicles, further reducing the cost of living. While many of these tools are currently being used in the region, little data exists to assess the extent to which these tools are being used and whether they are having an impact on generating housing units that are affordable.



Housing Trends

**FIGURE 5-1-5: HISTORICAL AND FORECAST
REGIONAL HOUSING STOCK BY STRUCTURE TYPE, CENTRAL PUGET SOUND REGION**

	Estimated				Forecast				
	1970	1980	1990	2000	2010	2020	2030	2040	
Housing Units	681,000	900,000	1,146,000	1,352,000	1,547,000	1,797,000	2,037,000	2,310,000	
% Single Family	77%	73%	70%	69%	68%	67%	65%	63%	
% Multifamily	23%	27%	30%	31%	32%	33%	35%	37%	
		1970-1980	1980-1990	1990-2000	2000-2010	2010-2020	2020-2030	2030-2040	2000-2040
Change		219,000	246,000	206,000	196,000	249,000	240,000	274,000	959,000
% Single Family		60%	57%	66%	62%	57%	52%	51%	55%
% Multifamily		40%	43%	34%	38%	43%	48%	49%	45%

Notes: Estimated from the 2005 PSEF Model historical database and forecast results of households by structure type and 1970-2000 decennial census estimates of vacancy rate by structure type.

Source: Puget Sound Regional Council, 2005 Puget Sound Economic Forecaster (PSEF) Model; U.S. Census Bureau.

Recent Historical Trends (1970-2000). In 2000, the region's housing stock was comprised of 1.35 million units, roughly 30 percent of which were multifamily housing (e.g., condominiums and apartments) and the other 70 percent of which were single-family housing (e.g., detached single-family homes, attached townhouse units, and mobile homes). In 1970, by comparison, the ratio of multifamily to single-family housing was substantially lower.

Over the last 30 years, a significant share of the new construction built to accommodate the region's growing population consisted of multifamily development, roughly four out of every 10 units built. In King County, the region's most heavily developed county, multifamily housing represented about half of all new construction during this period. This is in part because of market factors (i.e., demographic trends such as the increase in the number of senior citizens, the baby boom echo and their demands on starter homes, and trends to stay single longer and marry later — all of which have increased demand for smaller, more urban housing units) and also because of regulatory efforts to concentrate growth and curb sprawl. The adoption of Washington's Growth Management Act in 1990 and its policy direction to provide a diversity of housing types and opportunities affordable to all economic segments of the population, has further encouraged many local governments to adopt ordinances and regulations allowing for multifamily housing, mixed-use and infill development in more places. Various other innovative housing approaches that promote the efficient use of land, such as accessory dwelling units, small lot single-family housing, and cluster housing, are also being used.

In recent years, housing affordability has emerged as a growing issue of concern in many metropolitan areas across the U.S., particularly in the western states. A surge in demand for housing, spurred by population growth and wealth increases during the late 1990s, historically low mortgage rates, growing interest from first time home buyers, and an increase in real estate investment and some speculation, led to rapidly rising home prices in the central Puget Sound region and many other metropolitan areas. Average rents also increased rapidly in response to heightened demand during the late 1990s, although they have stabilized in recent years as a result of the 2001 recession.

For many, the increase in home prices and rents exceeded income gains, raising housing cost burdens, particularly for low-income households and first time homebuyers. Affordable housing initiatives by local governments are seen by many as being critical to meeting the housing needs of the region's low- and even moderate-income households.

Forecasts (2000-2040). Forecasts suggest that construction of nearly 1 million net new housing units might be needed between 2000 and 2040 to house the region's projected population increase of 1.7 million additional persons, an increase of 71 percent during this period. Given the expected decline in average household size, more housing units could be needed to accommodate future population growth, 1 unit per 1.77 additional persons, relative to the last 30 years, when 1 unit was built per 2.02 persons. It is expected that future housing construction is expected to be comprised by a greater share of multifamily housing than during the past.

Depending on where the region's 2000-2040 population growth actually occurs, as directed by both public policy and the development market, the ratio of multifamily to single-family new housing construction would likely vary. If development is directed to the region's more heavily built-out urban areas, higher land prices and the lack of vacant

developable land could likely result in more multifamily housing. In contrast, if development were directed to outlying areas, where more vacant developable land is available, more single-family housing could likely be constructed.

C. REGULATORY SETTING

The current statutory regulations guiding regional and local planning for population, employment, and housing growth are largely set forth in the Washington State Growth Management Act.

Under the Growth Management Act, all four counties in the central Puget Sound region are required to conduct long-range growth planning to accommodate 20-year forecasts of population growth, which are developed by the state Office of Financial Management. Each county has adopted population growth planning targets,³ which are then allocated among each county's jurisdictions through a collaborative process unique to each county. While the legal mandates of the Growth Management Act require jurisdictions to plan for a 20-year estimate of population growth, additional components to growth planning have been put into place through countywide planning policy provisions. The countywide planning policies for King and Snohomish counties, for example, have required their jurisdictions to also plan for employment growth.

Furthermore, in the central Puget Sound region, the Growth Management Act requires the adoption of multicounty planning policies. These are prepared and maintained by the Puget Sound Regional Council. The central Puget Sound's adopted multicounty planning policies are contained in VISION 2020, the region's long-range growth management, economic and transportation strategy.

Each city and county prepares its own comprehensive plan to accommodate growth projections under the Growth Management Act. When adopted, each plan is subject to review for consistency with the VISION at the regional, county and local level. Thus, the adoption of a preferred growth strategy is a critical overarching component of how the central Puget Sound region will accommodate expected population growth, both in the 20-year Growth Management Act and 35-year VISION 2020 planning horizons. Also, it could be through mechanisms such as each county's growth targets process that the VISION's preferred growth alternative is implemented.

5.1.2 Analysis of Alternatives (Long-Term Impacts)

This section describes and analyzes the macro-level impacts from population and employment growth that are likely to occur under each of the four alternatives. Several such impacts are described in broad terms in this section, and will be further expanded with more detail in subsequent chapters, particularly in *Chapters 5.2 – Land Use and 5.3 – Transportation*.

All four alternatives assume the same amount of regional growth in population and employment from 2000 to 2040 — 1.7 million additional persons and 1.2 million additional jobs. What differs between the alternatives is how this growth is allocated among the six regional geographies — metropolitan cities, core suburban cities, larger suburban cities, smaller suburban cities, unincorporated urban areas, and rural areas — among the region's four counties. For the purposes of this analysis, the alternatives all assume that the currently adopted urban growth area boundaries do not change.

A. IMPACTS COMMON TO ALL ALTERNATIVES

Land Use and Development Patterns

Under all four alternatives, each of the six regional geography categories and the region's four counties will need to accommodate some degree of additional growth and population and employment density. It is likely that growth directed to already built areas of the region, where there is less vacant developable land, could result in higher density residential, commercial and mixed-use development, as well as encourage infill and redevelopment activity. Population growth in these areas could be accommodated in large measure through the new construction and conversion of existing land uses to smaller lot single-family and various forms for multifamily housing. Conversely, growth directed to less developed areas of the region, where there is more vacant or easily redevelopable land, could more likely result in lower density single-family and commercial land use patterns. Growth in the region's rural areas could likely add development pressures on nearby agricultural and resource lands and open spaces. For additional detail, see *Chapter 5.2 – Land Use*.

³ For more information, see the *VISION 2020 Issue Paper on Growth Targets – Growth Management By the Numbers: Population, Household, and Employment Growth Targets in the Central Puget Sound Region*. July 2005. This paper is presented in *Appendix E* on the attached compact disk.



Housing

Housing figures are not part of the definition of alternatives. However, based on demographic trends that affect housing supply and demand, housing supply is discussed in qualitative terms. There are trade-off impacts to housing costs related to land use and development patterns. Under all alternatives, growth in population and economic activity could likely produce some added complexities to meeting housing demands. There is the potential for low-income households in affordable urban neighborhoods to be displaced by higher income households, unless adequate affordable housing opportunities are provided. The potential for such displacement to occur tends to rise during periods of rapid economic growth, when housing construction often lags behind the demand created by the influx of new workers and their families.

All else held constant, land and development costs are typically lower per multifamily unit than per single-family unit. However, land costs are generally higher in dense existing urban communities, and lower in outlying and less developed areas. In already built urban communities, the potential complexities associated with infill, redevelopment, and mixed-use projects are also an issue. The costs of building new or expanded infrastructure are higher in undeveloped areas, which also translate to potentially higher housing costs. Moreover, transportation costs for households in areas farther out are likely to be higher than those for households in existing urban communities where there is generally better access to transit and other services.⁴

B. ANALYSIS OF EACH ALTERNATIVE

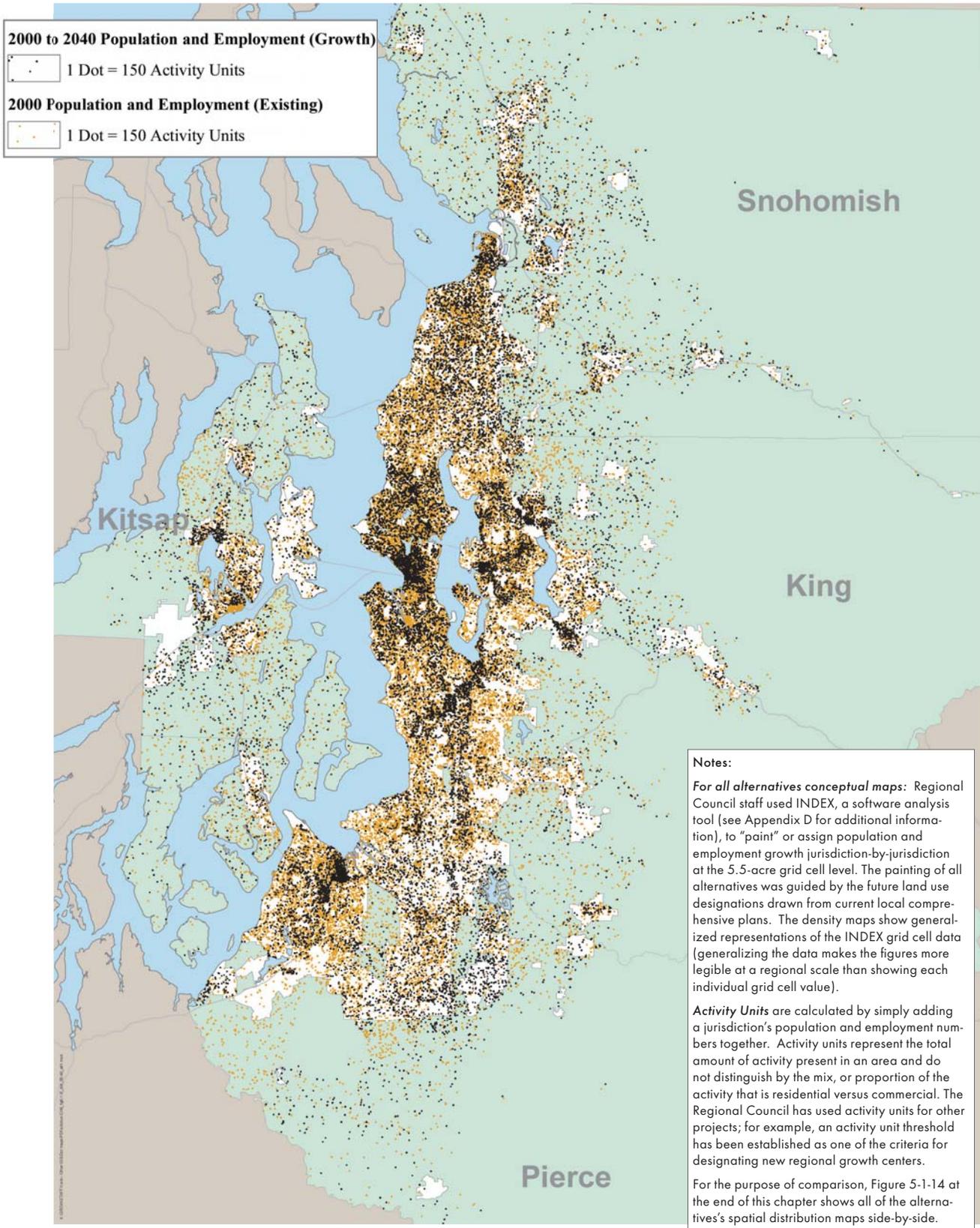
For each alternative, the impacts of growth in population and employment are assessed. The impacts of growth under the Growth Targets Extended Alternative are discussed relative to the base year 2000 distributions of population and employment, and the impacts of growth under the other three alternatives are analyzed and compared to the Growth Targets Extended Alternative.

GROWTH TARGETS EXTENDED ALTERNATIVE

The Growth Targets Extended Alternative assumes that current local comprehensive plans are extended beyond their current planning horizons of 2022 and 2025 to the year 2040. The following figure presents a conceptual map of the distribution of new growth under Growth Targets Extended.

⁴ For more information on development costs under different land use patterns, see the *VISION 2020 Issue Paper on the Costs of Sprawl*. This paper is presented in *Appendix E* on the attached compact disk.

**FIGURE 5-1-6: GROWTH TARGETS EXTENDED ALTERNATIVE CONCEPTUAL MAP:
SPATIAL DISTRIBUTION OF 2000 AND 2040 ACTIVITY UNITS**



Source: Puget Sound Regional Council



**FIGURE 5-1-7: GROWTH TARGETS EXTENDED ALTERNATIVE:
2000-2040 POPULATION AND EMPLOYMENT GROWTH ALLOCATIONS**

	Metro Cities	Core Suburban Cities	Larger Suburban Cities	Smaller Suburban Cities	Unincorp. Urban Areas	Rural Areas	TOTAL
King							
Population	264,000	201,000	81,000	50,000	70,000	38,000	704,000
Employment	385,000	281,000	53,000	24,000	18,000	5,000	766,000
Kitsap							
Population	23,000	12,000	13,000	11,000	51,000	44,000	154,000
Employment	19,000	10,000	6,000	7,000	4,000	22,000	68,000
Pierce							
Population	113,000	51,000	10,000	69,000	108,000	44,000	396,000
Employment	63,000	34,000	4,000	51,000	43,000	6,000	201,000
Snohomish							
Population	52,000	23,000	47,000	50,000	184,000	103,000	459,000
Employment	79,000	22,000	17,000	27,000	32,000	8,000	185,000
REGION							
Population	452,000	286,000	151,000	179,000	413,000	229,000	1,712,000
Employment	545,000	347,000	80,000	109,000	98,000	41,000	1,219,000

Note: Numbers may vary due to rounding.

Counties

Under Growth Targets Extended, the majority (59 percent) of the population growth goes to Kitsap, Pierce, and Snohomish counties, with King County receiving the remainder. However, the reverse is true of employment, with nearly two-thirds of the anticipated job growth (63 percent) going to King County, and the remaining one-third to the region's other counties. Kitsap County receives its largest share of population growth (9 percent) under this alternative. Snohomish County receives a relatively large share of population growth as well.

Regional Geographies

Under Growth Targets Extended, the population growth of 1.7 million additional persons from 2000 to 2040 is allocated across the six regional geographies in a relatively dispersed manner, with most growth being allocated to both the most urban places and the most non-urban places. Roughly a quarter of the population growth goes to the region's metropolitan cities, another quarter to the core and larger suburban cities, and the remaining half to smaller suburban cities, unincorporated urban areas, and rural areas. In contrast, the forecast employment growth of 1.2 million additional jobs occurs in a more highly concentrated pattern, with the bulk of the job growth (73 percent) going to the metropolitan and core suburban cities. The rural areas receive the most population growth (13 percent) in this alternative. The unincorporated urban areas also receive a significant share of the population growth.

- **Metropolitan Cities.** The metropolitan cities receive 26 percent of the forecast 2000-2040 population growth (452,000 persons) and 45 percent of the forecast employment growth (545,000 jobs).
- **Core Suburban Cities.** The core suburban cities receive 17 percent of the forecast population growth (286,000 persons) and 28 percent of the forecast employment growth (347,000 jobs).
- **Larger Suburban Cities.** The larger suburban cities receive 9 percent of the forecast population growth (151,000 persons) and 7 percent of the forecast employment growth (80,000 jobs).
- **Smaller Suburban Cities.** The smaller suburban cities receive 10 percent of the forecast population growth (179,000 persons) and 9 percent of the forecast employment growth (109,000 jobs).
- **Unincorporated Urban Growth Areas.** The unincorporated urban areas receive 24 percent of the forecast population growth (413,000 persons) and 8 percent of the forecast employment growth (98,000 jobs).
- **Rural Areas.** The rural areas also receive 13 percent of the forecast population growth (229,000 persons) and 3 percent of the forecast employment growth (41,000 jobs).

Impacts

Under Growth Targets Extended, concentrated employment growth in the metropolitan and core suburban cities could likely produce significant levels of higher density commercial development in these areas and focus new job growth into existing major employment centers that could be well served by transit, existing infrastructure, and services. At the same time, these facilities and infrastructure could be strained by the additional increment of growth, which could require additional maintenance, service, and investment. For more information, see *Chapter 5.7 – Public Services and Utilities*.

These cities are already planning for significant employment growth, however the extension to 2040 could mean that some jurisdictions might need to revisit their local comprehensive plans to ensure they are able to accommodate this additional increment.

Residential development patterns could be comparatively more dispersed, with a significant amount of higher density housing likely to be produced in the metropolitan cities, more modest amounts in core and larger suburban cities, a significant amount of lower density single-family housing construction in the outlying areas of the region, especially in unincorporated urban and rural areas, and small amounts of both housing types in the core and larger suburban cities. For each of these geographies, there could be a need for additional planning to accommodate this additional increment.

This alternative allocates the greatest share of population growth (and the second highest combined population and employment growth) to the region's rural areas, which could provide additional development opportunities in these areas. At the same time, additional development has the potential to impact rural character and lifestyle. Growth in the rural area has the potential to result in additional development pressure on nearby agricultural and resource lands and open spaces. For more information, see *Chapter 5.2 – Land Use*.

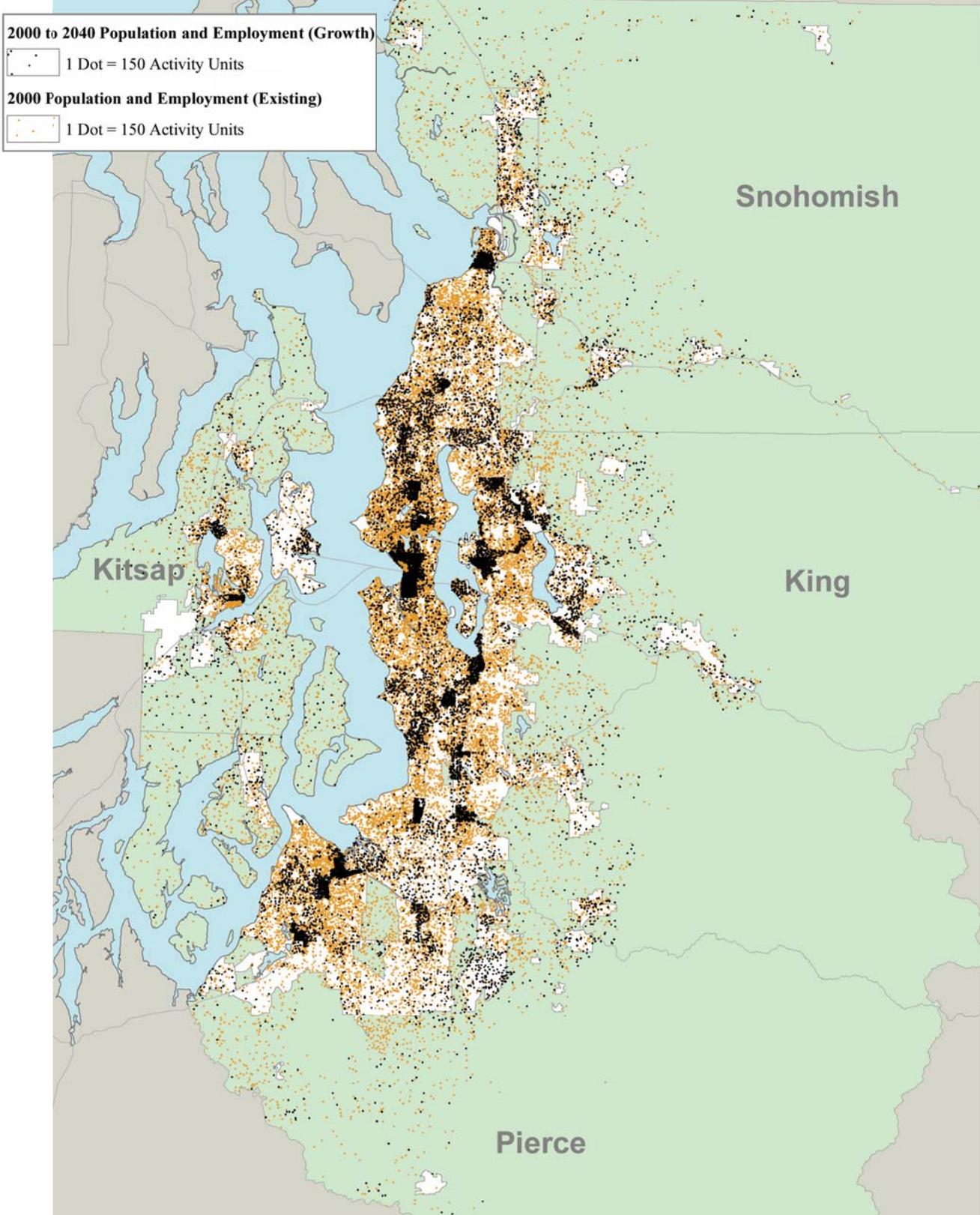
Growth Targets Extended reflects the greatest discrepancy between where future job growth and population growth are being directed, which is reflected in the larger increases in average distances between residences and work and other destinations. Of the four regional growth alternatives, the Growth Targets Extended Alternative produces the highest increases in vehicle miles traveled and average trip times. For more information, see *Chapter 5.3 – Transportation*.

METROPOLITAN CITIES ALTERNATIVE

The Metropolitan Cities Alternative represents the most concentrated growth pattern of the alternatives. The following figure presents a conceptual map of the distribution of new growth under Metropolitan Cities.



**FIGURE 5-1-8: METROPOLITAN CITIES ALTERNATIVE CONCEPTUAL MAP:
SPATIAL DISTRIBUTION OF 2000 AND 2040 ACTIVITY UNITS**



Note: See note accompanying Figure 5-1-6 for an explanation of activity units.
Source: Puget Sound Regional Council, 2006

FIGURE 5-1-9: METROPOLITAN CITIES ALTERNATIVE: 2000-2040 POPULATION AND EMPLOYMENT GROWTH ALLOCATIONS

	Metro Cities	Core Suburban Cities	Larger Suburban Cities	Smaller Suburban Cities	Unincorp. Urban Areas	Rural Areas	TOTAL
King							
Population	443,000	311,000	138,000	60,000	24,000	21,000	996,000
Employment	406,000	300,000	77,000	14,000	14,000	14,000	824,000
Kitsap							
Population	29,000	13,000	18,000	9,000	8,000	17,000	94,000
Employment	18,000	7,000	7,000	5,000	5,000	20,000	62,000
Pierce							
Population	145,000	70,000	21,000	53,000	23,000	22,000	335,000
Employment	66,000	34,000	6,000	25,000	23,000	15,000	168,000
Snohomish							
Population	68,000	34,000	80,000	49,000	30,000	26,000	287,000
Employment	59,000	25,000	32,000	18,000	19,000	12,000	165,000
REGION							
Population	685,000	428,000	257,000	171,000	86,000	86,000	1,712,000
Employment	549,000	366,000	122,000	61,000	61,000	61,000	1,219,000

Note: Numbers may vary due to rounding.

Counties

The distribution of employment growth across the four counties is similar to Growth Targets Extended, with slightly more job growth (68 percent) going to King County. Under the Metropolitan Cities Alternative, King County also receives the largest share of regional population growth (58 percent). Both Kitsap and Snohomish counties receive their smallest shares of population and employment growth in this alternative.

Regional Geographies

In the Metropolitan Cities Alternative, the majority of the forecast 2000-2040 growth in population and employment (65 percent and 75 percent, respectively) is directed to the region's metropolitan and core suburban cities. The metropolitan cities receive their largest shares of population (40 percent) and employment (45 percent) growth under the Metropolitan Cities Alternative. The core suburban cities receive the greatest share of employment growth in equal amounts (30 percent) under both the Metropolitan Cities and the Larger Cities alternatives. The smaller suburban cities, unincorporated areas and rural areas receive much less, often the least amounts of, population and employment growth under this alternative.

- **Metropolitan Cities.** The metropolitan cities receive 40 percent of the forecast 2000-2040 population growth (685,000 persons) and 45 percent of the forecast employment growth (549,000 jobs), which is 233,000 more persons and 4,000 more jobs than under Growth Targets Extended.
- **Core Suburban Cities.** The core suburban cities receive 25 percent of the forecast population growth (428,000 persons) and 30 percent of the forecast employment growth (366,000 jobs), which is 142,000 more persons and 19,000 more jobs than under Growth Targets Extended.
- **Larger Suburban Cities.** The larger suburban cities receive 15 percent of the forecast population growth (257,000 persons) and 10 percent of the forecast employment growth (122,000 jobs), which is 105,000 more persons and 42,000 more jobs than under Growth Targets Extended.
- **Smaller Suburban Cities.** The smaller suburban cities receive 10 percent of the forecast population growth (171,000 persons) and 5 percent of the forecast employment growth (61,000 jobs), which is 8,000 fewer persons and 48,000 fewer jobs than under Growth Targets Extended.
- **Unincorporated Urban Growth Areas.** The unincorporated urban areas receive 5 percent of the forecast growth in population (86,000 persons) and employment (61,000 jobs), which is 328,000 fewer persons and 37,000 fewer jobs than under Growth Targets Extended.
- **Rural Areas.** The rural areas also receive 5 percent of the forecast growth in population (86,000 persons) and employment (61,000 jobs), which is 144,000 fewer persons and 20,000 more jobs than under Growth Targets Extended.



Impacts

Under the Metropolitan Cities Alternative, both employment growth and population growth are highly concentrated within the region's metropolitan and core suburban cities, and to a more moderate degree, in the larger suburban cities. By directing growth to already built urban areas where there is less vacant developable land, this development alternative could likely encourage the highest rates of infill and redevelopment activity. Similar to the Growth Targets Extended Alternative, under the Metropolitan Cities Alternative, metropolitan and core suburban cities could potentially need to revisit existing comprehensive plans, given the level of growth allocated to them.

The levels of growth and development allocated under this alternative could impact existing neighborhoods in metropolitan, core and larger suburban cities, as both more (and potentially larger) buildings are developed to accommodate this growth. The growth could also impact traffic congestion, service levels for all types of infrastructure, and could potentially require upgrades and retrofits to existing utilities. For more information, see *Chapter 5.7 – Public Services and Utilities*.

Focusing growth into urban areas (and to cities in general) could support the goal of directing future growth to the region's designated regional growth and manufacturing industrial centers to improve jobs and housing balances. Metropolitan cities, core suburban cities, and many of the larger suburban cities might likely see greater amounts of higher density commercial, mixed use, multifamily, and non-traditional single-family development than under Growth Targets Extended.

By channeling growth to the region's urban cores, the Metropolitan Cities Alternative allocates the least amount of population and employment growth to the region's unincorporated urban and rural areas of any of the alternatives. The amount of residential growth allocated for the period between 2000 and 2040 for unincorporated urban areas (86,000) and rural areas (86,000) are less than currently adopted Growth Targets for 2000-2022/2025 for these areas (267,000 and 127,000 respectively). Achieving the allocations under this alternative could potentially limit development opportunities in the region's unincorporated urban and rural areas and might necessitate planning actions to limit growth.

These actions could potentially impact the rural areas in a number of ways, ranging from potentially limiting job and development opportunities, to reducing the potential for conflicts between non-compatible uses. This alternative might provide the greatest potential for maintaining the *existing* character, lifestyle, and development patterns in these areas.

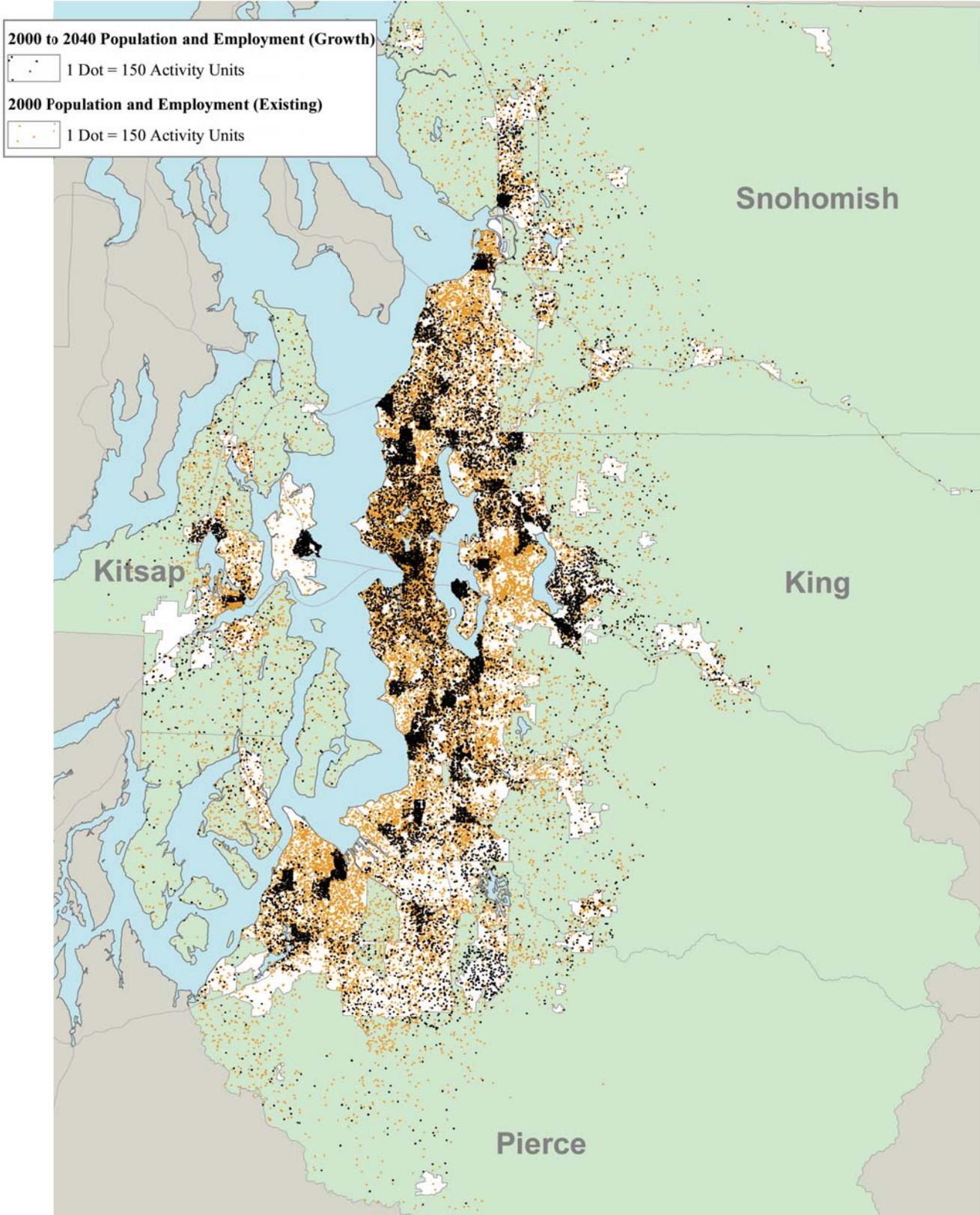
By limiting growth in close proximity to the region's agricultural and resource lands and open spaces, Metropolitan Cities Alternative has the potential to offer the most protection against development pressures on these lands. For more information, see *Chapter 5.2 – Land Use*.

The Metropolitan Cities Alternative allocates a closer ratio of population and employment to many of the regional geographies as compared to Growth Targets Extended. This closer ratio, and the higher levels of existing and planned transit services and facilities in the metropolitan and core suburban cities, produces the highest transit access to work and non-work destinations under the Metropolitan Cities Alternative. Transit ridership is highest in this alternative and single occupancy vehicle travel lowest. For more information, see *Chapter 5.3 – Transportation*.

LARGER CITIES ALTERNATIVE

The Larger Cities Alternative, like the Metropolitan Cities Alternative, assumes existing suburban cities in the region would accommodate the bulk of future population and employment growth. The following figure presents a conceptual map of the distribution of new growth under the Larger Cities Alternative.

**FIGURE 5-1-10: LARGER CITIES ALTERNATIVE CONCEPTUAL MAP:
SPATIAL DISTRIBUTION OF 2000 AND 2040 ACTIVITY UNITS**



Note: See note accompanying Figure 5-1-6 for an explanation of activity units.
 Source: Puget Sound Regional Council, 2006



FIGURE 5-1-11: LARGER CITIES ALTERNATIVE: 2000-2040 POPULATION AND EMPLOYMENT GROWTH ALLOCATIONS

	Metro Cities	Core Suburban Cities	Larger Suburban Cities	Smaller Suburban Cities	Unincorp. Urban Areas	Rural Areas	TOTAL
King							
Population	222,000	373,000	275,000	30,000	48,000	21,000	968,000
Employment	180,000	300,000	230,000	14,000	28,000	14,000	767,000
Kitsap							
Population	14,000	16,000	36,000	5,000	16,000	17,000	104,000
Employment	8,000	7,000	22,000	5,000	10,000	20,000	72,000
Pierce							
Population	73,000	84,000	43,000	26,000	47,000	22,000	295,000
Employment	29,000	34,000	18,000	25,000	45,000	15,000	166,000
Snohomish							
Population	34,000	41,000	160,000	24,000	61,000	26,000	346,000
Employment	26,000	25,000	96,000	18,000	38,000	12,000	215,000
REGION							
Population	342,000	514,000	514,000	86,000	171,000	86,000	1,712,000
Employment	244,000	366,000	366,000	61,000	122,000	61,000	1,219,000

Note: Numbers may vary due to rounding.

Counties

Like the Metropolitan Cities Alternative, the growth allocations under the Larger Cities Alternative focus the majority, albeit slightly less, of the forecast population (57 percent) and employment (63 percent) into King County. Pierce County receives its smallest share of population (17 percent) and employment (14 percent) growth in this alternative. Kitsap and Snohomish counties also receive relatively small shares of population and employment growth under the Larger Cities Alternative.

Regional Geographies

This alternative minimizes the amount of population and employment growth allocated to smaller suburban cities, unincorporated urban areas, and rural areas in a manner similar to the Metropolitan Cities Alternative. However, whereas the Metropolitan Cities Alternative focuses the bulk of the remaining growth into the metropolitan and core suburban cities, the Larger Cities Alternative shifts the balance of the region's forecast growth toward the larger suburban cities, with less going to the metropolitan cities. The core and larger suburban cities receive their largest shares of population and employment growth under this alternative.

- **Metropolitan Cities.** The metropolitan cities receive 20 percent of the forecast 2000-2040 growth in population (342,000 persons) and employment (244,000 jobs), which is 110,000 fewer persons and 301,000 fewer jobs than under Growth Targets Extended.
- **Core Suburban Cities.** The core suburban cities receive 30 percent of the forecast growth in population (514,000 persons) and employment (366,000 jobs), which is 227,000 more persons and 19,000 more jobs than under Growth Targets Extended.
- **Larger Suburban Cities.** The larger suburban cities also receive 30 percent of the forecast growth in population (514,000 persons) and employment (366,000 jobs), which is 362,000 more persons and 286,000 more jobs than under Growth Targets Extended.
- **Smaller Suburban Cities.** The smaller suburban cities receive 5 percent of the forecast growth in population (86,000 persons) and employment (61,000 jobs), which is 94,000 fewer persons and 48,000 fewer jobs than under Growth Targets Extended.
- **Unincorporated Urban Growth Areas.** The unincorporated urban areas receive 10 percent of the forecast growth in population (171,000 persons) and employment (122,000 jobs), which is 242,000 fewer persons and 24,000 more jobs than under Growth Targets Extended.
- **Rural Areas.** The rural areas receive 5 percent of the forecast growth in population (86,000 persons) and employment (61,000 jobs), which is 144,000 fewer persons and 20,000 more jobs than under Growth Targets Extended.

Impacts

By directing the majority of forecast growth to the region's core and larger suburban cities (in contrast to metropolitan and core cities under the Metropolitan Cities Alternative), the Larger Cities Alternative may result in relatively high density housing and commercial development throughout the four-county region (albeit at a slightly lower density relative to the Metropolitan Cities Alternative). Population and employment growth, while still relatively concentrated within the region's urban core, is more evenly distributed between major urban activity centers in the metropolitan and core suburban cities and smaller activity centers in the larger suburban cities.

Under this alternative, residential growth allocations to metropolitan cities would be somewhat higher between 2000 and 2040 (342,000) as compared to currently adopted Growth Targets for 2000-2022/2025 (248,000). For other regional geographies, it is the reverse. The amount of residential growth allocated for the period between 2000 and 2040 for smaller suburban cities (86,000) unincorporated urban areas (171,000) and rural areas (86,000) are all less than currently adopted Growth Targets for 2000-2022/2025 (117,000, 267,000 and 127,000 respectively). Achieving the allocations under this alternative could potentially limit development opportunities in these cities and areas and might necessitate planning actions to limit growth. The impacts to these areas from actions such as these would be similar to the impacts under the Metropolitan Cities Alternative.

For other regional geographies, particularly larger suburban cities and to a lesser extent core suburban cities, the growth is much higher than current Growth Targets. This could mean that some jurisdictions might need to revisit their local comprehensive plans to ensure they are able to accommodate this additional increment.

The region's larger suburban cities would accommodate significantly higher amounts of both population and employment growth in this alternative. Similar to the Metropolitan Cities Alternative, the levels of growth and development allocated under this alternative could impact existing neighborhoods in metropolitan cities (but to a lesser extent than under the Metropolitan Cities Alternative), core cities and larger suburban cities (but to a greater extent than under the Metropolitan Cities Alternative), as both more (and potentially larger) buildings are developed to accommodate this growth. The growth could also impact traffic congestion, service levels for all types of infrastructure, and could potentially require upgrades and retrofits to existing utilities. For more information, see *Chapter 5.7 – Public Services and Utilities*.

The Larger Cities Alternative results in relatively the same level of potential impacts and development pressures in these cities and rural, agricultural, and natural resource areas as in the Metropolitan Cities Alternative. The potential impacts on the rural area could take a number of forms, ranging from potentially limiting job and development opportunities to reducing the potential for conflicts between non-compatible uses. This alternative might provide the greatest potential for maintaining the *existing* character, lifestyle, and development patterns in these areas. For more information, see *Chapter 5.3 – Land Use*.

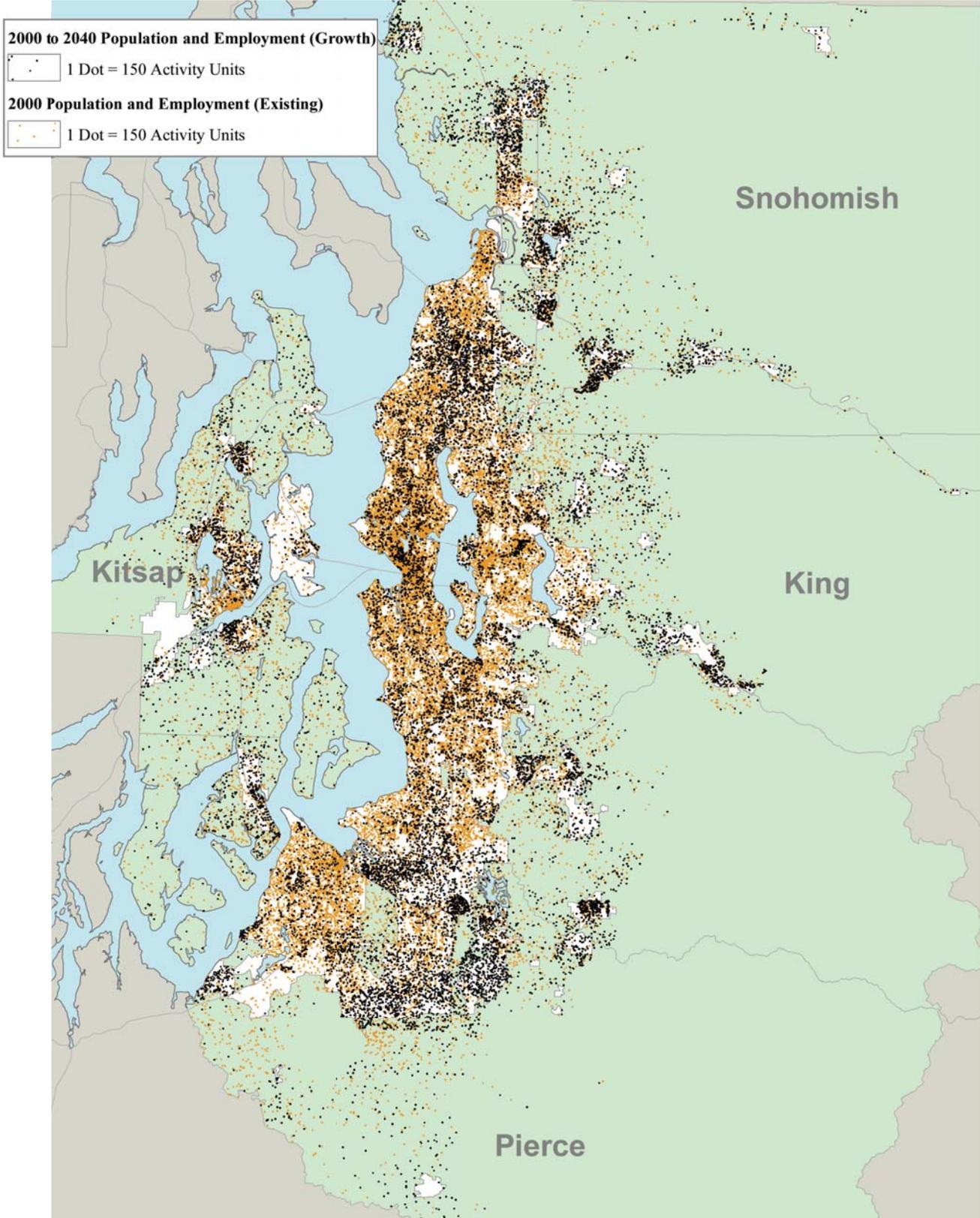
The slightly more dispersed, yet still urban, focus of growth under Larger Cities Alternative creates a situation where transit ridership is lower for work trips and higher for non-work trips than in Growth Targets Extended, reflecting likely improvements in jobs and housing balances in the region. For more information, see *Chapter 5.3 – Transportation*.

SMALLER CITIES ALTERNATIVE

The Smaller Cities Alternative represents the most dispersed growth pattern of the four alternatives. The following figure presents a conceptual map of the distribution of new growth under the Smaller Cities Alternative.



**FIGURE 5-1-12: SMALLER CITIES ALTERNATIVE CONCEPTUAL MAP:
SPATIAL DISTRIBUTION OF 2000 AND 2040 ACTIVITY UNITS**



Note: See note accompanying Figure 5-1-6 for an explanation of activity units.
 Source: Puget Sound Regional Council, 2006

FIGURE 5-1-13: SMALLER CITIES ALTERNATIVE: 2000-2040 POPULATION AND EMPLOYMENT GROWTH ALLOCATIONS

	Metro Cities	Core Suburban Cities	Larger Suburban Cities	Smaller Suburban Cities	Unincorp. Urban Areas	Rural Areas	TOTAL
King							
Population	111,000	124,000	46,000	181,000	166,000	41,000	669,000
Employment	90,000	100,000	38,000	84,000	99,000	27,000	439,000
Kitsap							
Population	7,000	5,000	6,000	28,000	57,000	34,000	138,000
Employment	4,000	2,000	4,000	28,000	36,000	41,000	115,000
Pierce							
Population	36,000	28,000	7,000	158,000	164,000	45,000	438,000
Employment	15,000	11,000	3,000	148,000	158,000	30,000	365,000
Snohomish							
Population	17,000	14,000	27,000	146,000	212,000	52,000	468,000
Employment	13,000	8,000	16,000	106,000	133,000	24,000	301,000
REGION							
Population	171,000	171,000	86,000	514,000	599,000	171,000	1,712,000
Employment	122,000	122,000	61,000	366,000	427,000	122,000	1,219,000

Note: Numbers may vary due to rounding.

Counties

The distribution of population growth across the four counties is similar to Growth Targets Extended, with slightly less population going to King and Kitsap counties, and slightly more to Pierce and Snohomish counties. Pierce and Snohomish counties receive their largest shares of population growth (26 and 27 percent, respectively) under the Smaller Cities Alternative, and King County its smallest share (39 percent).

Regional Geographies

In this alternative, the majority of the forecast 2000-2040 growth in population and employment (75 percent) is directed to the region's outlying areas comprised of smaller suburban cities, unincorporated urban areas, and rural areas. The smaller suburban cities and unincorporated urban areas receive, by far, their largest shares (30 and 35 percent, respectively) of population and employment growth under the Smaller Cities Alternative. The rural areas also receive their largest share of total growth, with the most employment growth (10 percent) and a relatively large share of population growth. Metropolitan, core suburban, and larger suburban cities receive the smallest amounts of population and employment growth under the Smaller Cities Alternative.

- **Metropolitan Cities.** The metropolitan cities receive 10 percent of the forecast 2000-2040 growth in population (171,000 persons) and employment (122,000 jobs), which is 281,000 fewer persons and 423,000 fewer jobs than under Growth Targets Extended.
- **Core Suburban Cities.** The core suburban cities also receive 10 percent of the forecast growth in population (171,000 persons) and employment (122,000 jobs), which is 115,000 fewer persons and 225,000 fewer jobs than under Growth Targets Extended.
- **Larger Suburban Cities.** The larger suburban cities receive 5 percent of the forecast growth in population (86,000 persons) and employment (61,000 jobs), which is 66,000 fewer persons and 19,000 fewer jobs than under Growth Targets Extended.
- **Smaller Suburban Cities.** The smaller suburban cities receive 30 percent of the forecast growth in population (514,000 persons) and employment (366,000 jobs), which is 334,000 more persons and 257,000 more jobs than under Growth Targets Extended.
- **Unincorporated Urban Growth Areas.** The unincorporated urban areas receive 35 percent of the forecast growth in population (599,000 persons) and employment (427,000 jobs), which is 186,000 more persons and 329,000 more jobs than under Growth Targets Extended.
- **Rural Areas.** The rural areas receive 10 percent of the forecast growth in population (171,000 persons) and employment (122,000 jobs), which is 58,000 fewer persons and 81,000 more jobs than under Growth Targets Extended.



Impacts

Of the four alternatives, the Smaller Cities Alternative directs the greatest amount of population and employment growth, in equal shares, to the region's smaller suburban cities, unincorporated urban areas, and rural areas. Compared to Growth Targets Extended, this alternative allocates significantly more employment growth to each of these outlying regional geographies, with more population growth assigned to the smaller suburban cities and unincorporated urban areas, and the second highest share population growth going to rural areas.

By directing the majority of population and employment growth to the region's outlying areas where there is considerably more vacant developable land, the Smaller Cities Alternative could likely produce the greatest amount of low-density single-family housing and commercial development at the farthest distances from the region's existing urban activity centers.

Under this alternative, residential growth allocations to metropolitan cities would be less between 2000 and 2040 (171,000) as compared to currently adopted Growth Targets for 2000-2022/2025 (248,000). For core suburban and larger suburban cities, and to a lesser extent for rural areas, the allocation under the Smaller Cities Alternative for the period between 2000 and 2040 are fairly similar to their currently adopted Growth Targets for 2000-2022/2025.

For other regional geographies, particularly smaller suburban cities and to a lesser extent the unincorporated urban areas, the growth is much higher than current Growth Targets. This could mean that some jurisdictions might need to revisit their local comprehensive plans to ensure they are able to accommodate this additional increment. Also, for these cities and areas, the levels of growth and development allocated under this alternative could impact existing neighborhoods as both more (and potentially larger) buildings are developed to accommodate this growth. The growth could also impact traffic congestion, service levels for all types of infrastructure, and could potentially require upgrades and retrofits to existing utilities.

Depending upon how the growth is accommodated, this alternative could likely generate the highest need for additional infrastructure and public services to support new growth in relatively undeveloped areas (See *Chapter 5.2 – Land Use* and *Chapter 5.9 – Public Services and Facilities* for more discussion of development patterns and infrastructure).

The distribution of identical population and employment numbers under the Smaller Cities Alternative, as compared to the Growth Targets Extended Alternative, results in better transportation system performance on a variety of regional-level indicators; examples include average trip distances, vehicle miles traveled, and total delay. On other indicators, the larger share of growth to metropolitan and cores suburban cities under the Growth Targets Extended Alternative results in better system performance; examples include transit access to work, and walk/bike mode shares. For more information, see *Chapter 5.3 – Transportation*.

Similar to Growth Targets Extended, agricultural and resource lands and open spaces in the rural areas could likely experience development pressure, due to higher levels of employment growth, and due to the significant increase in growth in the unincorporated urban areas (See *Chapter 5.2 – Land Use*).

5.1.3 Cumulative Effects

Depending on the alternative, cumulative impacts and significant unavoidable impacts may vary. Each alternative presents different approaches for managing population growth and directing the location of housing and employment opportunities in the region. Growth planning actions in cities and counties beyond the four-county region may not follow these patterns. These decisions could potentially impact the concentrations of employment or housing within the four-county region. Residential patterns may be more dispersed, with some development occurring in urban or urbanizing areas, and some development also occurring in rural areas. Growth could occur at varying rates throughout the region, and may not be as balanced as envisioned.

Other external factors could also affect population and employment levels in the region include both localized economic conditions as well as larger-scale economic trends. Some businesses could close or relocate in other areas, including outside of the area. This could include larger scale businesses or sectors that could have a regional impact. Downturns or rapid increases in the economy could also affect the rate of development and demand for housing, and the availability of jobs. The price of land and lending rates and other market factors could also affect the affordability and supply of housing.

5.1.4 Potential Mitigation Measures

Local governments may implement any number of strategies to help preserve and encourage the production of affordable housing options. Best Housing Practices also provide several techniques to promote effective housing policy and to direct growth to intended areas. These include:

- Planning Practices such as comprehensive planning, buildable lands analyses, performance monitoring, and fair share housing programs. These measures could provide for analysis and tracking of housing issues and needs. If implemented consistently, they may help coordinate tracking and review processes among local jurisdictions in the region.
- Design approaches such as design guidelines, small-lot development, zero lot line development, and reduced (maximum) setback requirements. Mixed use design approaches and planned unit developments also could be used to integrate housing and employment opportunities.
- Regulatory approaches such as zoning changes, minimum density ordinances, performance zoning, inclusionary zoning ordinances, and regulatory review and streamlining.
- Financial incentives such as fee exemptions, density bonuses, tax credits, and transfer of development rights programs. Housing tax levies, public land donations, and non-traditional homeownership opportunities also can provide incentives to facilitate development of planned housing and employment opportunities. Where transfer of development rights programs are used, jurisdictions should consider the use of public proceeds from TDR sales to supplement revenues devoted to affordable housing goals.

In addition to managing growth and directing development, Best Housing Practices can also assist in promoting affordable housing opportunities. Other potential measures that could be employed locally or regionally in support of affordable housing goals could include:

- Development of consistent definitions for “affordable” and “low-” and “moderate-income” thresholds among different regions. This could assist in monitoring affordable housing measures regionally.
- Adoption of affordable housing targets for local jurisdictions to guide the development, implementation and monitoring of affordable housing strategies and programs.
- Housing targets specific to identified regional growth centers could be established. PSRC funding for regional growth center projects also could be redirected to more strongly emphasize housing development within the regional centers.
- Regular review and updating of local land use regulations can help assure that these regulations are consistent with affordable housing goals. In particular, where density standards are too restrictive, land prices per housing unit may be high. Standards allowing for density increases can have a positive influence on housing affordability.

Other mitigations that relate to the economy might include:

- Measures to preserve adequate land at reasonable cost for land-intensive commercial industries, (e.g., manufacturing, wholesale). The measures noted above also could be used to direct growth and development away from lands that could be used for specific industries. Similar to affordable housing goals, these measures could be directed toward maintaining land prices and may influence the amount and availability of these lands for the intended industries.
- Measures to mitigate transportation impacts, in order to promote economic prosperity and quality of life. This will include a variety of options, ranging from increased investments in transportation infrastructure and services, to traffic calming approaches, and more.

5.1.5 Significant Unavoidable Adverse Impacts

The growth in population and employment could result in increased demand for the use of land for housing and businesses, which could preclude other uses for currently undeveloped land. New housing stock could be needed, and existing housing stock or businesses could be removed in lower density areas to provide for higher density redevelopment. Depending on where development is directed under the different alternatives, the types of housing and the nature of employment opportunities could change in some areas. And, providing housing affordable to all economic segments could be a challenge, although this might depend on the amount of mitigation implemented. Further, depending on the alternative, additional planning for growth will be required in some of the region’s jurisdictions.



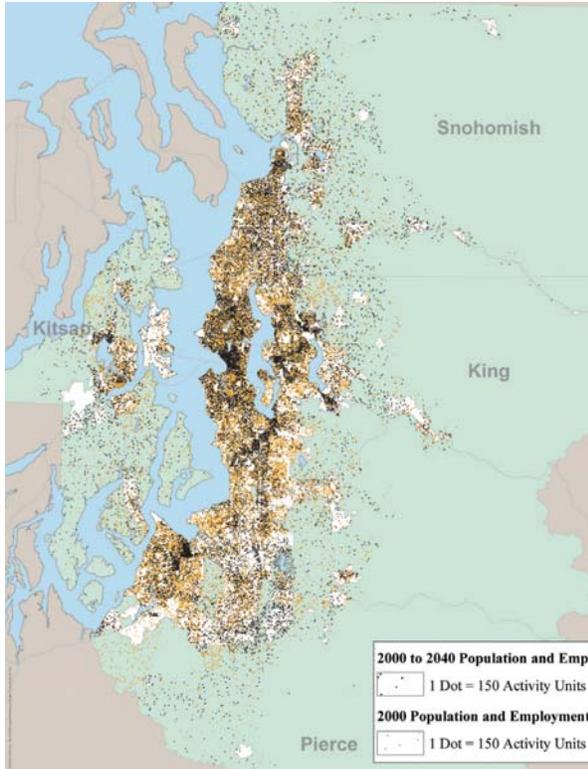
Supporting Figures

SIDE-BY-SIDE MAPS SHOWING SPATIAL DISTRIBUTION OF GROWTH

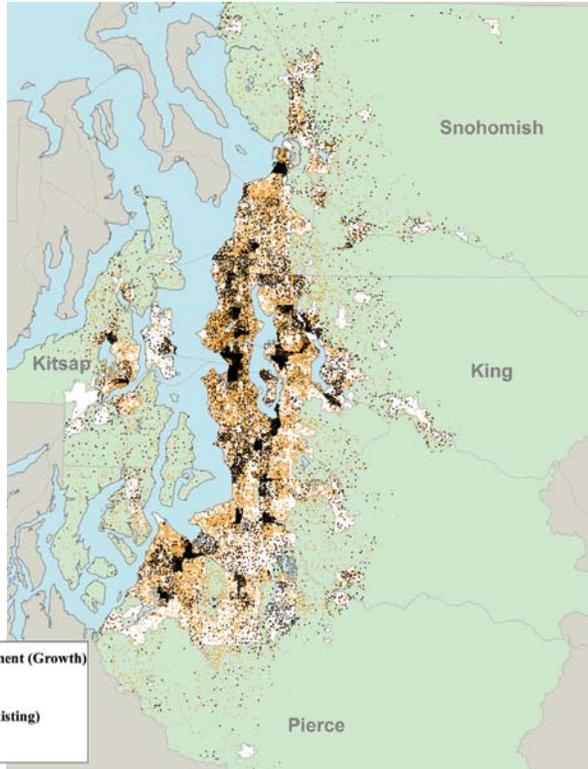
The following figure compares the distribution of population and employment as painted using INDEX.

FIGURE 5-1-14: SIDE-BY-SIDE COMPARISON OF ALTERNATIVE CONCEPTUAL MAPS: SPATIAL DISTRIBUTION OF 2000 AND 2040 ACTIVITY UNITS

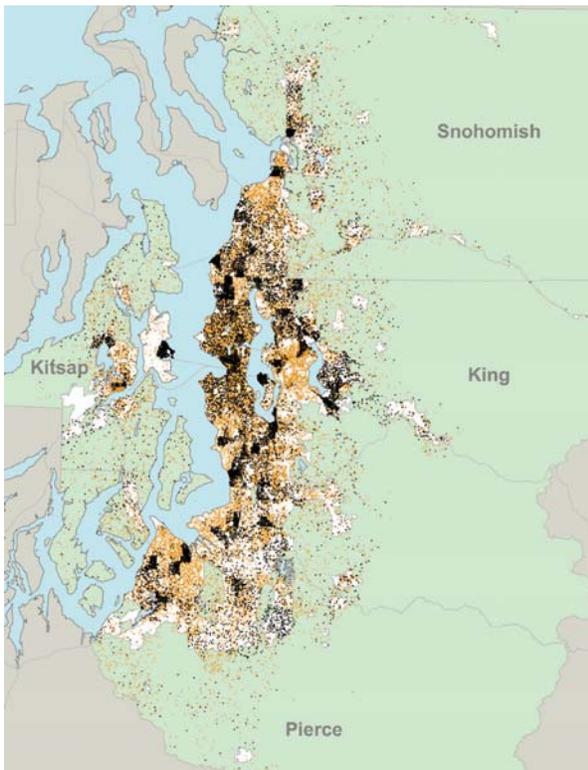
GROWTH TARGETS EXTENDED



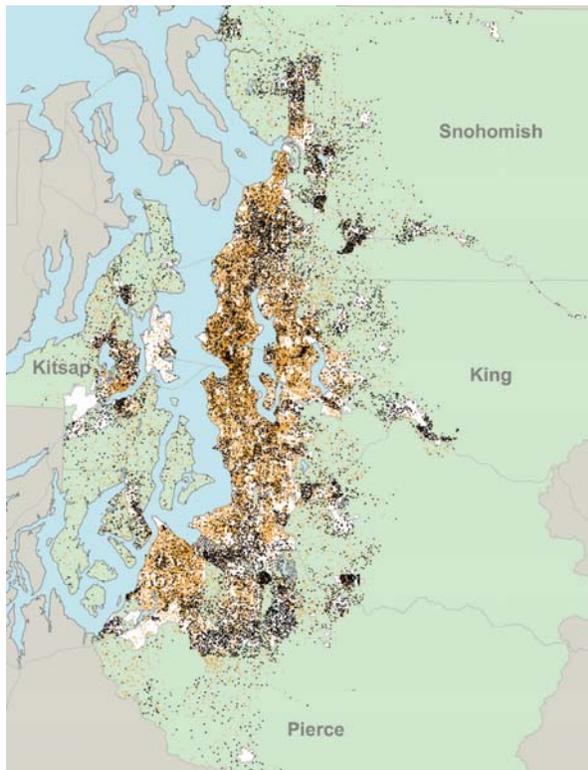
METROPOLITAN CITIES

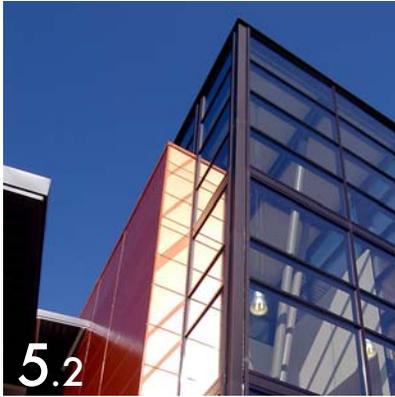


LARGER CITIES



SMALLER CITIES





Land Use

This chapter discusses existing and planned land use policies and development patterns, as well as the region's overall urban and rural form. It then discusses potential impacts to these policies and development patterns under each of the growth distribution alternatives.

5.2.1 Affected Environment

A. REGULATORY SETTING

Land use in the region is managed through comprehensive plans prepared for each jurisdiction and guided by the multicounty planning policies of VISION 2020 and the countywide planning policies adopted in accordance with the Growth Management Act. Land use management is accomplished through each jurisdiction's development regulations and capital investment programs. Generally, development outside the region's urban growth area is constrained by lower-density zoning and restrictions on the extension of utilities and services.

Passage of the Washington State Growth Management Act in 1990 and VISION 2020 in the late 1980s represented a landmark change for land use planning. The Growth Management Act required the adoption of land use plans at the regional, countywide, and local levels. The Growth Management Act and its mandated land use plans help shape and influence the pattern of future land use and development in the region.

The Growth Management Act establishes the underlying framework for local governments and state and regional agencies within the central Puget Sound region to coordinate their respective comprehensive plans and transportation planning efforts. King, Kitsap, Pierce, and Snohomish counties and their respective cities and towns have all developed and adopted countywide planning policies and comprehensive plans. These plans and countywide policies provide specific policy direction to the counties and their cities and towns for designating urban growth areas and preparing their individual comprehensive plans to accommodate population and employment growth. The county comprehensive plans also provide direction for managing growth in the unincorporated areas within the county.

Overall, the countywide planning policies include provisions for desired land use patterns that:

- Protect natural resource lands.
- Discourage development and the extension of urban services and/or infrastructure in rural areas.
- Promote growth and higher development densities in urban areas, particularly in regional growth centers and activity centers.
- Promote high-capacity transit to connect centers.

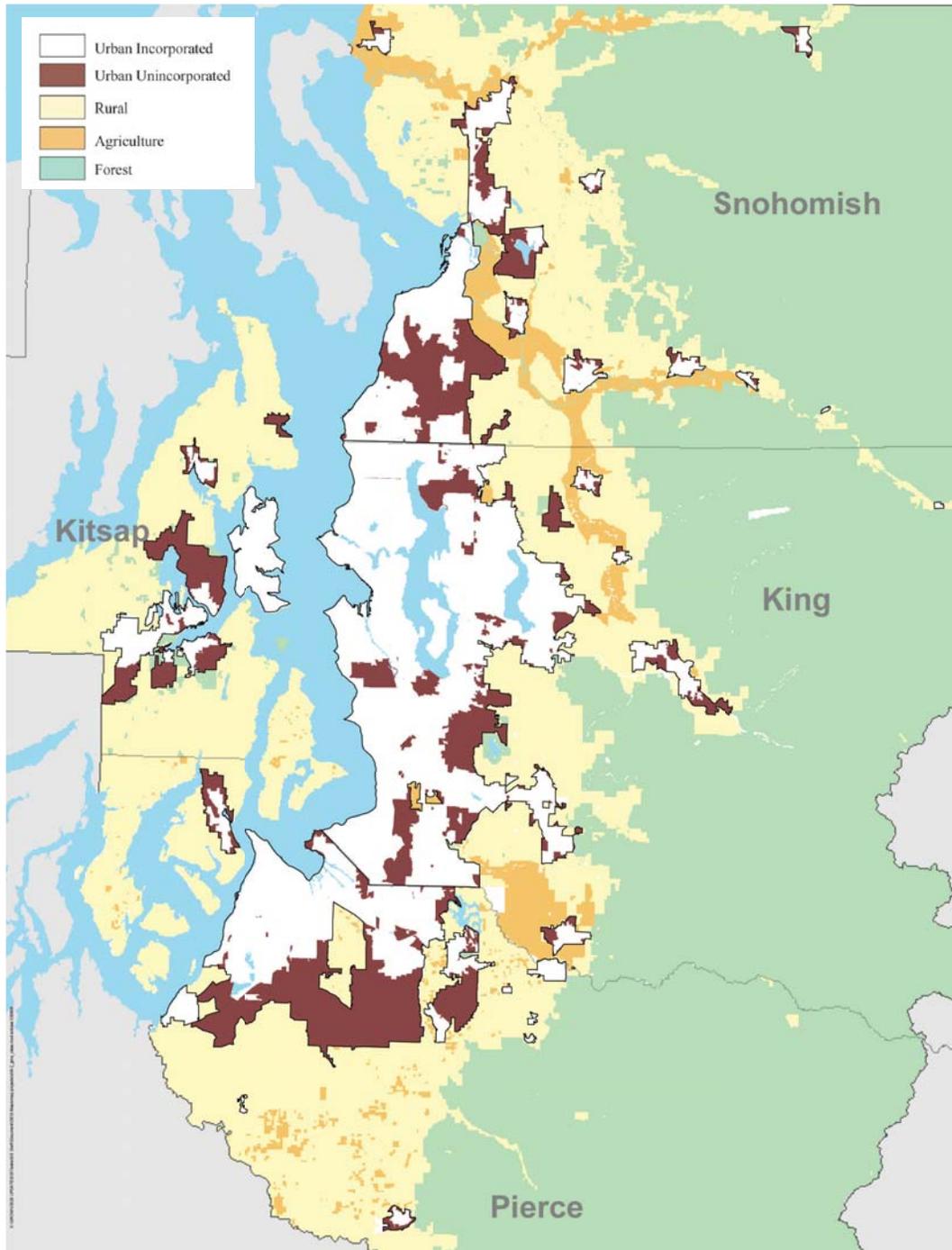


The Growth Management Act and Land Use

The Growth Management Act identifies three mutually exclusive landscapes: urban lands, rural lands and natural resource lands (e.g., agricultural, forest and open space, mineral and other). While the exclusive nature of these lands is important to recognize, the long-term sustainability of the resource and rural lands are also dependent on accommodating development demands within the urban growth area.

Within each of the three land use categories, there are different land use types. Figures 5-2-1 and 5-2-2 illustrate the land use categories and present the number of square miles within each of them

FIGURE 5-2-1: LAND USE CATEGORIES UNDER GMA



Source: Puget Sound Regional Council, 2006

**FIGURE 5-2-2: AMOUNT OF LAND IN GMA LAND USE CATEGORIES
– URBAN, RURAL, AND RESOURCE LAND AREAS IN SQUARE MILES**

Area Name	Total Land Area				Resource Land By Type		
	Total	Urban	Rural Non Resource	Resource	Agriculture	Forest and Open Space	Mineral and Other Resource
King	2,146	461	321	1,364	66	1,291	7
Kitsap	398	96	292	10	0	6	4
Pierce	1,682	256	516	910	26	884	0
Snohomish	2,100	179	398	1,523	98	1,425	0
Region	6,326	992	1,527	3,807	190	3,606	11

Source: Puget Sound Regional Council, 2005

- Urban Land.** Counties and cities are required to designate urban growth areas under Revised Code of Washington (RCW) 36.70A.110. These are designated areas where growth is intended to be concentrated as a means of controlling suburban sprawl. The presently adopted urban growth areas in King, Kitsap, Pierce and Snohomish counties and their respective cities and towns comprise about 16 percent of the region’s total land area. Urban growth on urban land refers to growth that makes intensive use of land for the location of buildings, structures, and impermeable surfaces to such a degree as to be incompatible with the primary use of land for the production of food, other agricultural products, or fiber, or the extraction of mineral resources, rural uses, rural development, and natural resource lands. Part of the intent of designating urban growth areas is to help channel investments in infrastructure within the already built-up areas (especially cities) and to discourage growth in rural areas. Within the urban area, there are incorporated lands (cities), and unincorporated urban growth areas. Portions of the region’s unincorporated urban lands are designated as “potential annexation areas.”¹
- Rural Land.** Counties are required to designate rural lands. This is done primarily through the development of county comprehensive plans, and the requirement for a “rural element” of a county comprehensive plan under RCW 36.70A.070(5). Rural lands are those lands that are not designated for urban growth, agriculture, forest, or mineral resources. Rural development can consist of a variety of uses and residential densities, including clustered residential development, at levels that are consistent with the preservation of rural character. Rural development does not refer to agriculture or forestry activities that may be conducted in rural areas. Comprising about 24 percent of the region’s total land area, rural lands in the region contain different types of uses and each county has a unique approach to rural development.
- Natural Resource Land.** Counties and cities are required under RCW 36.70A.170 to designate natural resource lands. Comprising the majority of the region’s total land area, about 60 percent, natural resource areas contain: (a) agricultural lands that are not already characterized by urban growth and that have long-term significance for the commercial production of food or other agricultural products, (b) forest lands that are not already characterized by urban growth and that have long-term significance for the commercial production of timber, (c) mineral resource lands that are not already characterized by urban growth and that have long-term significance for the extraction of minerals, and (d) critical areas which are resident within the other three categories (see the next bullet). The vast majority of this land, 95 percent, falls under the forest lands designation and much of this is protected under federal, state and local regulations.
- Critical Areas.** The Growth Management Act requires that each city and county identify critical areas before identifying areas of urban growth. Critical areas include both hazardous areas such as floodplains and steep slopes (see *Chapter 5.13 – Earth*), and environmentally sensitive areas like wetlands and streams (see *Chapters 5.5 – Ecosystems and 5.6 – Water Quality and Hydrology*). Critical areas also include zones that are important for protecting groundwater. The Growth Management Act requires counties to protect the “functions and values” of these identified critical areas. Examples of wetland functions are filtration of pollutants, wildlife habitat, flood control, and groundwater recharge. The importance of these areas is made apparent in language of the Growth Management Act that specifies this designation as a top priority of the Growth Management Act.

These designated areas exist within the other three categories of land, and contain the following types:

- (a) wetlands, (b) areas with a critical recharging effect on aquifers used for potable water, (c) fish and wildlife

¹ These affiliated areas are called Potential Annexation Areas in King County, sometimes referred to as Urban Service Areas in Pierce County and as Municipal Urban Growth Areas for parts of Snohomish County. For more information on Potential Annexation Areas and their targeted growth, see the *VISION 2020+20 Issue Paper on Growth Targets (“Growth Management by the Numbers”)*, which is included in *Appendix E* on the attached compact disk.



habitat conservation areas, (d) frequently flooded areas, and (e) geologically hazardous areas. Interestingly, the definition of “critical areas” lists these five types but also states that they include “the following areas and ecosystems” (for more information, see *Chapter 5.5 – Ecosystems*). Critical areas are managed through development regulations (36.70A.060), have defined guidelines for classification (36.70A.170), and require that the “best available science” be used in their designation and protection (36.70A.172). Per RCW 36.70A.480, shorelines of the state may contain critical areas, but are subject to the requirements of the Shoreline Management Act as set forth in RCW 90.58.020, not to the Growth Management Act.

VISION 2020 and Land Use Planning

VISION 2020 includes policies and provisions that address a range of land use issues, including resource lands, rural areas, urban growth areas, and contiguous and orderly development. The VISION and its proposed update will provide a regionwide framework for local, county and regional planning. To that end, the VISION is the foundation for an overarching strategy for enhancing mobility and protecting valuable rural and resource lands from inappropriate urban development and urban sprawl through compact regional growth. The components that define the compact urban form include population and employment density with pedestrian-oriented design, scale and a variety of transportation modes.

- **Urban Land.** VISION 2020 calls for focusing growth and development within the region’s urban growth areas. In addition, regional growth centers are to be designated as locations of higher intensity residential and employment development. These centers are to be connected by an efficient transportation system with high-capacity transit.
- **Rural Land.** The VISION calls for the preservation of rural character, open space, recreation, non-designated resource lands, scenic and historic areas, and small-scale farming, forestry, and cottage industries. “Rural lands primarily contain a mix of low-density residential development, agriculture, forests, open space and natural areas, as well as recreation uses. Counties, small towns, cities and activity areas provide limited public services to rural residents. They buffer large resource areas and accommodate small-scale farming, forestry, and cottage industries as well as other natural-resource based activities.” (1995 VISION 2020 Update, page 33)
- **Natural Resource Land and Critical Areas.** VISION 2020 calls for preserving the region’s resource lands for their natural, economic, and ecological value. The VISION also calls for protecting critical areas as environmentally significant lands, recognizing that their protection contributes to health, safety, and the well-being of the region.

B. PHYSICAL SETTING: EXISTING LAND USE AND TRENDS

This section discusses existing land use trends by the land use categories described in the previous sections.

Urban Land

As of 2003, urban areas contained the vast majority of the region’s population, employment and housing. As shown in the following figure, variations exist among the four counties in terms of how much of each activity is contained within each county’s designated urban growth area.

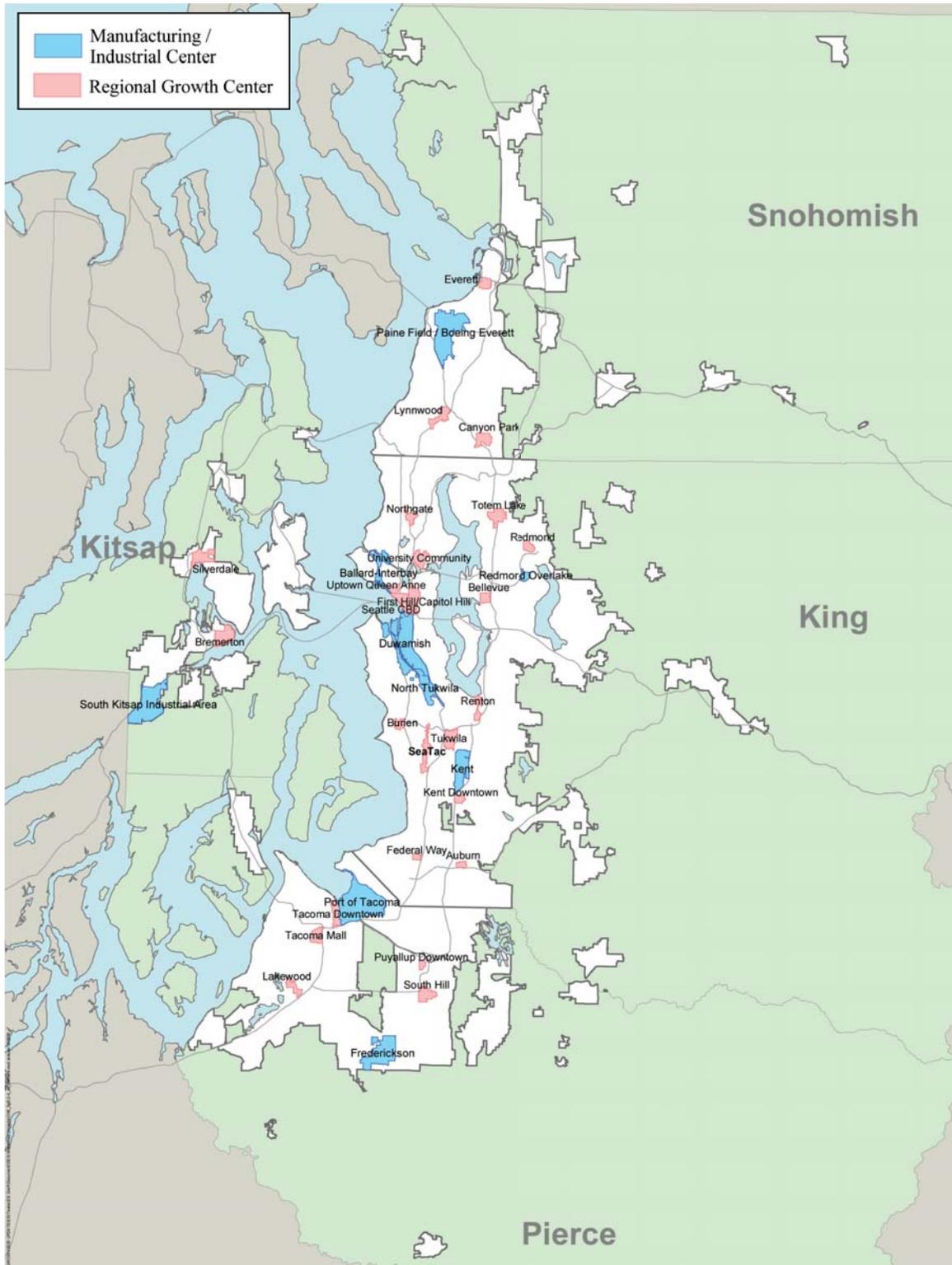
FIGURE 5-2-3: POPULATION, EMPLOYMENT, AND HOUSING INSIDE DESIGNATED URBAN GROWTH AREA

	Population	Percent In UGA	Covered Employment	Percent in UGA	Housing Units	Percent in UGA
King	1,652,900	92.9%	1,059,600	98.3%	728,300	93.9%
Kitsap	133,600	56.4%	62,200	82.0%	56,000	58.0%
Pierce	584,500	79.7%	223,000	92.7%	235,600	80.1%
Snohomish	515,900	80.9%	194,000	94.2%	206,100	81.8%
Region Total	2,886,900	85.2%	1,538,800	96.1%	1,226,100	86.5%

Note: Totals may vary due to rounding.
Source: Puget Sound Regional Council, 2005

Within the region's urban lands, cities have designated regional growth centers and manufacturing/industrial centers as part of the process begun with the 1995 VISION 2020 document. These are illustrated in the following figure and are discussed in summary fashion in the following text.

FIGURE 5-2-4: MAP OF DESIGNATED REGIONAL GROWTH CENTERS AND MANUFACTURING/INDUSTRIAL CENTERS



Source: Puget Sound Regional Council, 2005



- **Regional Growth Centers.** The central Puget Sound region first embraced the concept of centers in the original VISION 2020 plan adopted in 1990. Centers were presented in a hierarchy of mixed-use, compact communities where people could live, work, and play. Regional growth centers are envisioned as focal points of higher-density population and employment, with efficient multimodal transportation infrastructure and services. They are intended to house mixed-use neighborhoods containing jobs, retail, services, and housing. Twenty-one regional growth centers were identified in the 1995 update of VISION 2020. Since that time, four additional centers have been designated.

FIGURE 5-2-5: DESIGNATED REGIONAL GROWTH CENTERS

King	Auburn*	Seattle Downtown
	Burien*	Seattle First Hill/Capitol Hill
	Bellevue Downtown	Seattle Northgate
	Federal Way	Seattle University Community
	Kent	Seattle Uptown Queen Anne
	Redmond	Totem Lake (Kirkland)*
	Renton	Tukwila
	SeaTac	
Kitsap	Bremerton	Silverdale*
Pierce	Lakewood	Tacoma Downtown
	Puyallup Downtown	Tacoma Mall
	Puyallup South Hill	
Snohomish	Bothell Canyon Park	Lynnwood
	Everett	

Note: The asterisk (*) identifies those centers that have been designated after the adoption of the 1995 update of VISION 2020.

Overall, cities anticipate focusing much of their growth within regional growth centers.² Some cities have aggressive plans to add substantial numbers of housing units within these centers, while others expect nominal increases in population but large increases in jobs. The regional growth centers represent planning areas that are expected to develop as the region’s major hubs over time, although it is not the intent that they all develop uniformly. Some centers may have a greater mix of housing, jobs, or other activities, while other may remain predominantly places with a high concentration of employment. Although regional growth centers have been identified as major locations for accommodating a significant portion of development anticipated in the region over the next 35 years, most are commercially oriented and only a few currently have large concentrations of population and housing. During the update process, additional center-like places were identified and discussed as part of the process to develop alternatives. These places were termed “subregional” centers.³

- **Manufacturing/Industrial Centers.** These centers have a much different urban form and purpose than regional growth centers. The region’s manufacturing/industrial centers can be characterized as areas of large contiguous blocks served by the region’s major transportation infrastructure, including roadways, rail, and port facilities. They generally have developed an urban form suitable for manufacturing and industrial uses, which often requires areas for outdoor storage, buffers from residential areas, and facilities with large spaces for assembly lines. Typically, there is not a residential component in these types of centers. Evolving over many decades, the size, shape, and location of the manufacturing/industrial centers have been determined by the needs of the region’s industrial market and the need for efficient access to the region’s land and water transportation systems. They also account for a large number of jobs within the areas in which they are located.

² See Appendix E: *Informational Paper Describing Current and Future Land Uses in the Central Puget Sound Region’s Regional Growth Centers* on the attached compact disk.

³ See Appendix E: *VISION 2020+20 Issue Paper on Subregional Centers* on the attached compact disk.

FIGURE 5-2-6: DESIGNATED MANUFACTURING/INDUSTRIAL CENTERS

King	Ballard Interbay Duwamish	Kent North Tukwila	Overlake
Kitsap	South Kitsap Industrial Area		
Pierce	Frederickson	Port of Tacoma	
Snohomish	Paine Field/Boeing Everett		

The purpose of designating manufacturing/industrial centers is to help protect and preserve areas of intense manufacturing and industrial uses and to provide them with the necessary services and infrastructure to allow these uses to continue. These areas have been affected by suburban growth, which has consumed large areas for housing, schools, stores, streets and other urban uses.

- **Shorelines.** These lands are governed under the State Shoreline Management Act (RCW 90.58); however, the state requires close coordination of shorelines with Growth Management Act planning. Most of the shorelines in King and Pierce counties are within urban areas, although this is less the case in Snohomish County or Kitsap County. The impacts of development on Puget Sound shorelines and the Sound itself have been significant, including water pollution, sediments laden with toxic pollutants, and declines in populations of salmon, orcas, marine birds and rockfish. Puget Sound has experienced significant physical changes to its near shore habitat as well as population declines in some of its best-known, important plant and animal species:
 - Human development has modified one-third of the Puget Sound shoreline.
 - Intertidal salt marsh habitat has declined 75 percent since the 1800s.
 - Nine of the 10 species listed as endangered or threatened within the Puget Sound region inhabit the nearshore.
 - Three Puget Sound salmon species have been listed as in danger of becoming extinct according to the federal Endangered Species Act.
 - Resident orca whale populations have declined significantly from 97 in 1996 to 82 in 2003.

The recent listing of orca whales as threatened under the federal Endangered Species Act is likely to affect both shoreline and upland development activities.

Rural Land

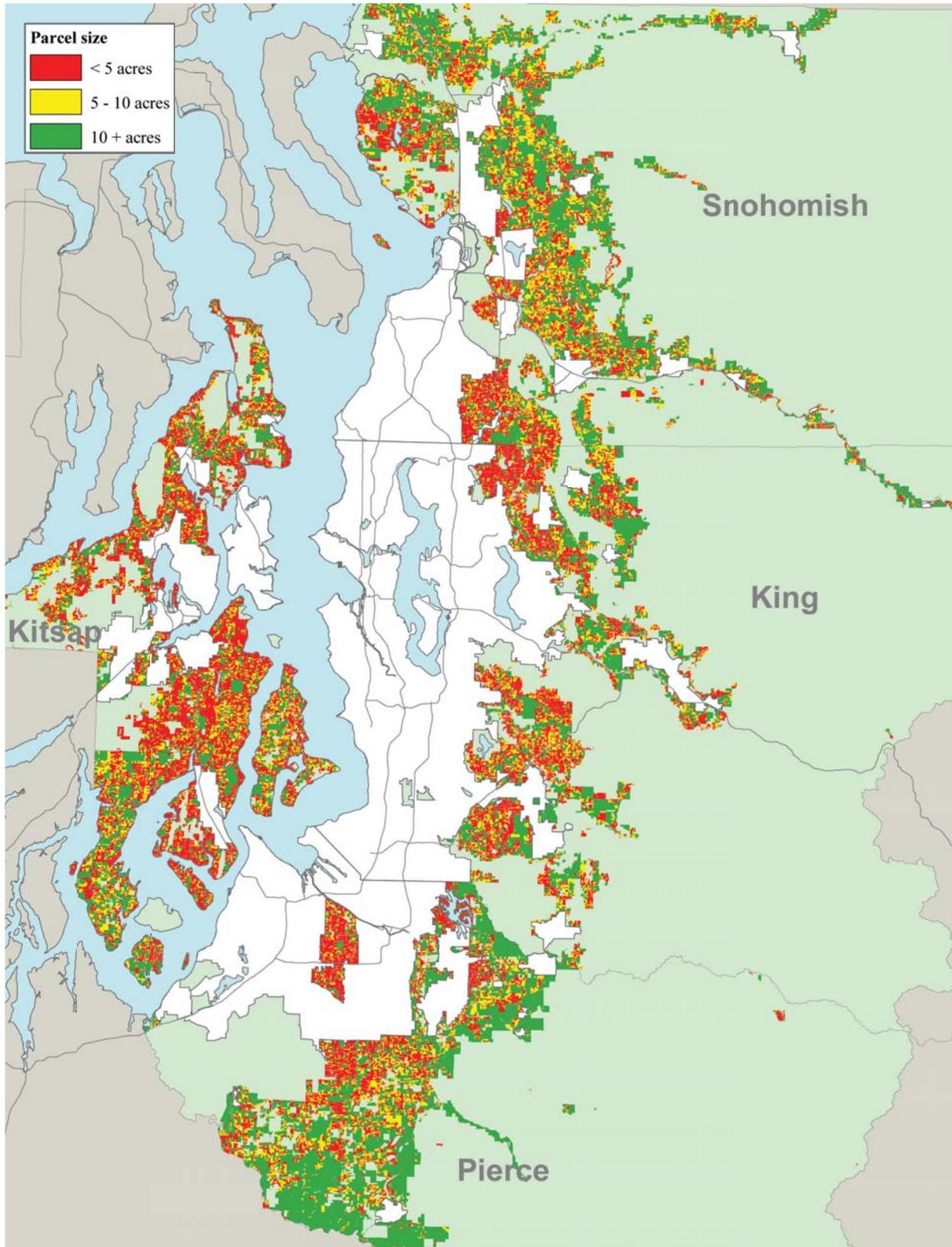
The region's varied rural areas offer a diverse set of natural amenities. Common elements of rural areas include small-scale farms, wooded areas, lakes and streams, and open spaces. Historically, rural lands have undergone rapid change as they became more accessible. Between 1995 and 2003, the amount of land within the region's rural area has remained relatively stable; however, about 24 square miles of additional land have been added to the urban areas, with the majority of the land coming from the region's rural lands.⁴

The following figure depicts parcel sizes in the region's rural non-resource areas. As of 2004, 85 percent of parcels were less than 5 acres in size, and another 10 percent were between five and 10 acres in size. Meaning, only 5 percent of the parcels in the region's rural areas were greater than 10 acres in size. At the same time, the parcels that are greater than 10 acres in size account for all most half (45 percent) of the land area.

⁴ See *Population, Employment, and Housing Milestones Report*. Puget Sound Regional Council, 2003 update.



FIGURE 5-2-7: PARCEL SIZE IN THE REGION'S RURAL AREAS



Source: Puget Sound Regional Council, 2004

Natural Resource Land

The Growth Management Act is designed to protect the natural environment by such initiatives as controlling urban sprawl through regional countywide and local comprehensive plans. The Growth Management Act also contains specific provisions to ensure that most of the region's future growth is accommodated in or immediately adjacent to areas that are already urban in character. This approach has helped to protect existing rural areas, environmentally sensitive areas, and resource lands.

- **Agricultural Land.** Agricultural production remains a meaningful contributor to the region's economy and makes up about 3 percent of the region's land and 5 percent of the region's natural resource land. In addition to supplying food for the central Puget Sound region, agricultural lands provide open spaces close to cities, towns and rural communities. Well-managed agricultural lands also provide habitats and buffers for salmon and upland wildlife, aquifer recharge, floodwater retention, urban-rural separators, and scenic vistas. The recent housing development boom and ensuing increase of agricultural land real estate value have resulted in increased pressure to develop these lands for other uses.
- **Forest Land.** Forest land represents 57 percent of the region's land and 95 percent of the region's natural resource land. Today nearly two-thirds (64 percent) of all forestlands in Washington are owned or managed by federal, state, local, and tribal governments. The U.S. Forest Service is the largest land manager in the state, overseeing 9.2 million acres of national forest land. Given the changing management emphasis on federal lands and the highly controversial nature of national forest timber sales in recent years, commercial timber harvests on the national forests in Washington have dropped to a small fraction of historic levels. Washington lumber producers also have been affected by the large volumes of lumber imports, coming not only from Canada, but also from producers in Europe and South America. Growth in the central Puget Sound region is affecting forestland in several ways:
 - Some forest land is being converted to building sites, street networks, and other non-forest uses.
 - The long-term future of forestland adjacent to urban development is uncertain and, therefore, has become less attractive to investors in long-term timber production and more attractive to developers. (Source: Municipal Research and Services Center Web site.)
- **Mineral Resource Land.** Mineral resource industries take a very small percentage of the region's land, much less than 1 percent. Coal mining is no longer active in the four-county region. The last coal mined for energy purposes was sold to large institutional users, such as the University of Washington in Seattle and state correctional facilities in Shelton and Monroe. By the 1970s these users had converted to natural gas and other sources.

Critical Areas

In practice,⁵ counties and cities do allow a certain amount of development in critical areas. In most jurisdictions, however, development can occur only under certain circumstances such as when disruption to critical areas is minimal. Many critical areas are also considered habitat for endangered species. The Endangered Species Act, a federal statute protecting threatened and endangered species, can override rights to develop by prohibiting certain activities on private property (see *Chapter 5.5 – Ecosystems*).

5.2.2 Analysis of Alternatives (Long-Term Impacts)

A. IMPACTS COMMON TO ALL ALTERNATIVES

The four alternatives distribute future growth among a set of regional geographies that include metropolitan cities, core suburban cities, larger suburban cities, smaller suburban cities, unincorporated urban or rural areas. Under the Growth Management Act, local governments must be able to provide transportation and other urban services that are needed to support growth.

The countywide planning policies for King, Kitsap, Pierce, and Snohomish counties support the strategy of preserving and developing compact communities, redeveloping urban transportation corridors, and encouraging a greater portion of planned employment and housing growth to locate in urban areas. Consistent with the Growth Management

⁵ County Critical Areas Ordinances: Pierce County Critical Areas Ordinance Title 18E, King County Critical Areas Ordinance 21A.24, Snohomish County Critical Areas Regulations Chapter 30.62B, Kitsap County Critical Areas Ordinance Title 19.



Act, and the existing VISION 2020, the countywide planning policies all support, to varying extents, the maintenance of the rural area and its existing rural character through limiting growth. The alternatives are based on the same urban growth area and assume that directing growth anywhere within the region's urban growth area would be generally consistent with state law and local plans and regulations. At the same time, the Central Puget Sound Growth Management Hearings Board has interpreted the Growth Management Act to support the focusing of growth into incorporated cities, as opposed to unincorporated urban areas, in order to lead to "facilitate the transformation of local governance in the urban growth area so that cities become the primary providers of urban governmental services and counties become the providers of regional and rural services."

Regardless of the alternative selected, adopted plans, policies and regulations might need to change to accommodate any of the future growth alternatives. Local jurisdictions would determine the actual permitted densities and types of land uses within the planned urban growth areas, and outside them in each county's rural area.

The actual changes in land use and development patterns that could occur with each alternative would be attributed to complex interactions between many variables, including the national and regional economy's health, the balance between transportation infrastructure investments and development, land use policies and tax structure, political leadership, and public consensus on the region's future. Mixed-use, which represents compact growth and higher densities of residential and commercial land uses close together, might generally be expected to be focused within urban centers or activity nodes and along certain major redevelopment corridors. Individual preferences regarding where to live and work is also a key factor, as is local communities' willingness to promote and accept higher densities.

Now in the second decade of planning under the Growth Management Act, many regional agencies and local governments are refining growth plans. As part of these refinements, growth and transportation plans are increasingly focusing on making strategic infrastructure investments to help concentrate growth where utility and transportation infrastructure capacity exists or is planned to exist.

Proximity Analysis

Using the INDEX model grid cell data, PSRC conducted supplemental analysis to estimate the amount of population and employment that are within a quarter mile of specific resources under each of the alternatives. These are presented below.

FIGURE 5-2-8: CONCEPTUAL ESTIMATE⁶ OF POPULATION AND EMPLOYMENT WITHIN ¼ MILE OF TRANSIT ROUTES

	Base Year 2000		Growth Targets Extended Alternative		Metropolitan Cities Alternative		Larger Cities Alternative		Smaller Cities Alternative	
	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total
King	2,562,000	86%	3,847,200	86%	4,276,600	88%	4,113,300	87%	3,402,300	82%
Kitsap	184,500	62%	316,400	59%	302,800	65%	328,700	68%	346,000	62%
Pierce	580,300	62%	921,100	59%	977,500	67%	886,600	62%	947,000	54%
Snohomish	555,600	66%	924,900	62%	900,000	70%	977,800	70%	1,061,400	66%
Region	3,882,400	77%	6,009,600	75%	6,456,900	80%	6,306,400	78%	5,756,700	71%

Note: Totals may vary due to rounding.

FIGURE 5-2-9: CONCEPTUAL ESTIMATE OF POPULATION AND EMPLOYMENT WITHIN ¼ MILE OF THE URBAN GROWTH AREA BOUNDARY

	Base Year 2000		Growth Targets Extended Alternative		Metropolitan Cities Alternative		Larger Cities Alternative		Smaller Cities Alternative	
	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total
King	142,100	5%	236,800	5%	222,900	5%	243,100	5%	336,100	8%
Kitsap	45,900	15%	93,900	18%	75,400	16%	75,100	15%	110,600	20%
Pierce	101,050	11%	190,400	12%	163,500	11%	164,200	12%	288,500	16%
Snohomish	88,100	10%	201,400	14%	166,000	13%	169,800	12%	292,500	18%
Region	377,150	7%	722,500	9%	627,800	8%	652,200	8%	1,027,700	13%

Note: Totals may vary due to rounding.

⁶ For all alternatives conceptual tables: Regional Council staff used INDEX, a software analysis tool (see *Appendix D* for additional information), to "paint" or assign population and employment growth jurisdiction-by-jurisdiction at the 5.5-acre grid cell level. The painting of all alternatives was guided by the future land use designations drawn from current local comprehensive plans.

FIGURE 5-2-10: CONCEPTUAL ESTIMATE OF POPULATION AND EMPLOYMENT WITHIN ¼ MILE OF THE NATURAL RESOURCE LANDS

	Base Year 2000		Growth Targets Extended Alternative		Metropolitan Cities Alternative		Larger Cities Alternative		Smaller Cities Alternative	
	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total	Pop & Emp	% of Total
King	70,100	2%	110,600	2%	111,000	2%	123,200	3%	134,100	3%
Kitsap	100	0%	1,000	0%	100	0%	100	0%	200	0%
Pierce	39,000	4%	64,300	4%	51,100	3%	51,900	4%	76,400	4%
Snohomish	62,700	7%	126,700	9%	92,200	7%	86,800	6%	137,300	9%
Region	171,900	3%	302,600	4%	254,400	3%	262,000	3%	348,000	4%

Note: Totals may vary due to rounding.

As noted in Figure 5-2-8, each of the alternatives is estimated to increase the amount of population and employment that is located adjacent (meaning, within ¼ mile) to existing and planned transit routes, with an increase of between 48 to 66 percent over the base year (2000). However, the levels of population and employment will vary among the alternatives both at the regional and county levels. As noted in Figure 5-2-9, each of the alternatives is estimated to increase the amount of population and employment that is located adjacent (meaning, within ¼ mile) to the urban growth area boundary, with an increase of between 66 to 172 percent over the base year (2000). However, the levels of proximity will vary among the alternatives both at the regional and county levels. It can be assumed that additional growth adjacent to the urban growth area boundary will have the potential for increasing pressure for additional annexations or incorporations.

Urban Land

With compact growth, new residential development could occur at increased densities and there could be more intensive use of land. Cities might need to incorporate a percentage of their projected population growth in the form of infill (on developable or redevelopable parcels within city boundaries) and counties might need to adopt policies designed to direct new development in unincorporated areas near existing city boundaries or within city spheres-of-influence.

The region’s urbanized area is likely to become denser as an additional 1.6 million people populate the region by 2040. A variety of development trends may challenge the region’s ability to realize its growth and transportation objectives over the next 35 years:⁷

- Comparatively low-density suburban development dispersed throughout the urban area may result in less efficient delivery of services. Lower density development translates into added distances between sites, which in turn translates into longer lengths for infrastructure and service delivery. For example, larger amounts of sewer and water pipes might be necessary, and there may be related operational issues of additional pumping stations needed to move sewage and water greater distances. Local bus transit service may not adequately serve the majority of the population in the lower-density communities (fewer than four households per acre). For these areas, the automobile will likely remain the dominant transportation option.
- Low-density suburban development often occurs in areas that are not close to employment opportunities. Yet when housing is developed near employment centers, there may be a mismatch between the types of employment available and the relative affordability of the local housing being developed. The result may be an increasing reliance on expanded transportation infrastructure.
- Low-density suburban development creates challenges for the siting of commercial services in a more pedestrian-friendly, transit-oriented manner and increases reliance on the automobile to access goods and services in areas more removed from residential areas.
- The high cost and complexity of in-fill development may lead to higher costs of housing in urban areas.

Rural Land

The region’s counties all support maintaining rural character; however, they have taken different approaches to how much growth to assign to the rural area in their Growth Targets processes. All of the alternatives allocate additional growth to the region’s rural areas — some at levels that exceed currently adopted Growth Targets, and some at levels

⁷ See 2001 Metropolitan Transportation Plan Alternatives Analysis and Draft Environmental Impact Statement. Puget Sound Regional Council, 2000.



lower than adopted Targets. The growth has the potential to impact existing rural character; however, it also has the potential to increase opportunity for economic and land development. Depending on how this development occurs, there is the possibility that the new growth can either help to maintain rural character and rural-based economic development, or hinder it.

Another possibility, in relation to the amount of growth estimated to be located adjacent to the urban growth area boundary (Figure 5-2-9), is that the levels of growth may lead to expanding the size of the urban growth area or potentially allowing levels of development in the region's rural area that may impact existing rural character. If the urban growth area expands to include these areas, there will be significantly different development options than what currently exists today and the existing character will likely change.

Natural Resource Land

The alternatives do not envision any additional growth on any of the natural resource lands. However, growth close to these lands can have environmental impacts and create pressure for conversion of these lands to other land use types, although this depends on a number of factors including location, how development is designed and what mitigations are put in place through the development process. Alternatives that minimize development adjacent or proximate to these lands are likely to have less impact on water resources (see *Chapter 5.6 – Water Quality and Hydrology*), ecosystem change (see *Chapter 5.5 – Ecosystems*), or infrastructure impacts (see *Chapters 5.7 – Public Services and Utilities* and *5.3 – Transportation*).

Alternatives that minimize growth close to resource lands are less likely to create conversion pressure. This is particularly a factor for agricultural lands, given their relative ease of conversion and the fact that they often are surrounded on all sides by rural non-resource lands. Further, alternatives that assign less growth adjacent to these areas are likely to decrease the potential for conflicts between incompatible land uses, such as residential and some types of farming and/or forestry activities.

Figure 5-2-10 estimates the amount of population and employment that could be located adjacent to land currently designated as natural resource. Each of the alternatives is estimated to increase the amount of population and employment located adjacent to these lands, with an increase of between 48 to 102 percent over the base year (2000). However, the levels of population and employment will vary among the alternatives both at the regional and county levels.

Critical Areas

The alternatives do not envision any growth in critical areas. However, similar to natural resource lands, growth close to critical areas can have environmental impacts and create pressure for conversion of these areas to other land use types. Alternatives that minimize development adjacent or proximate to critical areas are likely to have less impact on floodplains and steep slopes, and other environmentally sensitive areas like wetlands and streams (see *Chapters 5.5 – Ecosystems* and *5.6 – Water Quality and Hydrology*).

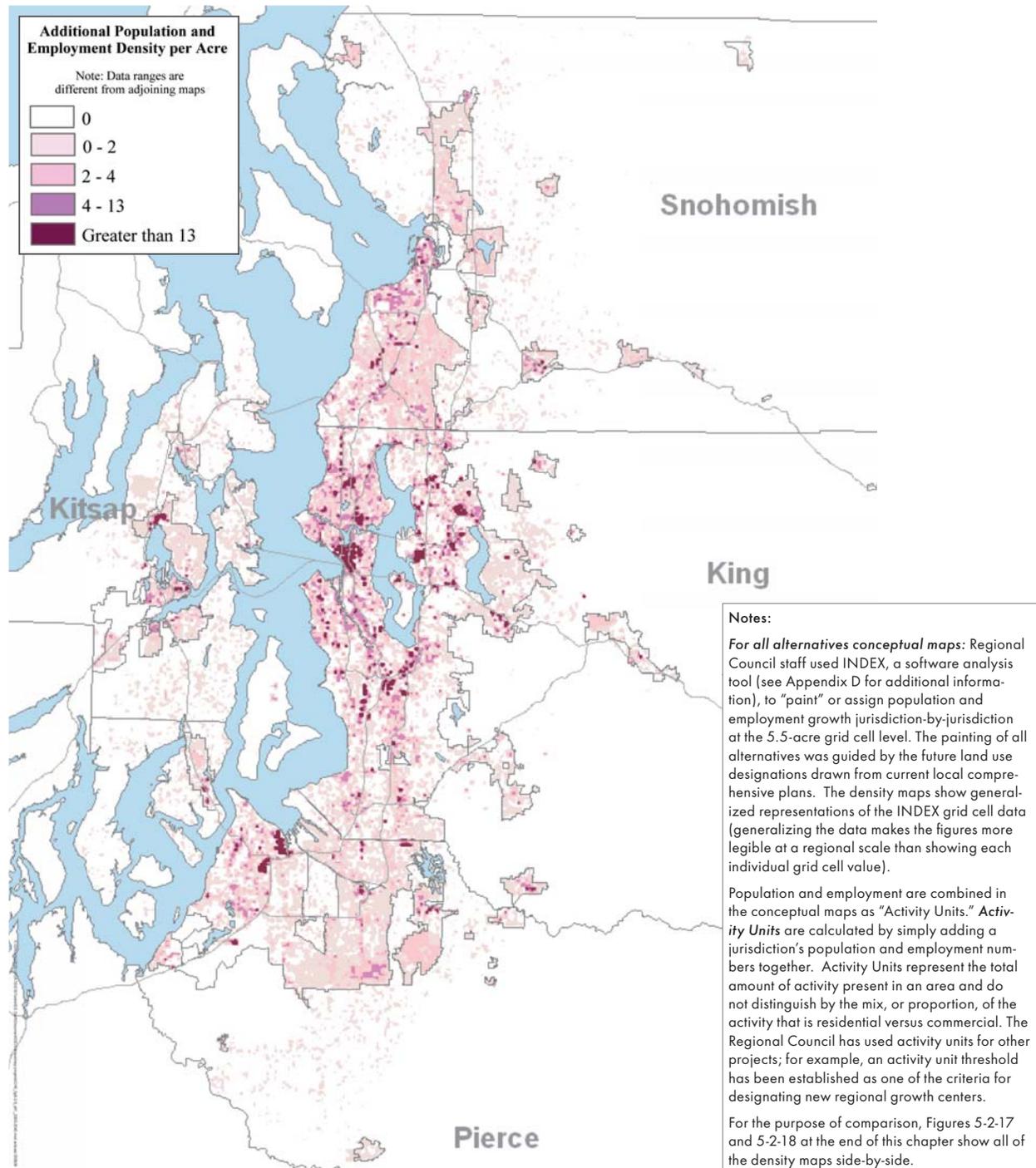
B. ANALYSIS OF EACH ALTERNATIVE

Using the grid-cell data of the INDEX model, the following figure presents a conceptual illustration of existing density in the base year 2000. This map is meant to provide context for the next set of maps that show density increases (between 2000–2040) and future density conditions (in 2040).

GROWTH TARGETS EXTENDED ALTERNATIVE

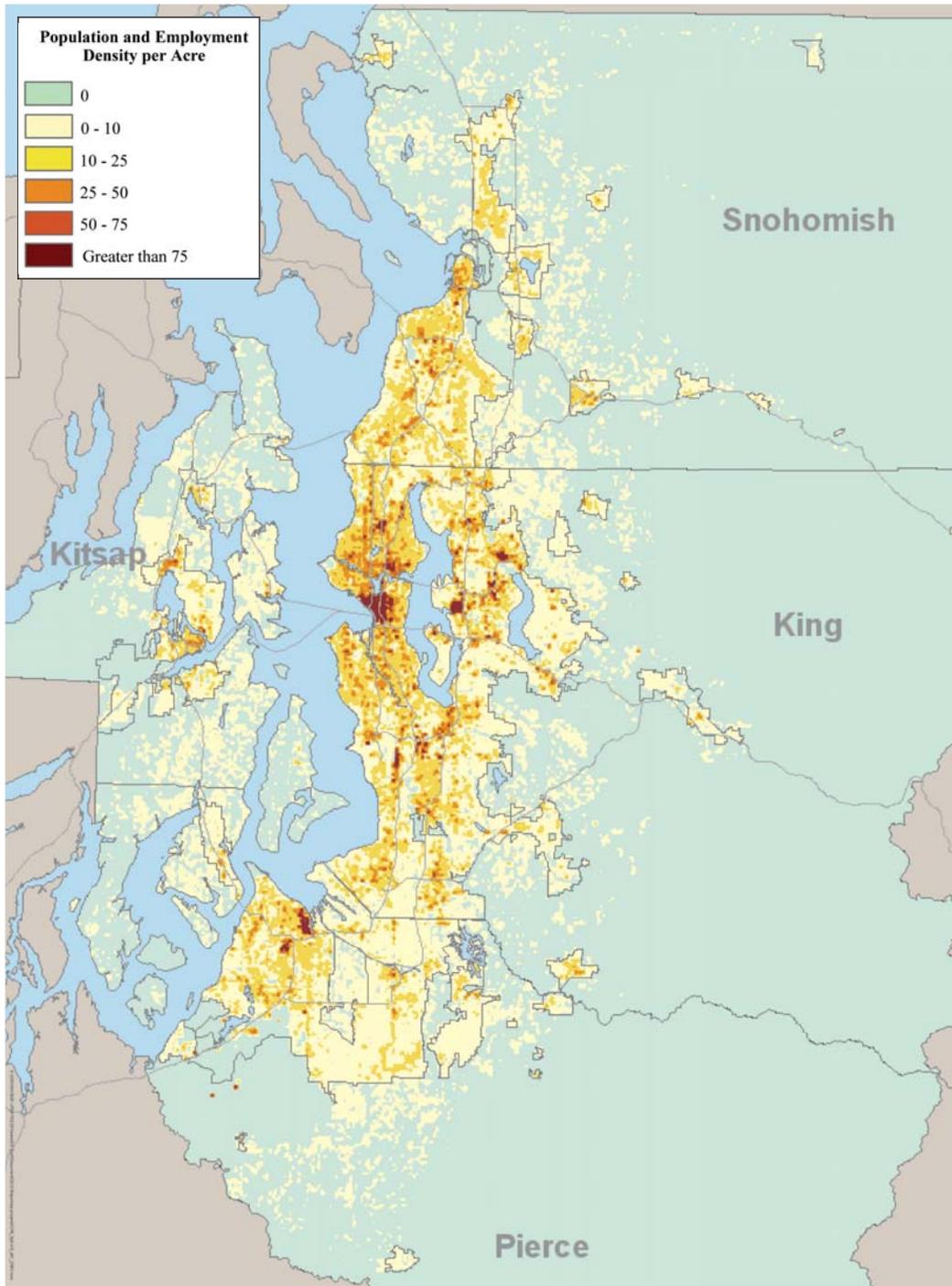
With Growth Targets Extended, current adopted comprehensive plans and growth targets would extend to 2040 and their relative share and distribution of planned growth would be maintained. Localized intensification of land use or compact growth could occur consistent with adopted plans, policies, and regulations, although the extension to 2040 may require revisiting existing land use designations. The following figure presents a conceptual illustration of future density of activity under the Growth Targets Extended Alternative.

FIGURE 5-2-12: GROWTH TARGETS EXTENDED ALTERNATIVE CONCEPTUAL MAPS: DENSITY OF POPULATION AND EMPLOYMENT – ADDITIONAL DENSITY (2000-2040)



Source: Puget Sound Regional Council

**FIGURE 5-2-12: GROWTH TARGETS EXTENDED ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – FUTURE CONDITION (2040)**



Source: Puget Sound Regional Council



This alternative concentrates growth in the largest number of the regional geographies, thereby affecting many areas throughout the region. The form of development would essentially be an intensification of current planned development throughout the region. As noted in Figure 5-2-8, this alternative is estimated to have the second highest amount of population and employment that could be located adjacent to existing and planned transit routes with almost 6,010,000 (an increase of about 55 percent over the base year 2000).

Urban Land

Land use densities might be more evenly distributed among the regional geographies than currently exists, with concentrations in metropolitan cities, core suburban cities, and the unincorporated urban area.

- **Metropolitan cities** would see significant increases in both population and employment. It is likely that this might be accommodated through additional mixed-used development given the large increases in both population and employment. Similar to the Metropolitan Cities Alternative, this alternative could mean increased densities in these already dense areas. This could be accommodated through infill development as well as development of underutilized parcels. Accommodating the residential growth under this alternative could probably be accomplished through multifamily housing — sometimes this might replace existing single-family homes. These cities contain designated regional growth centers that are anticipating higher rates of growth. Growth might continue to be focused into these areas. However, the levels of growth allocated under this alternative might lead to the designation of new centers. A fair amount of residential growth could need to be accommodated in these cities' neighborhoods, and smaller commercial centers might grow — potentially with higher-rise office buildings.

Also, these cities have some of the densest street networks, making it possible to accommodate growth and provide some level of walk-access to transit facilities. For those cities with manufacturing/industrial centers, there could be some degree of additional employment growth in these places. While the alternatives do not paint employment growth by sector or industry, it is possible that these types of centers might see continued encroachment of non-manufacturing industries. The general character of these cities could be much more intense, with much more activity than what exists today. This intensification would likely lead to a change in the existing character of these cities and their neighborhoods as both more (and potentially larger) buildings are developed to accommodate this growth. The growth could also impact crowding, traffic congestion, service levels for all types of infrastructure, and could potentially require upgrades and retrofits to existing utilities. For more information, see *Chapter 5.7 – Public Services and Utilities*.

- **Core suburban cities** would receive the second least amount of growth under this alternative. Spread across the 13 cities and unincorporated Silverdale, this growth could be accommodated through infill development. Each of these cities has a designated regional growth center where higher rates of growth are anticipated. Regional growth centers could likely take a good proportion of the employment growth and probably some of the residential growth. These cities could see an increase in multifamily housing, and some mixed-use development may occur. The general character of these cities might be more urban and active than exists today. Impacts could be similar, although to a lesser extent, to those in metropolitan cities.
- **Larger suburban cities** would also receive the second least amount of growth under this alternative (and less than half of what is envisioned for the core suburban cities). Spread across 13 cities, this growth might potentially be accommodated with a much more limited amount of land use change. There could certainly be some growth in the downtowns of these cities, which might accommodate much of the employment growth, although some employment could likely spread to industrially-zoned areas or other small commercial centers in these cities. Residential growth might be absorbed through land use tools such as short plats, and perhaps some additional multifamily housing. The general character of these cities might not be significantly different than what exists today.
- **Smaller suburban cities** would receive the second most growth under this alternative (similar to the Metropolitan Cities Alternative, but dramatically less than the Smaller Cities Alternative). Spread across these 52 cities, the growth might be accommodated by some increased development, but without dramatic changes in land use. Similar to the larger suburban cities in this alternative, the majority of the employment growth might be accommodated in the downtown areas, and industrially-zoned areas or other small commercial centers. Residential growth might be absorbed throughout these cities' neighborhoods, without much multifamily or mixed-use development. The general character of these cities might not be significantly different than what exists today.
- **Unincorporated urban growth areas** would see a large amount of growth under this alternative, particularly on the residential side. Growth Targets Extended results in the second most amount of growth in unincorporated

urban areas. Given that existing conditions are predominantly residential, as is the growth assigned under this alternative, the types of land uses might not change dramatically. However, this alternative could represent some significant intensification of land use in these areas, and there might be a fair amount of low-rise multifamily development, such as townhomes. For the most part, these areas have more limited road networks, meaning there could be a need for additional collector and local arterial streets to be built to provide access to new residences and commercial centers. This might be one of the larger land use impacts of this alternative in these areas. The general character of these areas could be more urban and intensified than what exists today. As noted in Figure 5-2-9, this alternative is estimated to have the second highest amount of population and employment that could be located adjacent to the urban growth area boundary with about 720,000 (an increase of about 90 percent over the base year 2000), which could impact the placement of the boundary.

Rural Land

This alternative has the largest amount of residential development on rural lands (although, combined with employment, it has the second most growth overall). Similar to the unincorporated urban areas, growth under this alternative could require additional collector streets and local arterials, thereby changing the character of these areas. Achieving this amount of growth potentially represents opportunities for economic and land use development, and the ensuing impacts this would have on rural economies and rural character. Although rural land areas might be attractive for increased residential development due to lower land costs, they could be more remote from employment opportunities, services and other urban amenities. It is possible that there could be housing types other than single-family residential, with townhomes being the most likely type — this would represent a change from the typical housing stock in these areas. Whereas in the first decade of planning under the Growth Management Act the region witnessed an overall reduction in the percent of development occurring in rural-designated areas, under this alternative, there would be increased growth in rural areas in the subsequent decades up to 2040. Kitsap and Snohomish counties might experience the bulk of the increased development in rural areas. The general character of these areas might still be predominantly residential, although more suburban and busier than what exists today.

Natural Resource Land

Given that no population or employment growth was assigned to any of these lands, the largest issue for these areas is how much growth is accommodated nearby and the pressure this creates for conversion. A second issue is the potential for conflicting land uses, with residential land uses close to uses such as forestry or agriculture. As this alternative has the second most growth in these rural and unincorporated growth areas, it has the second most potential for impact. Additionally, as noted in Figure 5-2-10, this alternative is estimated to have the second highest amount of population and employment that could be located adjacent to natural resource lands, with over 300,000 (an increase of about 75 percent over the base year 2000).

Critical Areas

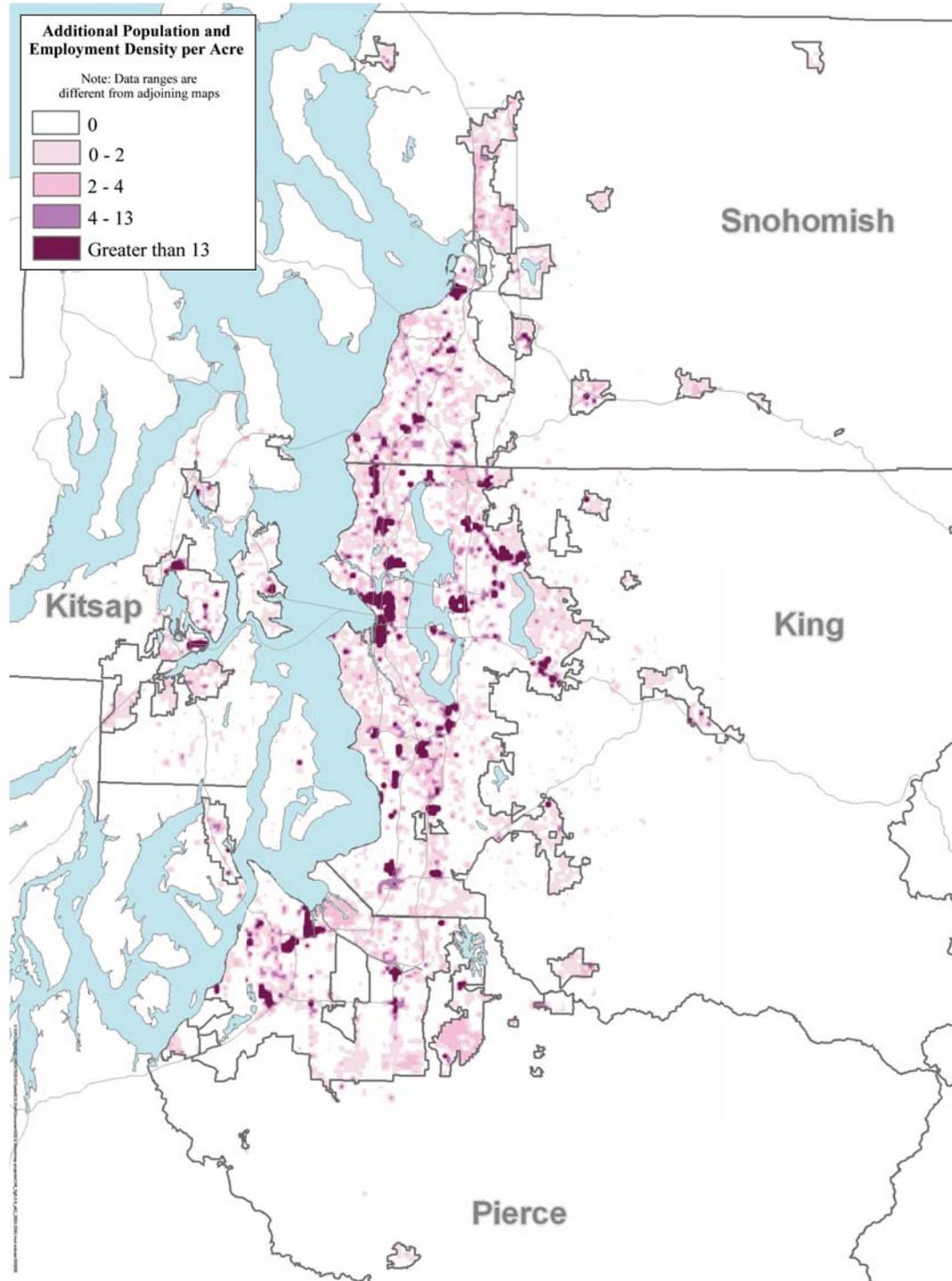
While critical areas are resident through all the geographies in the region, a higher amount of exists outside of the urban area (see *Chapter 5.5 – Ecosystems* and *5.6 – Water Quality and Hydrology*). Therefore, similar to natural resource land, more growth in the rural areas (and to some extent the unincorporated urban areas) increases the likelihood for conversion and the potential for land use conflicts. As this alternative has the second most growth in these rural and unincorporated growth areas, it has the second most potential for impacts to critical areas.



METROPOLITAN CITIES ALTERNATIVE

With the Metropolitan Cities Alternative, planned growth would be shifted from rural areas and the unincorporated urban growth area to metropolitan cities and core suburban cities. Because of this shift, unincorporated urban and rural areas might remain relatively similar to how they are currently. The following figure presents a conceptual illustration of future density of activity under the Metropolitan Cities Alternative.

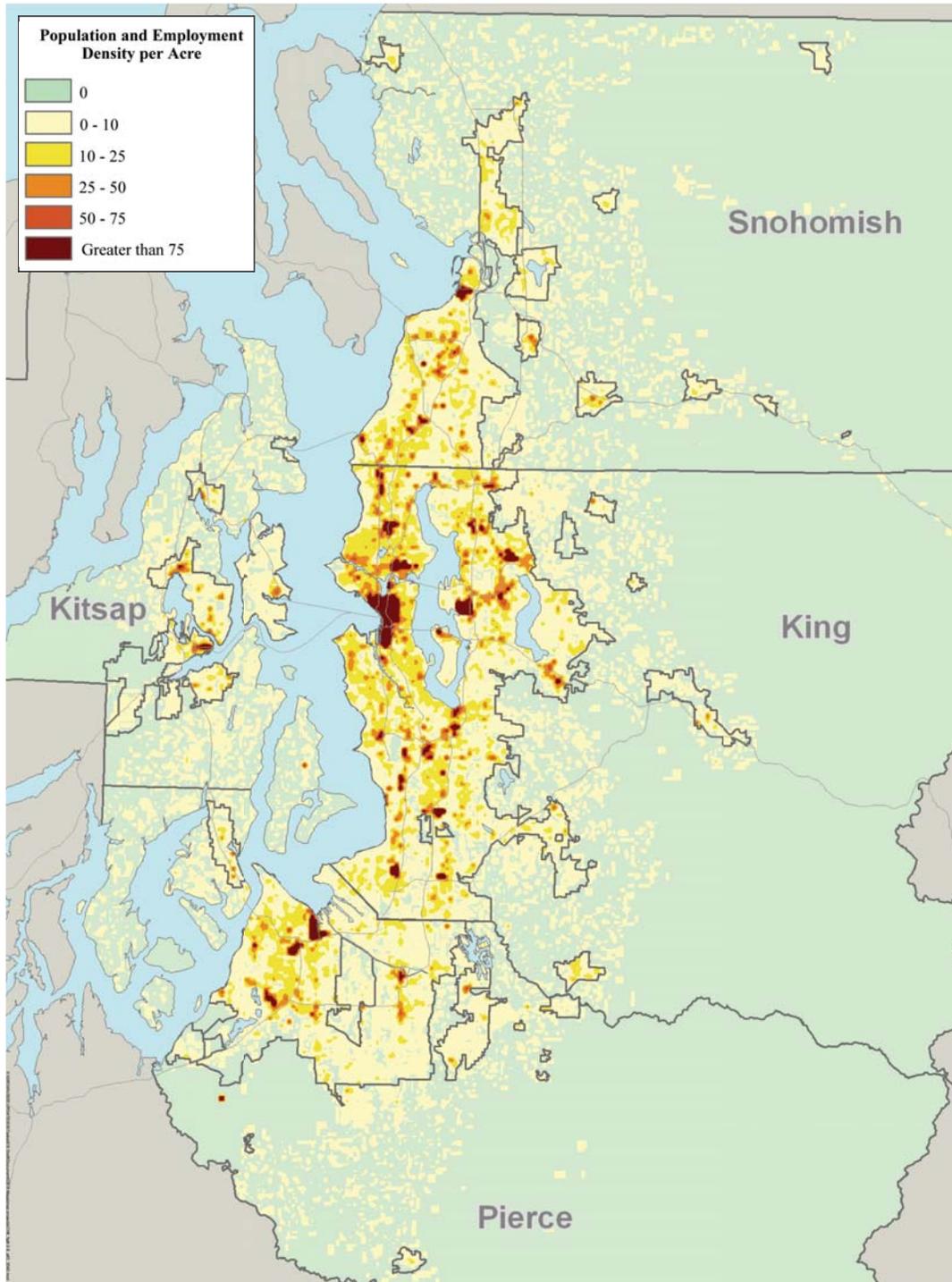
**FIGURE 5-2-13: METROPOLITAN CITIES ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – ADDITIONAL DENSITY (2000-2040)**



Source: Puget Sound Regional Council, 2006

Note: See notes for Figure 5-2-12.

**FIGURE 5-2-13: METROPOLITAN CITIES ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – FUTURE CONDITION (2040)**



Source: Puget Sound Regional Council, 2006

Note: See notes for Figure 5-2-12.



This alternative concentrates growth in the fewest of the regional geographies, thereby affecting land use in fewer areas throughout the region. In simple terms, this alternative could lead to highly developed cities (metropolitan and core suburban cities) and much less intensely developed areas (in the smaller cities, unincorporated urban and rural areas) leading to more differentiation between urban and rural land character (see *Chapter 5.12 – Visual Quality and Aesthetic Resources*). The region’s smaller cities, unincorporated urban areas, and rural areas are assigned less growth under this alternative than under Growth Targets Extended, meaning less land use change. The Metropolitan Cities Alternative would result in the most centrally focused growth compared to the other alternatives. As noted in Figure 5-2-8, this alternative is estimated to have the highest amount of population and employment that could be located adjacent to existing and planned transit routes, with almost 6,460,000 (an increase of about 65 percent over the base year 2000). This is almost 450,000 more than Growth Targets Extended.

Urban Land

The most built-out portion of the urban area would undergo the most change under in this alternative. It is expected that this growth could result in higher-density housing in the urban areas. Higher employment levels may also result in an increase in commercial and industrial land uses. Locating commercial and industrial land uses close to more compact residential uses could support goals to achieve a better balance between employment and housing in the region. The Metropolitan Cities Alternative would support a recent trend in many local jurisdictions to pass zoning ordinances that allow infill development, small-lot single-family homes, multi-family homes, and mixed-use development.

- **Metropolitan cities** receive more growth in the Metropolitan Cities Alternative than in any of the other alternatives, with essentially the same amount of employment as under Growth Targets Extended, but with more residential growth. Cities with regional growth centers such as Bellevue, Bremerton, Everett, Seattle, and Tacoma would be expected to have higher amounts of growth. By concentrating a much larger share of growth in metropolitan cities (and core suburban cities), these areas could become much more compact with mixed-use neighborhoods containing jobs, retail, services, and housing. Potentially, the levels of growth allocated under this alternative might lead to the designation of new centers in these cities. The impacts of this growth are similar to those under Growth Targets Extended, although, because there is more residential growth, this alternative could lead to the most impacts in these cities and their neighborhoods. Potential impacts could include crowding, which could negatively impact some residents’ and employees’ experience of these cities.

The increased population growth under the Metropolitan Cities Alternative could mean a closer job-to-housing balance than under Growth Targets Extended and could require more mid- to high-rise multifamily development. Mixed-use development is probably also more likely than in Growth Targets Extended. This intensification could lead to a change in the existing character of these cities, at levels similar to those described under the Growth Targets Extended Alternative.

- **Core suburban cities** receive the second most amount of growth under this alternative. This alternative has slightly more employment growth than under Growth Targets Extended and a fair amount of additional residential growth. These cities all have designated regional growth centers, which could accommodate some of the growth — probably more employment growth than residential growth. However, this amount of growth might lead to infill development and additional densification in both residential neighborhoods and in smaller commercial centers throughout these cities. The impacts of this growth are similar to those under Growth Targets Extended. Potentially, the levels of growth allocated under this alternative might lead to the designation of new centers in these cities. The increased population growth under the Metropolitan Cities Alternative wouldn’t be meaningfully different than Growth Targets Extended in terms of job-to-housing balance, but the alternative could lead to more mid-rise multifamily development. Mixed-use development is probably slightly more likely than in Growth Targets Extended. Impacts could be similar, although to a lesser extent, to those described for metropolitan cities.
- **Larger suburban cities** receive the second most amount of growth under this alternative, but at levels well below those assigned in the Larger Cities Alternative. The impacts and effects of this growth might be greater than under Growth Targets Extended. The growth assigned to these cities could potentially lead to the designation of new regional growth centers — possibly leading to the creation of a new class of “subregional center” as discussed in the *VISION 2020+20 Issue Paper on Subregional Centers* (see *Appendix E* on the compact disk). Whether designated or not, some of these cities might choose to focus their growth in central locations, and might seek to encourage mixed-use development, although there is the likelihood that growth could potentially spillover into these cities’ neighborhoods. Impacts could be similar, although to a lesser extent, to those described for metropolitan cities.

- **Smaller suburban cities** receive the second least amount of growth under this alternative — at levels similar to Growth Targets Extended but well below the Smaller Cities Alternative. This amount of growth could potentially be accommodated without a dramatically noticeable impact. There could be some increase in short-platting, and some of the larger lots may be subdivided, but major new commercial centers and major areas of new residential development might not be needed.
- **Unincorporated urban growth areas** would receive the least amount of growth under this alternative. Similar to the discussion of smaller suburban cities above, the impacts of this growth might not significantly change land use in these areas. The larger change for these areas is in the area of land use planning, as the amount of growth is significantly less than called for under current plans. Achieving this amount of growth might require downzones or other planning actions to limit growth. As noted in Figure 5-2-9, this alternative is estimated to have the lowest amount of population and employment that could be located adjacent to the urban growth area boundary, with almost 630,000 (an increase of about 65 percent over the base year 2000). This is almost 95,000 less than Growth Targets Extended.

Rural Land

This alternative ties with the Larger Cities Alternative for the least amount of growth assigned to the rural areas of any of the other alternatives. This amount of growth could have some impacts on parcelization. However, it is possible that it could be accommodated with minimal increases in arterials, although there might need to be some additional collector roads. In rural areas, this alternative could help preserve a higher percentage of the rural lands from being developed, although this potentially impacts economic and land development in these areas. Similar to unincorporated urban growth areas, this amount of growth might be inconsistent with adopted plans for these lands and might require some planning actions to limit growth.

Natural Resource Land

As noted under Growth Targets Extended, there is a correlation between the amount of growth assigned to the rural areas (and to some extent the unincorporated urban areas) and the impacts on these lands. The Metropolitan Cities Alternative has, in the aggregate, the least amount of growth in these areas, and therefore, the impacts are likely to be the least to natural resource lands. Additionally, as noted in Figure 5-2-10, this alternative is estimated to have the second lowest amount (essentially equal to the amount for the Larger Cities Alternative) of population and employment that could be located adjacent to natural resource lands, with over 250,000 (an increase of about 50 percent over the base year 2000). This is almost 50,000 less than Growth Targets Extended.

Critical Areas

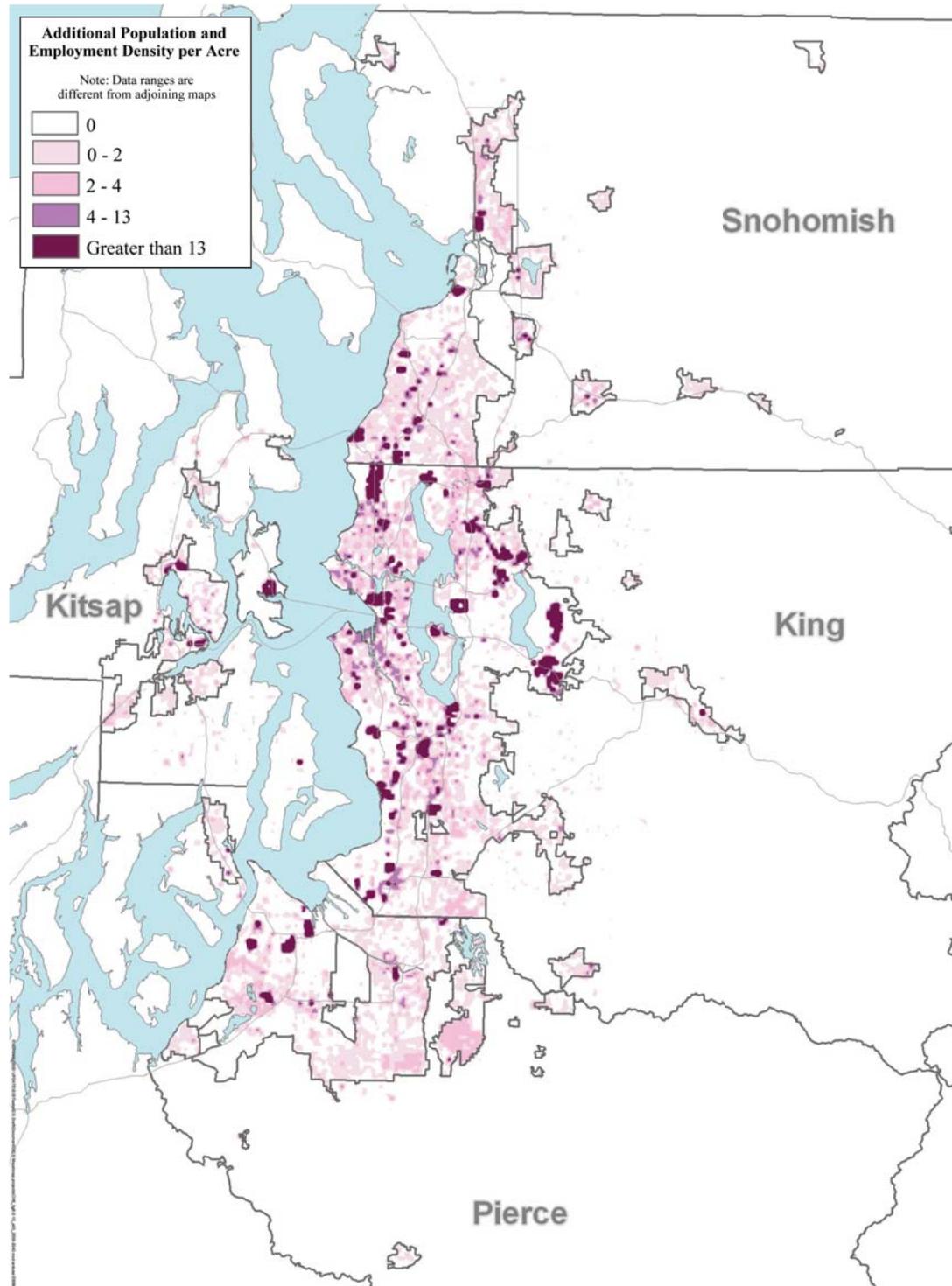
Similar to natural resource land, more growth in the rural areas (and to some extent the unincorporated urban areas) increases the likelihood for conversion, and the potential for land use conflicts. The Metropolitan Cities Alternative has, in the aggregate, the least amount of growth in these areas, and therefore, the impacts to critical areas are likely to be the least.



LARGER CITIES ALTERNATIVE

The Larger Cities Alternative would focus the largest amounts of growth in the region's core suburban cities and larger suburban cities, shifting growth from the unincorporated urban growth area, rural area, and metropolitan cities. The following figure presents a conceptual illustration of future density of activity under the Larger Cities Alternative.

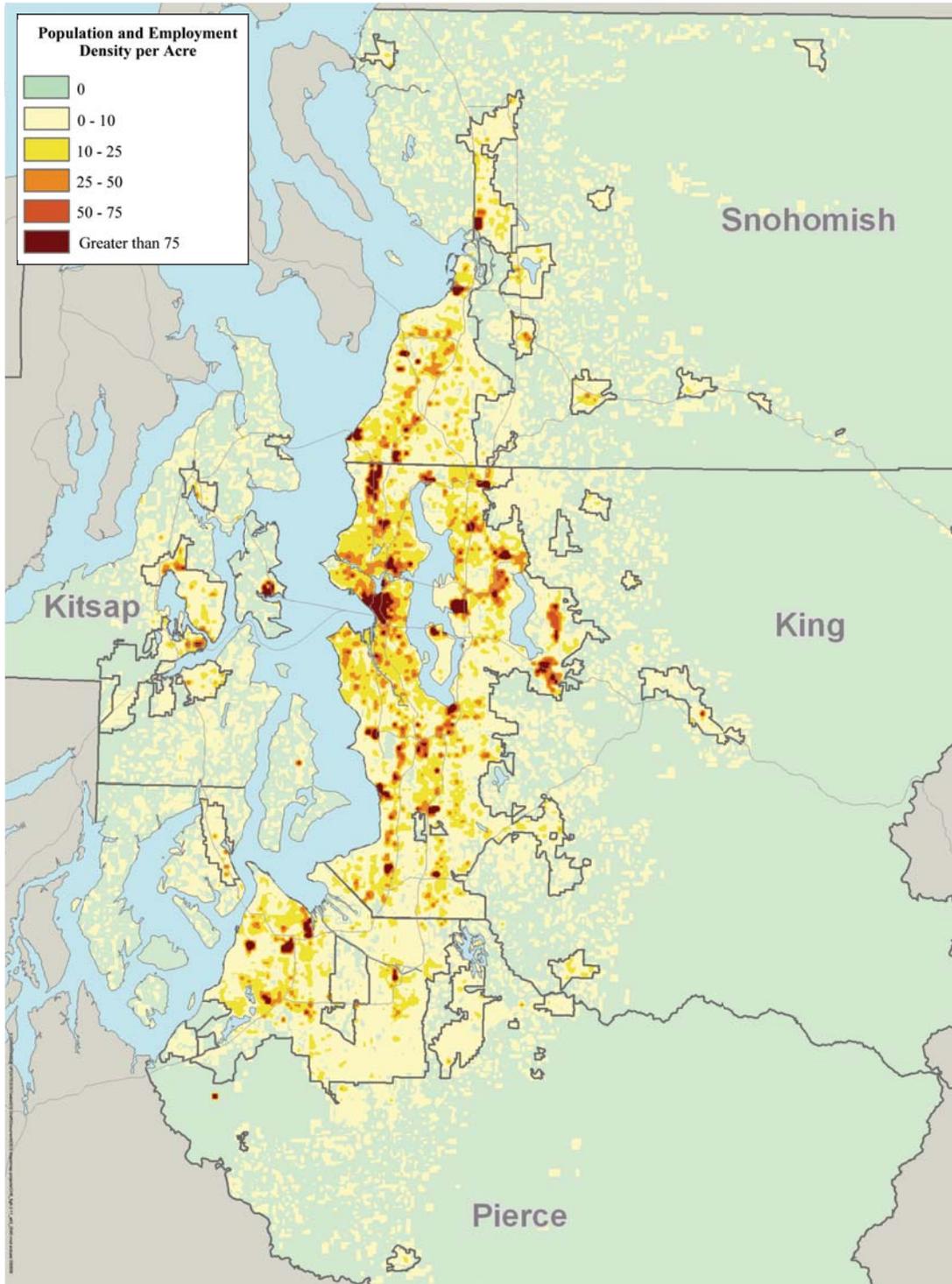
**FIGURE 5-2-14: LARGER CITIES ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – ADDITIONAL DENSITY (2000-2040)**



Source: Puget Sound Regional Council, 2006

Note: See notes for Figure 5-2-12.

**FIGURE 5-2-14: LARGER CITIES ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – FUTURE CONDITION (2040)**



Source: Puget Sound Regional Council, 2006

Note: See notes for Figure 5-2-12.



This alternative falls between Growth Targets Extended and the Smaller Cities Alternative in terms of how many of the regional geographies, and therefore areas, might be affected by significant amounts of new growth. This alternative could lead highly developed cities (metropolitan and core suburban cities) and a second set of highly urbanized cities (the larger suburban cities) — in short, a larger number of highly intense nodes of activity and other areas of rural character. Similar to the Metropolitan Cities Alternative and less than Growth Targets Extended, there could remain areas of much less intense development (in the smaller cities, and unincorporated urban and rural areas). As noted in Figure 5-2-8, this alternative is estimated to have the second highest amount of population and employment that could be located adjacent to existing and planned transit routes, with almost 6,310,000 (an increase of about 50 percent over the base year 2000). This is almost 300,000 more than Growth Targets Extended but 150,000 less than the Metropolitan Cities Alternative.

Urban Land

This alternative has an identical amount of growth being assigned to the region's urban lands as the Metropolitan Cities Alternative, meaning the overall impact on the urban area, from a land use perspective, is likely to be very similar. However, growth is shifted from the metropolitan cities to the larger suburban cities. The corridors within and between these larger cities may also experience greater infill and redevelopment. Higher densities and shorter commute trips may also support future transit operations within these geographies. The amount of growth could mean greater intensification in the urban area overall and in parts that have traditionally not had as significant an amount of higher-density development.

- **Metropolitan cities** are assigned half the amount of growth under this alternative as they are under the Metropolitan Cities Alternative. As such, the impacts to land use are decreased. Population and employment growth could be accommodated through infill and some redevelopment. Housing could take the form of townhomes, and other mid-rise housing types, in contrast to the high-rise housing that was more likely under the Growth Targets Extended and the Metropolitan Cities alternatives for these cities. It is possible that the majority of this growth could be accommodated in or around each of these cities' designated regional growth centers and other local activity centers.
- **Core suburban cities** receive a similar amount of growth (although more employment) under the Larger Cities Alternative as under the Metropolitan Cities Alternative. From a land use perspective, the impact could be similar to those described under the Metropolitan Cities Alternative.
- **Larger suburban cities** is the geography that shows the most distinction in this alternative as compared to the others, with more than double the amount of growth as compared to the next largest alternative (the Metropolitan Cities Alternative) for these cities. As the larger suburban cities become more intensively developed and compact, there could be greater potential for higher intensity land uses to spill over into adjacent neighborhoods. Depending on how growth is accommodated, there could be pressure to expand these cities' current boundaries. As noted under the Metropolitan Cities Alternative, this amount of growth could likely lead the establishment of additional designated growth centers, whether regional, subregional, or local.

Under this alternative, these cities could experience the greatest intensification of their land uses. This intensification could likely lead to a change in the existing character of these cities and their neighborhoods as both more (and potentially larger) buildings are developed to accommodate this growth. The growth could also impact crowding, traffic congestion, service levels for all types of infrastructure and could potentially require upgrades and retrofits to existing utilities. For more information, see *Chapter 5.7 – Public Services and Utilities*.

At the same time, this alternative could enable increased densities, or mixed-use development and may provide greater opportunities for employment near residential land uses in these locations. This alternative may also offer an opportunity for the expansion of commercial and office land uses in suburban areas, although residential land use may also compete with land available for employment uses.

- **Smaller suburban cities** receive their least amount of growth under this alternative. From a land use perspective, there might be the least amount of change from today. The larger change for these cities could be in the area of land use planning, as the amount of growth is about half of that called for under adopted plans. Achieving this amount of growth might require downzones or other planning actions to limit growth.

- **Unincorporated urban growth areas** receive double the amount of growth they would receive under the Metropolitan Cities Alternative. They receive approximately the same amount of employment and less than half the residential growth as under Growth Targets Extended (meaning a stronger commercial than residential focus). However, from a land use and land use planning perspective, the impacts would fall between those described under the Growth Targets Extended and Metropolitan Cities alternatives. As noted in Figure 5-2-9, this alternative is estimated to have the second lowest amount of population and employment that could be located adjacent to the urban growth area boundary, with about 650,000 (an increase of about 75 percent over the base year 2000). This is about 75,000 less than Growth Targets Extended but about 25,000 more than the Metropolitan Cities Alternative.

Rural Land

The amount of growth assigned to rural lands is identical to the amount of the Metropolitan Cities Alternative, therefore, the impacts under this alternative to rural areas are identical to those under the Metropolitan Cities Alternative.

Natural Resource Land

The impacts under this alternative are nearly identical to the Metropolitan Cities Alternative, although the increased amount of development in the unincorporated urban growth areas as compared to the Metropolitan Cities Alternative means that the potential to impact these lands is somewhat higher. The Larger Cities Alternative is estimated to have the lowest amount (but nearly equal to the Metropolitan Cities Alternative) of population and employment that could be located adjacent to natural resource lands (as shown in Figure 5-2-10), with over 260,00 (an increase of about 50 percent over the base year 2000). This is about 40,000 less than Growth Targets Extended (and about 7,500 more than the Metropolitan Cities Alternative).

Critical Areas

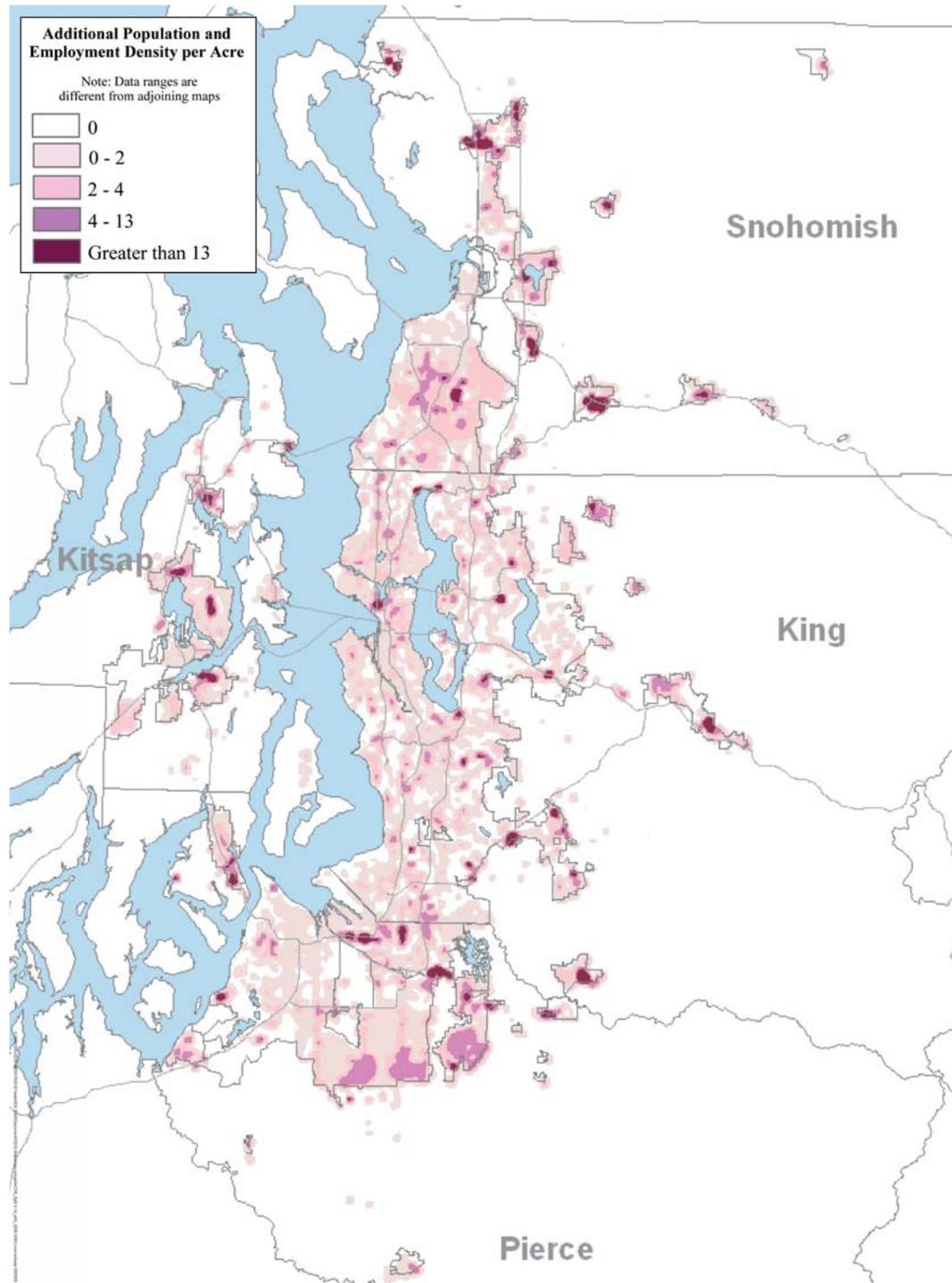
Similar to natural resource land, impacts to critical areas under this alternative are nearly identical to the Metropolitan Cities Alternative, although the increased amount of development in the unincorporated urban growth areas compared to the Metropolitan Cities Alternative could slightly increase the potential for impacts to critical areas.



SMALLER CITIES ALTERNATIVE

The Smaller Cities Alternative would focus a larger amount of growth in smaller suburban cities and the unincorporated urban growth area, shifting growth from metropolitan cities and core suburban cities. In both geographies, the amount is at levels that are substantially higher than is currently planned. The following figure presents a conceptual illustration of future density of activity under the Smaller Cities Alternative.

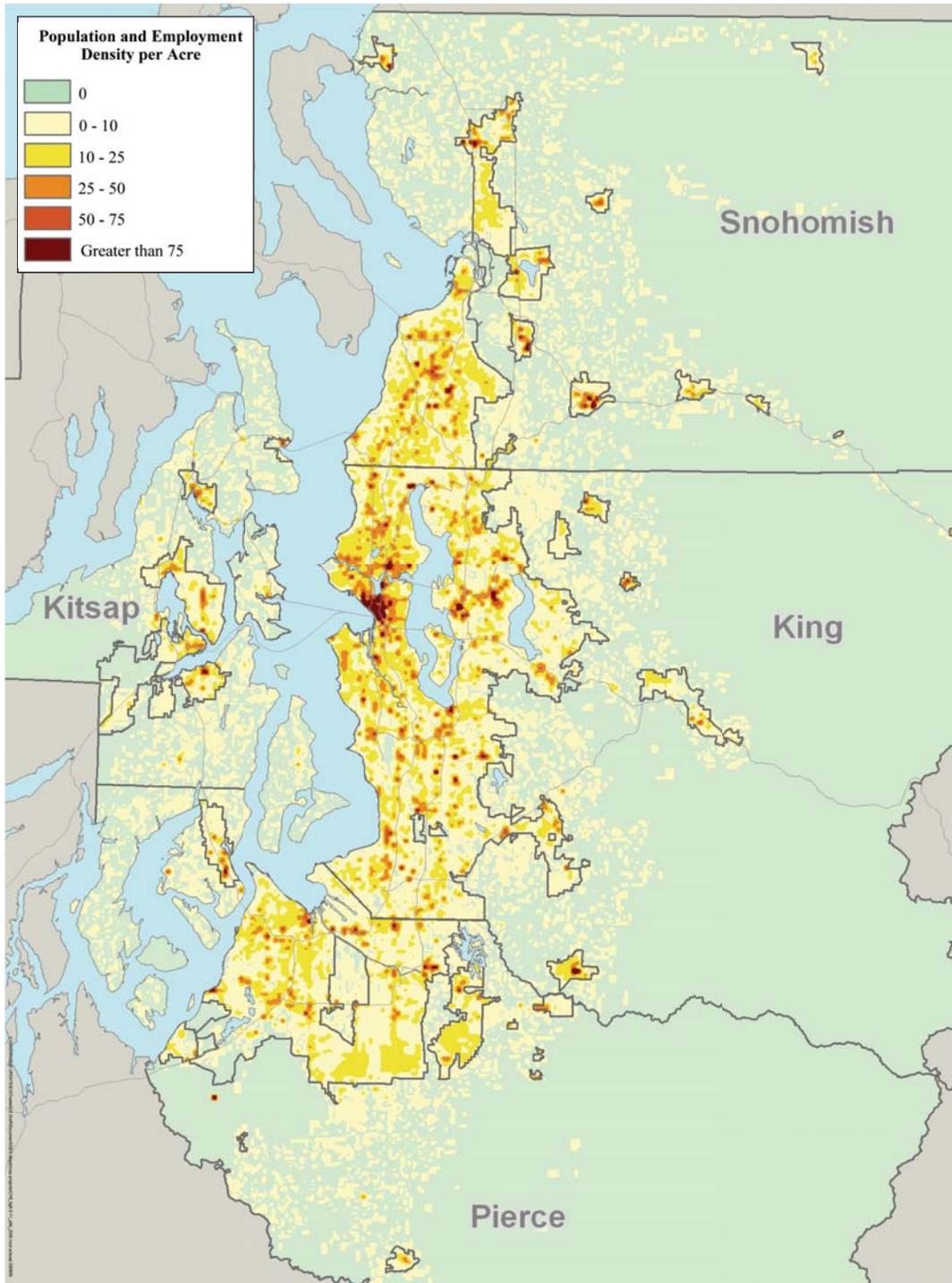
**FIGURE 5-2-15: SMALLER CITIES ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – ADDITIONAL DENSITY (2000-2040)**



Source: Puget Sound Regional Council, 2006

Note: See notes for Figure 5-2-12.

**FIGURE 5-2-15: SMALLER CITIES ALTERNATIVE CONCEPTUAL MAPS:
DENSITY OF POPULATION AND EMPLOYMENT – FUTURE CONDITION (2040)**



Source: Puget Sound Regional Council, 2006

Note: See notes for Figure 5-2-12.



This alternative concentrates growth in just a few of the regional geographies. However, these geographies contain a large number of cities and unincorporated areas throughout the region, which means that this alternative could affect land use in many areas throughout the region. This alternative could lead to a form that would be much less differentiated (between urban and rural land uses) than what exists today. The existing highly urbanized portions of the region (metropolitan cities, core suburban cities, and larger suburban cities) could remain much as they are currently. However, intensified land use could occur at the urban fringe and beyond (smaller suburban cities, unincorporated urban areas, and rural areas), essentially spreading low-density urban development throughout the urban growth area and into the rural area. As noted in Figure 5-2-8, this alternative is estimated to have the lowest amount of population and employment that could be located adjacent to existing and planned transit routes, with over 5,750,000 (an increase of about 50 percent over the base year 2000). This is about 250,000 less than Growth Targets Extended and about 700,000 less than the Metropolitan Cities Alternative.

Urban Land

The Smaller Cities Alternative would result in the most dispersed growth and the most growth at the edge of the region's urban growth area. This alternative assigns just a little bit less growth to the urban area than Growth Targets Extended. However, the growth is shifted dramatically to the smaller cities and to the unincorporated urban area.

- **Metropolitan cities** receive by far their least amount of growth. From a land use perspective, there might be the least change from today, and almost none of the change as described under the Growth Targets Extended and Metropolitan Cities alternatives. The larger change for these jurisdictions is in the area of land use planning, as the amount of growth is significantly less than called for under adopted plans, and anticipated growth rates for designated regional growth centers may not be fulfilled. Achieving this amount of growth might require downzoning or other planning actions to limit growth.
- **Core suburban cities** are treated the same as metropolitan cities under this alternative, and similarly, there might be little change from today to the land use in these cities. Similar to metropolitan cities, this amount of growth could be similarly inconsistent with adopted plans for these cities and might require some planning actions to limit growth.
- **Larger suburban cities** are treated the same as metropolitan cities under this alternative, and similarly, there might be little change to the land use in these cities from today. However, the amount of growth is not significantly different from adopted plans; therefore, there could likely not be much need for planning actions to limit growth.
- **Smaller suburban cities** is the geography that shows the most distinction in this alternative as compared to the others, with more than triple the amount of growth as compared to the next largest alternative (Growth Targets Extended) for these cities. Land use in these cities could change dramatically from what exists today. Although the growth could be spread to some extent over the 52 cities, there could almost certainly be more areas of high-density commercial development and probably more mid-rise housing than what exists today. Neighborhoods throughout these smaller cities might be impacted by the growth, with spillover of both commercial and residential growth.

Under this alternative, these cities could experience the greatest intensification of their land uses. This intensification could likely lead to a change in the existing character of these cities and their neighborhoods as both more (and potentially larger) buildings are developed to accommodate this growth. The growth could also impact crowding, traffic congestion, service levels for all types of infrastructure, and could potentially require upgrades and retrofits to existing utilities. For more information, see *Chapter 5.7 – Public Services and Utilities*. This could be particularly challenging for these cities, as they have traditionally not had as much mid-rise and high-rise development, and these might be necessary in order to accommodate the allocated levels of growth. Also, this alternative could likely mean that these cities will need to revisit adopted plans to ensure that planned land uses can accommodate these levels of growth.

Industrial areas and smaller commercial centers in these cities could see increased growth, and it is possible that taller buildings could be developed. Given the limited road network in many of these areas, there could be the need for a significant amount of collector and arterial streets to be built. In most cases, to achieve greater densities in smaller cities, the cities might require developing new downtown-type plans and design concepts, and potentially the designation of new subregional or local growth centers. To achieve a balance in land uses (jobs/housing), perhaps the highest amount of interjurisdictional planning could be needed to help achieve agreements on geo-

graphical boundaries (i.e., annexations) and to help ensure that the land use mix in the plans would allow balanced development. Land uses in these cities may develop at a variety of densities, and locations where lower-density residential commercial and office land uses are developed may result in challenges to achieving balance between housing and employment.

- **Unincorporated urban growth areas** are similar to smaller suburban cities under this alternative in that they would receive significantly more growth under this alternative than under any of the others (overall, more than double the next largest alternative — Growth Targets Extended). Land use in these areas could change dramatically from what exists today, with effects similar to those described for the smaller suburban cities. The residential orientation of these areas could change, with significant increases in commercial activities. This might require the development of new commercial centers. There could be more multifamily housing in these areas compared to today. And, given the limited road network in many of these areas, there could be the need for a significant number of collector and arterial streets to be built. It is possible this amount of growth in these areas could lead to expansions of the existing urban growth area, with potential for these lands to be annexed into cities, or to incorporate as new cities. As noted in Figure 5-2-9, this alternative is estimated to have the highest amount of population and employment that could be located adjacent to the urban growth area boundary, with about 1,025,000 (an increase of about 170 percent over the base year 2000). This is about 300,000 more than Growth Targets Extended and nearly 400,000 more than the Metropolitan Cities Alternative. Similar to smaller suburban cities, planned land uses might need to be revisited to ensure that the allocated levels of growth could be accommodated.

Rural Land

The amount of growth assigned to the rural area in the Smaller Cities Alternative is similar to the amount in Growth Targets Extended, although it contains less residential growth and more commercial growth. Because of the more balanced mix of uses, the impacts to the rural areas under the Smaller Cities Alternative are likely to be similar or less than the impacts under Growth Targets Extended. There is the potential that there would be less commuting to urban areas for employment and services than was estimated under the Growth Targets Extended Alternative. However, the amount of growth in the smaller suburban cities (which includes freestanding cities that are surrounded by rural areas) could markedly increase urban pressure on these lands, with a potential for re-designation of these lands to urban. This amount of growth might conflict with and diminish rural character; however, it also has the potential to increase opportunities for economic and land development. In addition, more growth in these areas may be less likely to be served by transit. This growth pressure in rural areas might be inconsistent with the Growth Management Act and to policies and programs in some county comprehensive plans.

Natural Resource Land

The Smaller Cities Alternative assigns the most amount of growth to those urban and rural areas that are near natural resource lands. This growth could likely lead to annexations, incorporations, and re-designations. Each of these actions moves land from less urban characteristics to more urban characteristics, both increasing the pressure for conversion of natural resource lands and increasing potential conflicts with natural resource land uses. As noted in Figure 5-2-10, this alternative is estimated to have the highest amount of population and employment that could be located adjacent to natural resource lands, with almost 350,000 (an increase of about 100 percent over the base year 2000). This is about 45,000 more than Growth Targets Extended, and over 90,000 more than the Metropolitan Cities and Larger Cities alternatives. The Smaller Cities Alternative has the highest potential to negatively impact natural resource lands.

Critical Areas

Similar to natural resource land, the Smaller Cities Alternative assigns the most amount of growth to those urban and rural areas that are close to critical areas, increasing the likelihood for conversion and the potential for land use conflicts. The Smaller Cities Alternative has the highest potential to negatively impact critical areas.



5.2.3 Cumulative Effects

Depending on the alternative, cumulative effects may vary. Planned growth, with its associated land development, as expressed in the alternatives, is the most substantial action affecting the magnitude and severity of cumulative effects to land use in the region. However, the actions of local jurisdictions and other infrastructure/transportation projects could also affect land use. Densities could increase within areas already designated for residential and/or employment-related land uses, and vacant land may also be utilized under existing plans for each of these broad uses. Transit might be provided to connect employment and housing centers and serve future high-density population centers.

Cumulative impacts have been incorporated into the analysis of land use, population, employment, and housing by basing growth on PSRC's model. This model forecasts future land use pattern changes at the local and regional levels and includes programmed future transportation improvements.

Local jurisdictions in the region are facing serious transportation facility adequacy problems. If these issues are not addressed adequately by 2040, local jurisdictions may not be able (or willing) to accommodate planned growth. If this occurs, growth could be expected to disperse elsewhere in the region, such as the rural areas. If allowed to occur, this growth pattern could have potential for cumulative effects typically associated with urban sprawl, such as increased demand on the transportation infrastructure, demand on public services, adverse impacts on the environment, and long-term increases in the cost of providing public services.

Another issue that could affect the location and character of development would be the recent listing of Orca whales under the Endangered Species Act. This might affect both shoreline and upland development activities.

5.2.4 Potential Mitigation Measures

The alternatives are intended to provide an assessment of regional policy and describe potential impacts associated with growth from a regional perspective. The Growth Management Act identifies available options for addressing imbalances between growth, infrastructure needs, and available funding. Comprehensive plans and/or capital facility plans must be revised to identify additional revenues, modify levels of service, or change land use. At the local level, jurisdictions with land use and planning responsibilities would identify discrete actions to mitigate the direct impacts of urbanization.

General strategies that could be pursued to address land use issues include:

- Evaluating the effects of Endangered Species Act listings and the resulting changes in development regulations on the regional land use pattern.

Strategies for urban lands:

- Maintaining a centers concept that emphasizes regional growth centers, while recognizing the importance of other types of subregional centers and redevelopment areas.
- Each of the region's municipalities should work to implement centers development in at least one town center to help accommodate growth while minimizing impacts on existing neighborhoods.
- Using existing urban areas more efficiently by promoting more density, where appropriate.
- Incorporating design standards into planning and development to make dense development more attractive and more compatible with existing development.
- Working with local jurisdictions to discuss and develop strategies for phasing growth, using centers and transportation improvements to determine the location and timing of growth.
- Improving long-range planning for unincorporated areas inside the urban growth area to address fully the transition of these areas to municipalities (through annexation or incorporation).
- Siting schools and other institutions in a manner that reinforces overall growth management objectives.
- Promoting transportation investments that can help mitigate congestion and provide viable transportation alternatives to serve increased amounts of population and employment in these areas.

Strategies for rural lands:

- Promoting programs that support rural-based economic development and prosperity that are consistent with rural activity and rural character.
- Increasing development densities or clustering to help reduce the conversion of rural land. This may also be effective for reducing the loss of farmland. In addition, this could create more centralized areas of employment to reduce longer-distance commuting and potentially make more jobs accessible by transit.
- Recognizing sub-categories within the rural area to provide flexibility in addressing differences that exist within and among lands designated as rural throughout the four-county region. Provide regional guidance for allocating growth in rural subareas.
- Establishing regional criteria for urban growth area expansion. Providing some level of regional guidance in decisions of counties and countywide planning organizations regarding movement of urban growth area boundaries.
- Designing facilities and infrastructure according to rural standards that neither negatively impact rural character nor provide new opportunities for increased development.
- Addressing level-of-service standards for all services in rural areas, including sewage disposal, water, and transportation.
- Providing regional guidance on siting special purpose district facilities within rural areas.
- Establishing rural population and employment targets to maintain appropriate limits on allowable rural development.

Strategies for resource lands and critical areas:

- Increasing the use of innovative programs for preserving certain lands, including prime agricultural land or critical areas, through efforts such as the Transfer of Development Rights programs, to help provide economic benefit to land owners.
- Developing new or enhanced revenue sources to conserve lands, through tools such as mitigation banking, or enhancing the use of tools such as current use taxation.
- Providing for agricultural-related accessory uses on agricultural lands to keep the land in agricultural use while allowing for supplemental income.
- Promoting programs such as farmer's markets to increase consumption of locally-grown products.
- Providing for programs to acquire as public lands areas that have been designated as critical areas.

5.2.5 Significant Unavoidable Adverse Impacts

Depending on the alternative, significant unavoidable adverse impacts may vary. Adopted plans, policies and regulations might need to change to accommodate any of the future growth alternatives. There could be an intensification of development throughout the region, but local jurisdictions would determine the actual permitted densities and types of land uses.

- **Urban Land.** The region's urbanized area is likely to become denser as an additional 1.6 million people populate the region between today and 2040. With compact growth, development could occur at increased densities.
- **Rural Land.** Growth and development of rural land could occur. Counties might need to adopt policies designed to direct new development in unincorporated areas near existing city boundaries or within city spheres-of-influence and consider tools to minimize the impacts of rural development, while still supporting appropriate rural economic and land development.
- **Natural Resource Land.** Growth could occur close to natural resource lands, creating pressure for conversion of these lands to other land use types, making it important to implement tools to keep these lands economically viable.

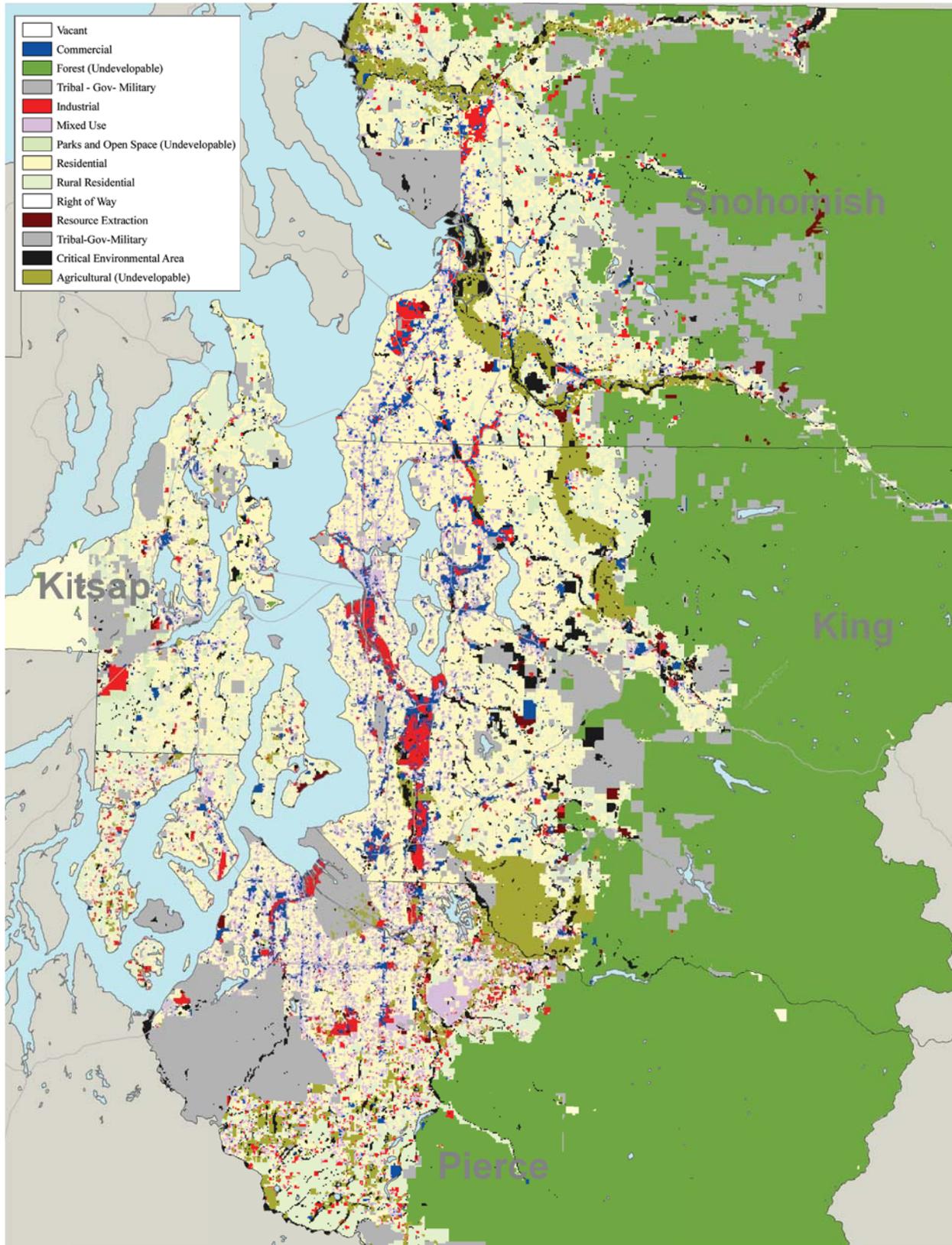


Supporting Figures

A. EXISTING LAND USE MAP

The following figure shows the existing land use in the base year (2000), based on the INDEX land use classification system.

FIGURE 5-2-16: BASE YEAR EXISTING LAND USE (2000)

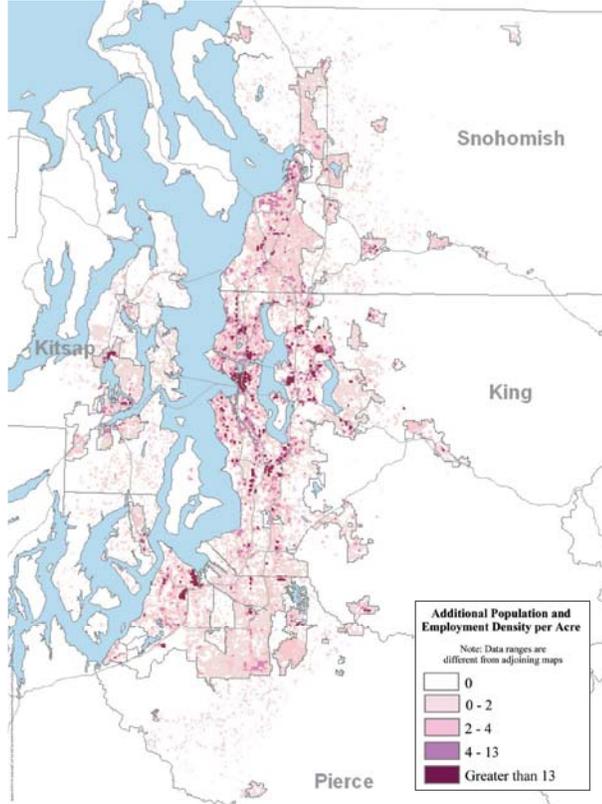


B. SIDE-BY-SIDE MAPS SHOWING DENSITY OF THE ALTERNATIVES

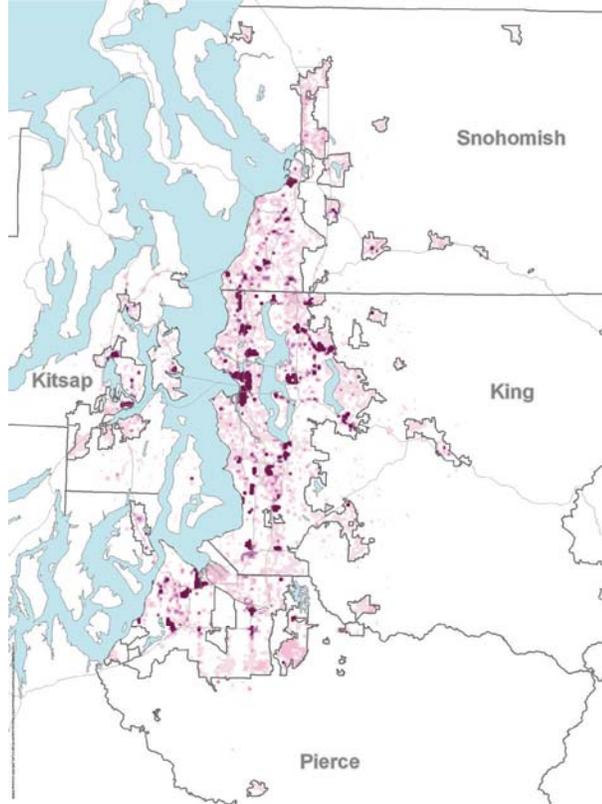
The following figures compare both the additional density that was “painted” using INDEX, as well as the future density condition.

**FIGURE 5-2-17: SIDE-BY-SIDE COMPARISON OF ALTERNATIVE CONCEPTUAL MAPS
— ADDITIONAL DENSITY OF POPULATION AND EMPLOYMENT (2000-2040)**

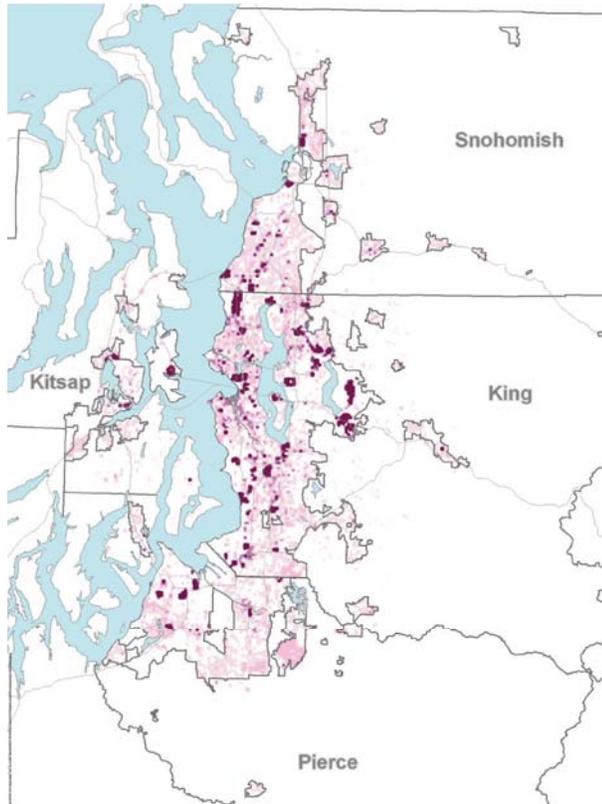
GROWTH TARGETS EXTENDED



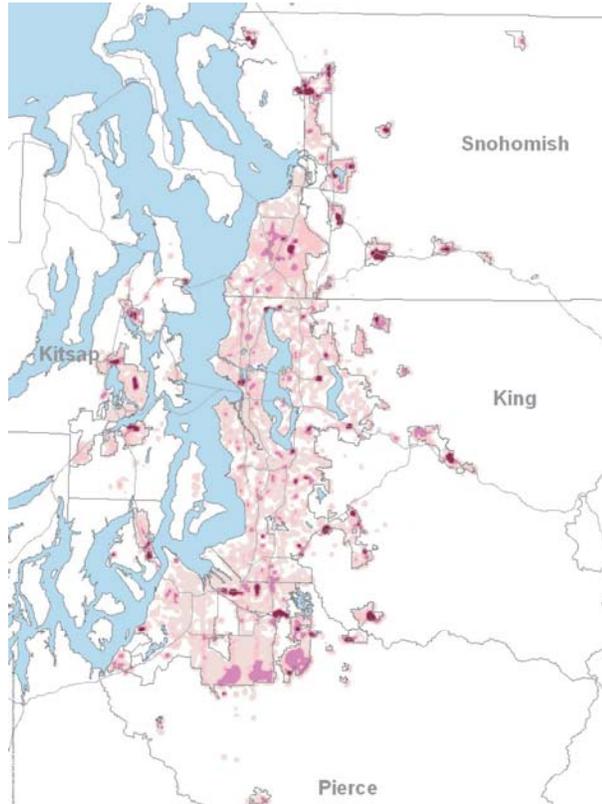
METROPOLITAN CITIES



LARGER CITIES

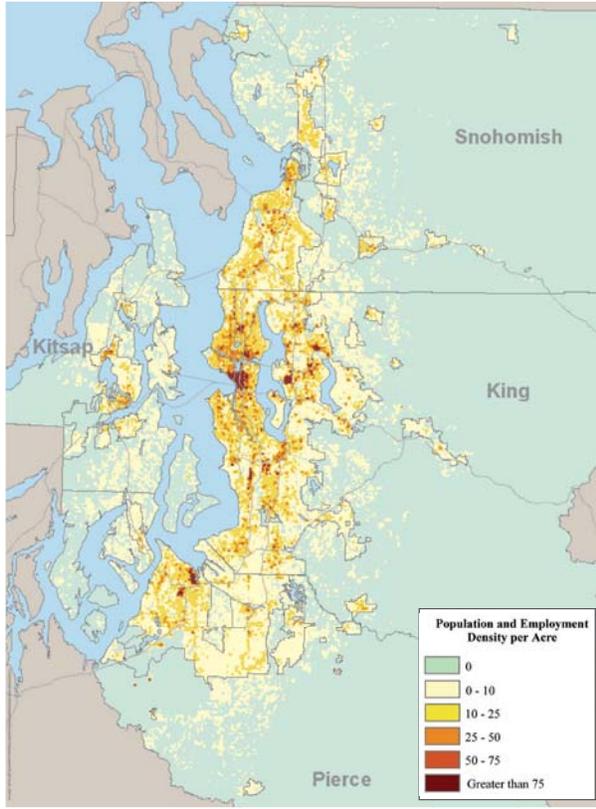


SMALLER CITIES

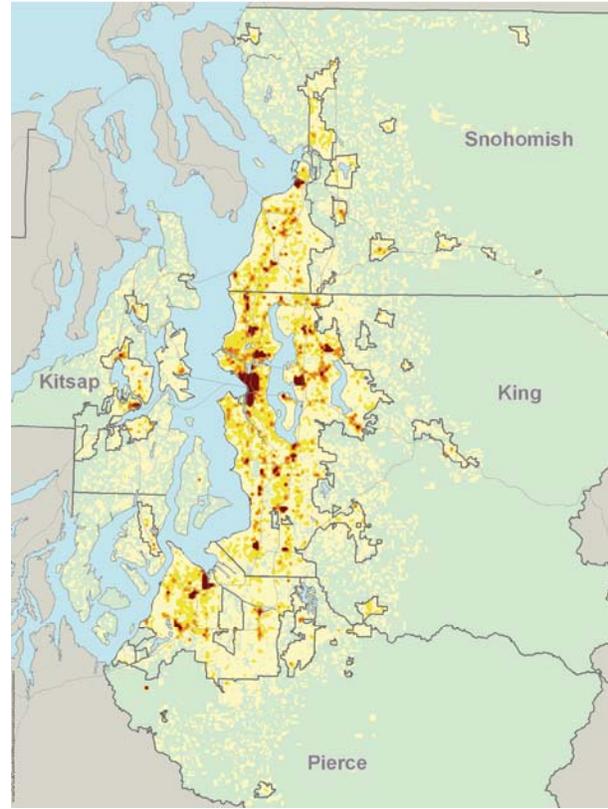


**FIGURE 5-2-18: SIDE-BY-SIDE COMPARISON OF ALTERNATIVE CONCEPTUAL MAPS
 – FUTURE DENSITY CONDITION OF POPULATION AND EMPLOYMENT (2040)**

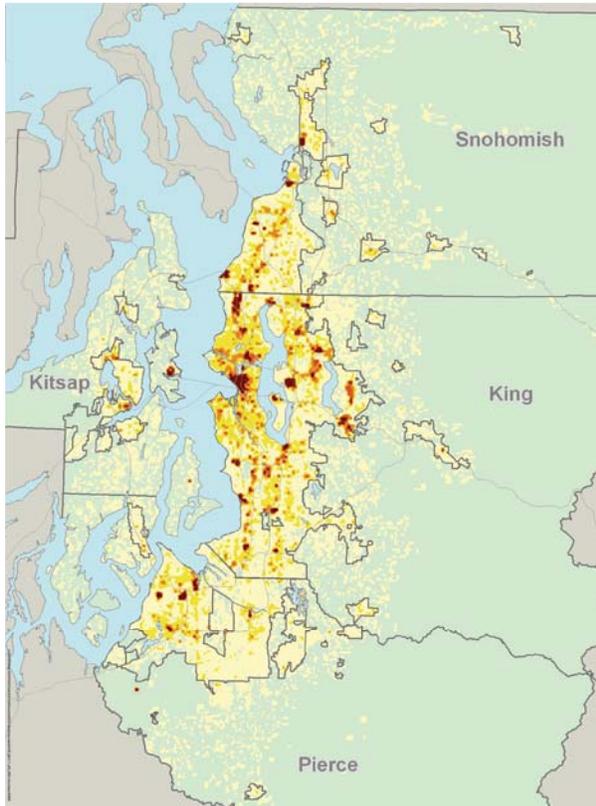
GROWTH TARGETS EXTENDED



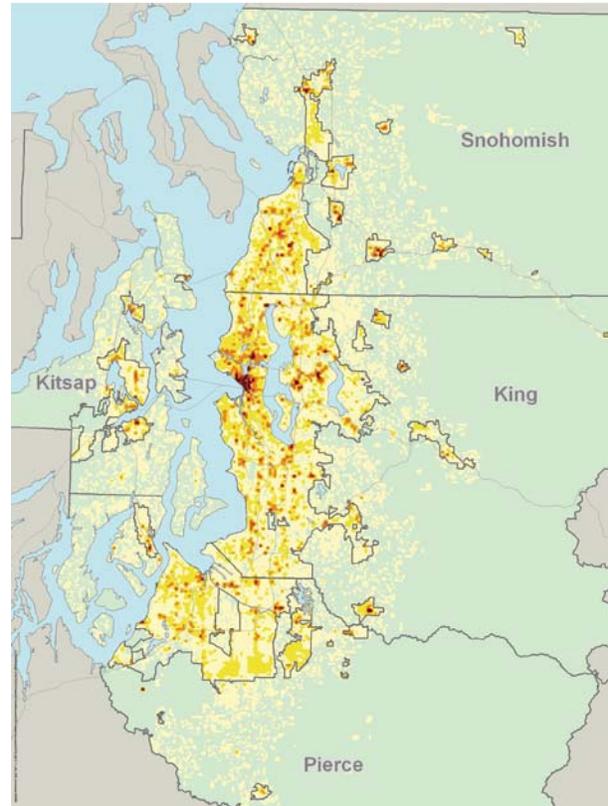
METROPOLITAN CITIES



LARGER CITIES



SMALLER CITIES





Transportation

This chapter describes the region’s existing and planned transportation services and infrastructure. It then analyzes how the growth distribution alternatives are served by, and impact, the planned system based on a wide range of transportation performance indicators.

5.3.1 Affected Environment

Expanding and maintaining a safe, efficient and reliable transportation system is critical to the regional and state economy. It is also an important factor in maintaining the quality of life for the people who live in the Puget Sound area and throughout the state. State, local, and regional governments and organizations face the challenge of maintaining, operating, and improving the existing transportation system to accommodate continued economic and population growth and the associated demands on the transportation system.

The initial transportation component of VISION 2020, which was adopted in 1990 and updated in 1995, identified the region’s strategies for meeting this challenge and provided a basis for the more detailed planning and investment strategies identified in the region’s Metropolitan Transportation Plan, called *Destination 2030*. VISION 2020 was the first major regional attempt to address growth and traffic congestion, and many communities in the region have begun to implement VISION 2020’s transportation objectives.

Population projections indicate that by 2040, over 5 million people could be living within the four-county region. This potentially translates into millions of additional trips and potentially many more hours of delay on a transportation network that is already crowded. While it is possible to expand transportation capacity (both roadways and transit), it is doubtful that the region has the financial capacity, land supply, or public support to add enough capacity to return the region to service levels of 20 years ago. Congestion, especially during the peak periods, could likely be a part of our future regardless of the growth alternative chosen. However, we can make improvements.

The current regional transportation plan, *Destination 2030*, has identified needed investments of over \$100 billion to preserve, maintain, operate and expand the region’s transportation system. The region has begun implementing that plan, with the first phase of Sound Transit either operating or under construction, the Washington State Legislature investing several billion dollars in highway expansion, and a regional investment package for both a Sound Transit Phase 2 and a roadway proposal from the Regional Transportation Investment District under development for a 2007 public vote. These investments could improve traffic flow at key chokepoints and provide travel options for our growing population. Still, the current plan calls for tens of billions of dollars of additional investments in system expansion to address growth expected up to 2030.

How does this transportation plan perform under the growth alternatives, which account for an additional 10 years of population and job growth? This section evaluates how the four different growth alternatives, described in further detail in *Chapter 4 – Definition of Alternatives*, affect the performance of the planned transportation system.



A. EXISTING AND PLANNED TRANSPORTATION SERVICES AND INFRASTRUCTURE

This section describes the different components of the region's existing transportation system and the planned improvements to the system as defined in *Destination 2030*.

The regional facilities and services that make up the existing Metropolitan Transportation System were identified in the 1995 Metropolitan Transportation Plan and updated in 2001 with the adoption of *Destination 2030*. Metropolitan Transportation System facilities and services are defined both functionally and geographically. A facility or service is part of the Metropolitan Transportation System if it provides access to any activities crucial to the social and economic health of the central Puget Sound region. Facilities that weave parts of the region together by crossing county or city boundaries are critical to the Metropolitan Transportation System. Any link that accesses major regional activity centers, such as an airport, is also an element of the Metropolitan Transportation System.

Facilities in the Metropolitan Transportation System include those from the following transportation systems and programs: (1) roadway system, (2) ferry system, (3) transit systems, (4) nonmotorized system, (5) freight and goods system, (6) intercity passenger rail, (7) regional aviation system, (8) transportation system management programs, and (9) transportation demand management programs. These are illustrated in Figure 5-3-1.

For more detailed maps of these Metropolitan Transportation System components, see *Destination 2030's* Technical Appendices (maps 4-1 through 4-6), which can be viewed on PSRC's Web site at www.psrc.org.

Figure 5-3-2 illustrates the nature and extent of the transportation improvements proposed in *Destination 2030* and as described on the subsequent pages.

1. Roadway System

Existing system.¹ The region includes 16,800 miles of roadways ranging from Interstate highways to residential streets. Roadways serve two primary functions: (1) they provide mobility to move goods and people from one location to another and (2) they provide access to land (residences and businesses). The degree to which one of these functions predominates over the other determines a roadway's functional classification. These functional classifications are hierarchical and comprise the following categories: freeways or expressways, principal arterials, minor arterials, collectors, and local streets.

At one end of the scale, interstate highways primarily move goods and people from one population or economic center to another and have high traffic volumes and speeds. At the other end of the scale, local streets primarily provide direct access to residences and businesses and have lower traffic volumes and speeds. Arterials and collector roadways complete the system and connect the interstate highway network to the local street system.

Destination 2030 planned investments. The plan includes additional capacity and system management enhancements to improve mobility on the region's highway and arterial roadways. The region's highest roadway priorities are safety, maintenance and preservation projects, and projects that optimize the use of the existing system (transportation systems management). Roadway capacity expansion projects include the following:

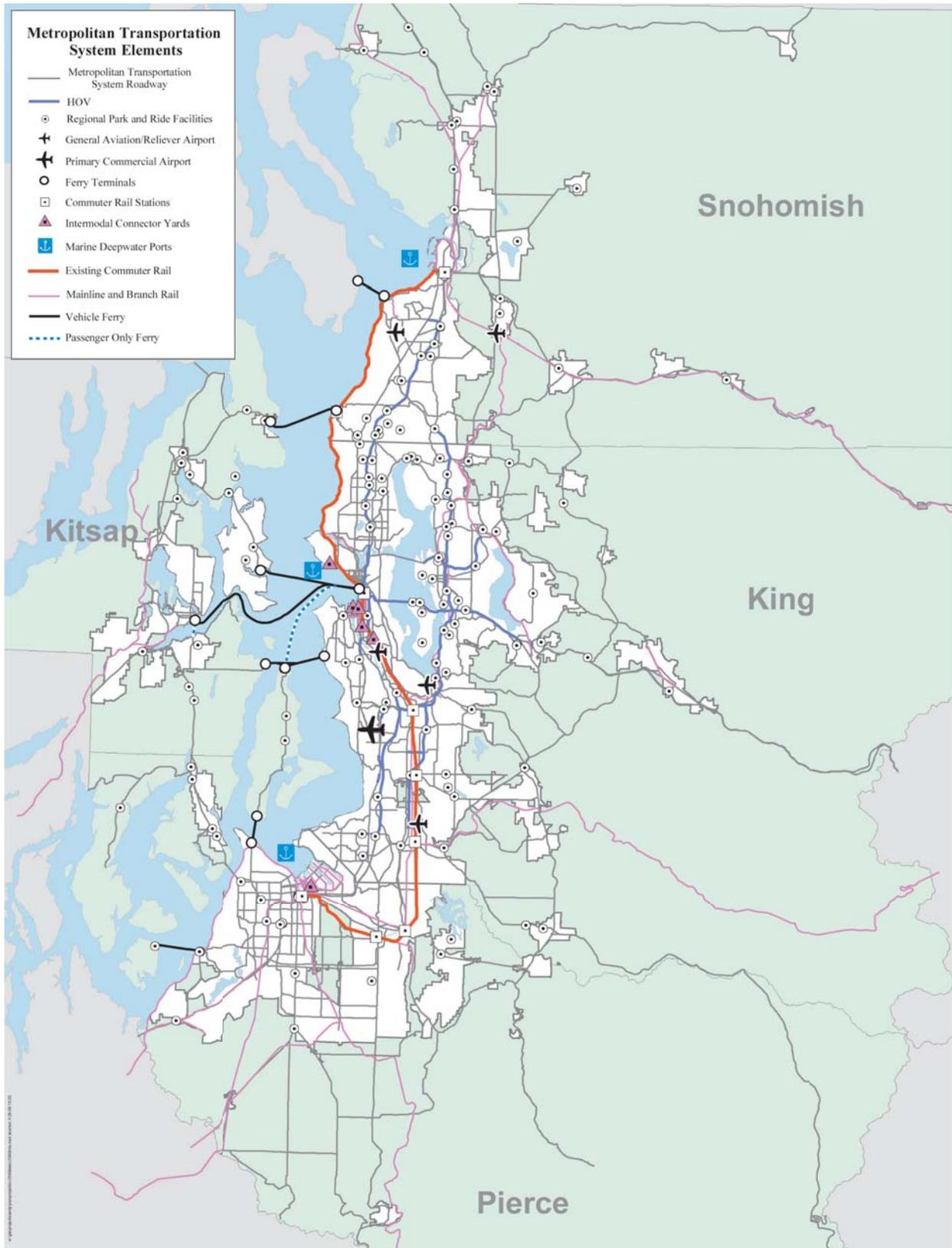
- Over 2,000 miles of new highway and regional arterial lanes to address the region's worst choke points, to finish projects that have already started and anticipate future problems. This represents an 18 percent increase in regional arterial and state freeway system lane miles.
- 1,000 lane miles of these projects are targeted to be open to traffic within the next 10 years.
- Over 27 new interchanges, 15 new overpasses and 185 upgrades to intersections.

The plan also provides for the adequate maintenance of roadways and the retrofit of critical bridges to meet earthquake standards. The following improvements are planned for these major transportation corridors:

- Interstate 90: Interstate 5 to Interstate 405 — Major widening to add HOV and general purpose capacity.
- Interstate 405: Tukwila to Lynnwood — Major widening to add general purpose capacity.
- State Route 3: Belfair to Silverdale and Poulsbo to Hood Canal — Widening to add HOV and general purpose capacity.

¹ The regional roadway component of the Metropolitan Transportation System includes any highway or roadway facility that is part of one of the following three categories: roadways included in the National Highway System (includes all Interstate and U.S. highways), state highways, and principal arterials, either locally identified or officially identified according to the Federal Functional Classification System.

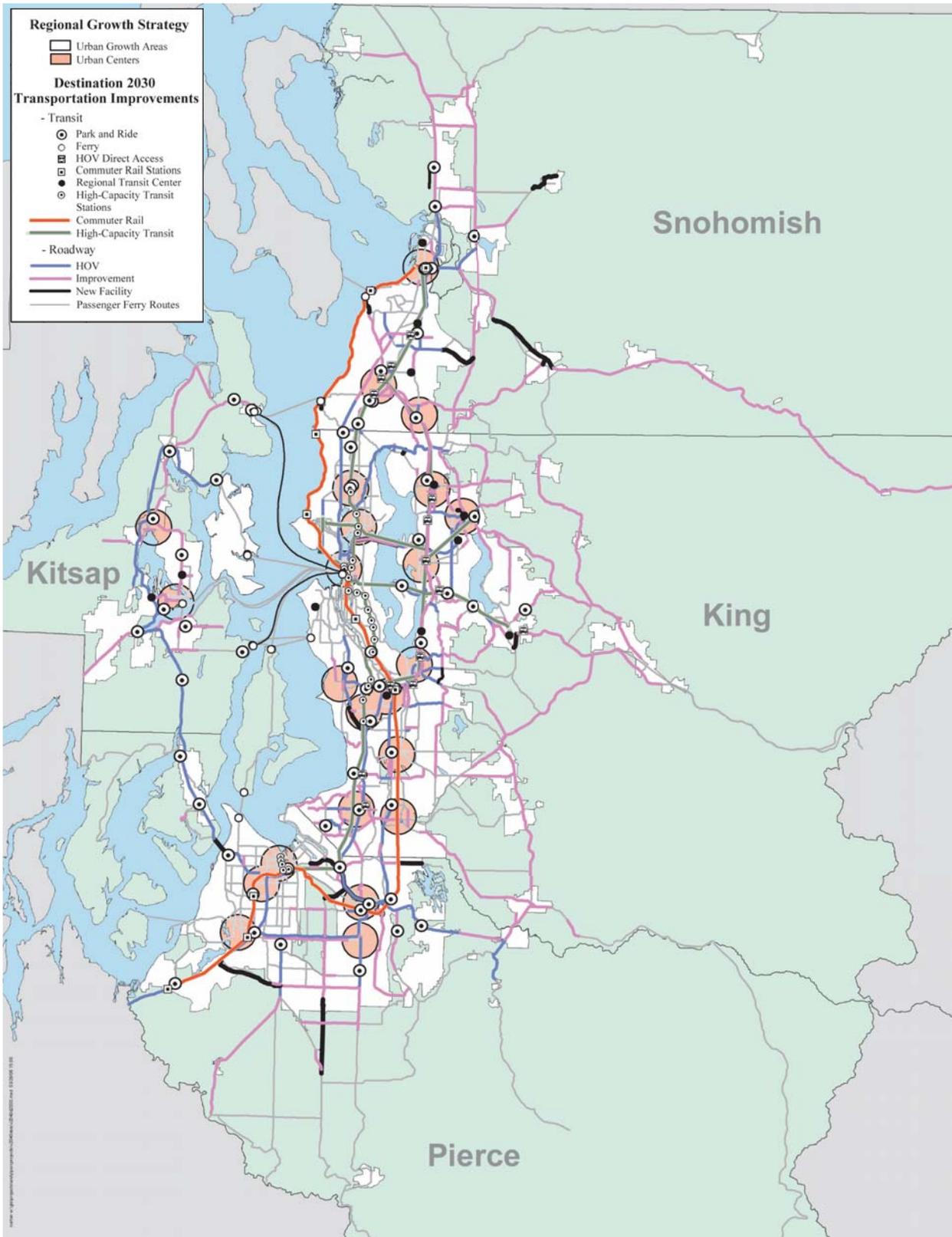
FIGURE 5-3-1: EXISTING METROPOLITAN TRANSPORTATION SYSTEM



Source: Puget Sound Regional Council



FIGURE 5-3-2: DESTINATION 2030 MAP



Source: Puget Sound Regional Council

- State Route 9: Woodinville to Arlington — Widening to add general purpose capacity.
- State Route 16: Interstate 5 in Tacoma to State Route 3 in Kitsap County — Widening to add HOV and general purpose capacity, interchange improvements and a freeway monitoring and management system.
- State Route 18: Interstate 5 to Interstate 90 (Covington to Snoqualmie) — Interchange construction, widening to add HOV and general purpose capacity and a freeway monitoring and management system.
- State Route 99: Federal Way to Lynnwood — New viaduct, widening to add HOV and general purpose capacity, intersection and traffic signal improvements.
- State Route 167: Puyallup to Port of Tacoma — Interchange construction and major widening to add HOV and general purpose capacity. Includes a freeway monitoring and management system. Construction of new facility from I-5 to Port of Tacoma.
- State Route 509: Completion of the corridor from Burien to Interstate 5 — Construction of new roadway.
- State Route 512: Interstate 5 to State Route 167 — Widening to provide HOV capacity. Includes a freeway monitoring and management system.
- State Route 520: Seattle to Redmond — New bridge with HOV capacity, widening to add general purpose capacity, interchange reconstruction.
- State Route 522: Woodinville to Monroe — Widening to add HOV capacity, complete interchange and add park and ride lot capacity.
- US 2: Everett to Skykomish — Widening to add general purpose capacity.

Within the roadway system is the high-occupancy vehicle system, which includes high-occupancy vehicle lanes on freeways and arterial roadways, limited access ramps to highway high-occupancy vehicle lanes, and high-occupancy vehicle by-pass lanes on metered highway ramps. This system provides a dedicated right-of-way for transit. Depending upon vehicle volumes and the operational characteristics of the roadway, other high occupancy vehicles share the system with transit. These include vanpools and carpools that have two or more passengers (on State Route 520, high-occupancy vehicle lanes are limited to three or more passengers).

The Washington State Department of Transportation (WSDOT) is responsible for the planning and construction of high-occupancy vehicle lanes but coordinates with PSRC, transit agencies, and local jurisdictions for high-occupancy vehicle operations and management. Washington State Department of Transportation has prioritized the freeway system with the identification of the “core” high-occupancy vehicle lanes that serve the central Puget Sound region. The core system represents a subset of Washington State Department of Transportation high-occupancy vehicle lanes that are identified in *Destination 2030* and includes high-occupancy vehicle lanes on interstate and limited-access state routes.

When complete in approximately 10 years, the planned high-occupancy vehicle network will consist of 276 miles of continuous freeway high-occupancy vehicle lanes, key arterial high-occupancy vehicle lane segments, and access ramps and interconnections. While the existing high-occupancy vehicle system already offers time-savings and more reliable travel times for those commuters using buses and carpools, additional time-savings and reliability could be realized when the high-occupancy vehicle system is complete. It is likely that changes in occupancy requirements and/or some other management strategy, like the implementation of High Occupancy Toll (HOT) lanes, could be required to keep these lanes operating reliably for transit. (HOT lanes allow single-occupant vehicles to access the HOV lane system by paying a toll. The amount of the toll is varied to keep traffic volume at a level that maintains reliable traffic flow.)

2. Ferry System

Existing system.² Puget Sound’s ferry transportation system is both a marine highway and high-capacity transit system. It functions as a vehicle-carrying marine highway that moves people and goods across Puget Sound and as a high-capacity transit system moving thousands of passengers in a single vehicle. Washington State Ferries operates 10 ferry routes within the four-county region. Nine of these routes provide service to a mixture of automobiles and walk-on passengers, and the remaining route is reserved exclusively for walk-on passengers. In addition to Washington State Ferries-operated ferries, the following ferry service is provided:

² The ferry component of the Metropolitan Transportation System includes: auto ferries, passenger-only ferries, and all the Washington State Department of Transportation ferry terminals and support facilities.



- Kitsap Transit Foot Ferry — Bremerton to Port Orchard (passenger only)
- Pierce County — Steilacoom to Anderson and Ketron Islands (autos and walk-ons)
- Kitsap Ferry Company — Bremerton to Seattle (passenger only)

Ferry terminals can provide an important link between the ferry route and the landside transportation system on both sides of Puget Sound. Terminals are being improved to strengthen the connections between ferries and other forms of transportation, such as bus, rail, automobile, pedestrian, and bicycle. Other terminal facilities supporting these system connections include high-occupancy vehicle lanes for preferential loading, park-and-ride lots, bicycle lockers, and ferry maintenance facilities.

Destination 2030 planned investments. The plan includes capital investments, terminal expansions and upgrades, park-and-ride facilities as well as vessel replacement and expansions. The plan calls for the following enhancements to the ferry system:

- Nine replacement passenger-only vessels and six new passenger-only vessels (while the importance of passenger-only service is recognized, there is currently no resolution regarding the proper entity to provide the service).
- Ten replacement auto-ferries and two new auto-ferries.
- New terminals at Edmonds and Mukilteo.
- Major improvements at Colman Dock in Seattle.
- Service improvements resulting in a 13 percent increase in vehicle capacity and a 24 percent increase in passenger capacity.

3. Transit Systems

Existing system.³ The region is served by both local and regional public transit service. Local transit service is provided by five transit operators serving five transit districts: Community Transit (Snohomish County), Everett Transit, King County Metro Transit, Kitsap Transit, and Pierce Transit. These operators provide fixed-route and demand responsive transit services, as well as vanpool and other alternative transportation services. Together, the five transit operators and the private sector providers offer the following services:

- 416 local fixed transit routes.
- Transit fleet of nearly 2,700 vehicles.
- One waterfront vintage streetcar route (the streetcar is temporarily out of service and service on the route is being provided by buses).
- One private monorail route.
- A park-and-ride inventory with roughly 35,000 parking spaces.
- Almost 5,000,000 annual fixed-route transit service hours.
- Over 1,000,000 annual demand responsive or paratransit service hours.

Destination 2030 planned investments. The plan depends heavily on providing more and better public transit service over the next 30 years. Moving from today's region that is largely auto-dependent to a region where numerous travel options are available and frequently used could require additional investment in public transportation.

Numerous service changes and facility improvements are planned by local transit operators to provide better local service and to support the regional high-capacity transit system. Investments include the following:

- A 40 percent increase in total transit service by the year 2010 and an 80 percent increase over 2000 levels by the year 2030.

³ The regional transit component of the Metropolitan Transportation System includes: existing and planned high-capacity transit services defined as public transportation services operating on exclusive right-of-way to provide a substantially higher level of passenger capacity, speed and service frequency than typical bus services operating on general purpose roadways; other existing and planned bus services (not considered high-capacity transit) that link major regional destinations and/or provide travel options in highly congested corridors; and existing and planned facilities that provide connections among and between the regional transit services, including large park-and-ride lots (>250 stalls), major bus transit centers, light rail and commuter rail stations, and auto and passenger-only ferry terminals.

- A 30 percent increase in demand responsive or para-transit service by 2010 and a 65 percent increase over 2000 levels by 2030.
- Expansion of regional park-and-ride capacity by 75 percent to meet projected 2010 needs (approximately 18,360 additional stalls) and by 175 percent to meet projected 2030 needs (25,850 stalls in addition to the 2010 expansion).

Beyond local transit service, major improvements are planned as part of the region's high capacity transit system. Sound Transit, the Central Puget Sound Regional Transit Authority, is responsible for creating and maintaining a mass transit system that connects regional economic and population centers in King, Pierce, and Snohomish counties. Sound Transit has made progress towards completing the following projects identified in *Sound Move* (1996):

- **Light Rail Service.** A light rail link between the Tacoma Dome and downtown Tacoma, called Tacoma Link, has been in operation since August 2003 and currently serves nearly 3,000 riders daily. *Sound Move* identified plans to construct 25 miles of new electric, light rail transit, known as the Central Link system, connecting SeaTac to Northgate. As of December 2005, Sound Transit is on track to construct and operate a 14-mile Initial Segment that will connect SeaTac, the Rainier Valley, and downtown Seattle by July 2009. By December 2009, a 1.7-mile Airport Link is expected to connect the Initial Segment to Seattle-Tacoma International (Sea-Tac) Airport. When additional funding becomes available, Sound Transit plans to extend this light rail line from downtown Seattle to Northgate via Capitol Hill, the University District, and Roosevelt.
- **Commuter Rail Service.** The Sounder system currently provides 82 miles of bidirectional, peak-hour, weekday commuter rail service connecting points along existing railroad tracks between Everett, Seattle, Tacoma, and Lakewood. Tacoma-Seattle service began in the fall of 2000 and currently provides three morning and three afternoon trips between seven stations. The Seattle-Everett service began in 2004 and serves two stations with one morning and afternoon trip. Service between Tacoma and Lakewood is projected to begin in late 2007. Sounder fare passes are also accepted on the daily Amtrak trains, providing access to additional commuter rail service.
- **High-Occupancy Vehicle Expressway.** The region's vision is to build a high-occupancy vehicle expressway by combining the state-funded freeway high-occupancy vehicle lane network with Sound Transit-funded direct high-occupancy vehicle access ramps. As of January 2005, more than \$800 million in transportation improvement projects were complete, including new and improved transit centers, park-and-ride lots, and high-occupancy vehicle access lanes and ramps.
- **Regional Express Bus Routes.** Sound Transit's Regional Express system includes a regional network of express bus routes operating on freeways and major arterials that service distant areas with limited stops. As of January 2005, Sound Transit operated 19 regional express bus routes that take advantage of the improved speed and reliability of the high-occupancy vehicle expressway facilities.
- **Community Connections.** As part of *Sound Move*, Sound Transit made the commitment to build numerous transit facilities called community connections — including transit centers, park-and-ride lots, and commuter rail and light rail stations — throughout the region to support easy connections between regional transit, local transit, and other travel modes.

4. Nonmotorized System

Existing system.⁴ The regional, nonmotorized system includes both bicycle and pedestrian facilities. The following three concepts guide the development of the regional nonmotorized transportation system:

- Link communities at the regional level.
- Substitute nonmotorized trips for vehicle trips at the local level.
- Provide intermodal connections at rail, ferry, and other transit stops.

There are five general types of nonmotorized facilities, each with varying levels of separation from adjacent roadways:

- **Shared Use Bicycle/Pedestrian Paths** are facilities that are separate from roadways.
- **Bike Lanes** are portions of roadways that are designated for exclusive bicycle travel by signs and pavement markings.

⁴ The nonmotorized component of the Metropolitan Transportation System includes facilities that meet one or more of the following criteria: multi-use trails and bike lanes within the corridors of the roadway component of the Metropolitan Transportation System, multi-use trails and bike lanes that connect designated urban centers; multi-use trails and bike lanes that are within, or provide direct access to, designated urban centers or high-capacity transit stations; and pedestrian facilities that provide circulation within, access to, or enhance designated urban centers, or high capacity transit station areas.



- **Bike Routes** are portions of roadways that are signed as preferred routes for bicycle travel but not striped for exclusive bicycle use.
- **Bikeways** are portions of roadways that are not signed or marked, but are accessible to bicycle travel and identified by the local jurisdiction as a preferred bicycle route.
- **Walkways** are pedestrian facilities that can be either separated from roadways, such as sidewalks and paths, or part of roadways, such as crosswalks or wide shoulders.

Destination 2030 planned investments. The plan includes a regional nonmotorized network based on county and local jurisdiction nonmotorized plans. The nonmotorized network is designed to connect urban centers and major destinations, link inter-modal facilities, and provide service to both commuters and recreational users.

Priority nonmotorized investments are those that complete the nonmotorized system by filling gaps in the existing network, creating connections to and improving circulation within urban centers and high-capacity station areas, and developing inter-modal connections. *Destination 2030* nonmotorized transportation improvements include the following:

- Approximately 800 miles of new paths and bikeways by 2010, including 529 miles of separated off-road bicycle/pedestrian paths and 286 miles of on-road bicycle lanes.
- Approximately 1,200 additional miles of new paths and bikeways by 2030, including 255 miles of off-road bicycle/pedestrian paths and 945 miles of on-road bicycle lanes.
- Pedestrian improvements in selected transit station and designated urban center zones.

5. Freight and Goods System

Existing system.⁵ The regional freight and goods system consists of roadways, port facilities, railroads and rail yards, and airport facilities, all of which serve to move freight within and through the region. A brief description of each component of the freight system follows:

- **Freight Roadways.** Parts of the freight and goods system were first designated as critical for freight movement by the state of Washington in 1995, and updated in 1999 and 2003. The system consists of five roadway classifications (T-1 through T-5) based on annual freight tonnage carried by trucks. The heaviest tonnage routes, those designated for four million annual tons and above (T1 and T2), may receive priority for funding improvements. Within the region, the following Interstate highways and state routes have segments classified as T-1 (more than 10 million annual tons): Interstate 5 and Interstate 90, and State Routes 3, 16, 18, 99, 167, 169, 410, 512, 515, 518, 522, 526, 599, and 900.
- **Ports.** Everett, Seattle, and Tacoma provide marine deepwater ports that accommodate ocean-going container ships that carry cargo in and out of the region. The ports of Seattle and Tacoma continue to be some of the busiest ports along the West Coast, and all three ports are continuously improving their facilities to accommodate growing demand.
- **Airports.** Freight is transferred to and from aircraft at two major airports in the region: the Seattle-Tacoma International Airport (Sea-Tac) and King County International Airport (Boeing Field). Sea-Tac handles the majority of the freight, although Boeing Field has captured a growing percentage. A limited amount of freight is moved by the “sea-air” link; that is, cargo is transferred from ships, loaded onto aircraft, and flown to the East Coast, Europe, or other international destinations. Roadways that provide access to Sea-Tac and Boeing Field for trucks, which account for the majority of freight transfers at the airports, are important parts of the freight roadway system.
- **Railroads.** Two major national railroads serve the central Puget Sound region and provide intercontinental service: Burlington Northern Santa Fe and Union Pacific. Each maintains significant yard and on-dock capacity to serve the ports.

Destination 2030 planned investments. The plan includes a Freight Action Strategy (FAST Corridor) program that includes 15 FAST Corridor Phase I projects. These projects were identified by a public/private partnership as strategic

⁵ The freight and goods component of the Metropolitan Transportation System includes facilities that meet the following criteria: state and local principal arterials; National Highway System routes within the region; T1 and T2 Freight and Goods Transportation System routes, as defined by the Washington State Transportation Commission in 1999; routes providing access to the designated regional growth centers, other major industrial and commercial sites; Port of Everett, Seattle and Tacoma facilities; mainline and branch rail lines, as well as intermodal rail yards associated with Burlington Northern/Santa Fe and Union Pacific railroad facilities; and air cargo facilities (Sea-Tac and King County International Airports).

investments in the region's transportation system to improve port access and reduce rail/highway conflicts along the Interstate 5 corridor from Tacoma to Everett. In addition, a group of projects designed to improve surface street access to multimodal freight facilities, identified as the FAST Corridor Phase II project, are included in *Destination 2030*.

6. Intercity Passenger Rail

Existing system. Amtrak passenger rail trains currently provide service between Eugene, OR, and Vancouver, B.C. (Amtrak Cascades), Seattle and Los Angeles (Coast Starlight), and between Seattle and Chicago (Empire Builder). Stations within the four-county region are located in Everett, Seattle, Tukwila, Tacoma, and Lacey.

Washington state is committed to safer, faster, more frequent and reliable north-south Amtrak intercity passenger rail service through western Washington. This will require capital investments in train station facilities, new train equipment, improvements to existing tracks and improved track crossings and signalization.

Destination 2030 planned investments. The plan includes Amtrak Cascade passenger rail service by 2018 with 13 trains per day between Seattle and Portland and four trains per day between Vancouver, B.C., and Seattle (two of which continue to Portland.) Travel time between Seattle and Portland are estimated to be approximately 2.5 hours and travel times between Vancouver, B.C., and Seattle is estimated to be just under three hours. These travel times are estimated to be between 25 and 30 percent shorter than travel times in 1999. Planned intercity rail investments include the following:

- South Tacoma crossovers
- Point Defiance bypass
- Black River Junction and Auburn sidings
- Everett yard tracks and siding
- Ballard double tracking and crossovers
- Track upgrades and signal system improvements from Everett north
- Station improvements at Tacoma, Tukwila, Seattle, Edmonds and Everett

7. Regional Aviation System

Existing system.⁶ The existing regional airport system is comprised of 26 public use airports and two military airfields within the four central Puget Sound counties. The airport system includes Seattle-Tacoma International Airport (the region's primary commercial service airport), King County International Airport (Boeing Field), McChord Air Force Base, and Gray Army Airfield at Fort Lewis, five general aviation reliever airports, 13 general aviation airports, four seaplane bases, and three state-owned emergency airfields. A subset of this regionwide aviation system is considered regionally significant and is part of the Metropolitan Transportation System. This subset consists of Sea-Tac Airport, Boeing Field, Paine Field, Renton Municipal Airport, Harvey Field, and Auburn Municipal Airport.

Destination 2030 planned investments. The plan includes a long-range program to improve the region's 25 general aviation airports. These system improvements will focus on maintaining and preserving the existing system, as well as on making strategic investments to meet growing demand and provide system enhancements. Aviation system investments include:

- Implementation of Sea-Tac's adopted master plan, including improvements to passenger terminals and completion of a third runway.
- Improved air cargo facilities at Sea-Tac and Boeing Field.
- 753 new aircraft hangars at the region's general aviation airports.

8. Transportation Systems Management

Existing system. Most of the systems that are part of the Metropolitan Transportation System include management elements so that they can be operated and utilized as safely and as efficiently as possible. System operations on the Puget Sound region's multimodal transportation system are the responsibility of many jurisdictions and agencies.

⁶ The regional aviation component of the Metropolitan Transportation System consists of the following facilities: Sea-Tac International Airport; King County International Airport (Boeing Field); Paine Field; Renton Municipal Airport; Harvey Field; and Auburn Municipal Airport.



Washington State Department of Transportation has an extensive freeway management system on the region's freeways, and many of the region's transit operators are using technology to provide transit information, count passengers, and collect fares. The Intelligent Transportation Systems program promotes the application of modern computer and communications technology to improve transportation operations and transportation demand management. The regionally significant Intelligent Transportation Systems projects and programs that have been applied in this region are described briefly in the following text.

- **Traffic Management Systems.** The Washington State Department of Transportation has Traffic Management Centers in Shoreline and Lakewood to manage the Seattle area and Tacoma area freeways, respectively. A system of vehicle detectors, television cameras, ramp meters, variable message signs or reader boards, and highway advisory radio systems, called the Surveillance, Control & Driver Information system, has been installed on the region's freeways. The ramp meters improve freeway flow and reduce merging-related accidents. The surveillance equipment helps to improve incident response and provide travel information. Many agencies in the region have their own traffic management centers that operate synchronized traffic signal systems that respond to traffic demand, thereby reducing vehicle delay during non-peak periods.
- **Transit Management Systems.** King County Metro has implemented an Automatic Vehicle Location system to track its buses. The system allows for improved scheduling and increased security. Data from the system are also used to provide real-time transit information to riders. Transit signal priority has also been implemented by most transit agencies in the region to improve schedule reliability and reduce travel time.
- **Electronic Fare Payment System.** The region's transit agencies, including the Washington State Ferry System, have collaborated on a "Smart Fare Card" project to allow transit passengers to use a single fare card to pay transit fares.
- **Commercial Vehicle Information Systems and Networks.** Commercial vehicle operations on Interstate 5 and Interstate 90 are being improved with weigh-in-motion scales, vehicle tags (called transponders) and roadside readers that allow truck weights and credentials to be checked without requiring the truck to stop. This reduces the delay for safe and legal trucks and helps focus enforcement efforts on problem truckers. Similar systems are being used at the international border and the ports of Seattle and Tacoma to help track and secure containers being imported and exported.

Destination 2030 planned investments. The plan includes the following transportation systems management strategies:

- New arterial management and transit signal priority projects on nearly 1,000 miles of roadways by 2030.
- Enhanced freeway management, including ramp metering and variable message signs on approximately 100 additional freeway miles by 2010.
- Transit operations projects, including new technology for vehicle tracking and travel information, for example.

9. Transportation Demand Management

Existing system. Transportation demand management is not focused on facilities but instead focuses on programs and strategies to improve the efficiency of the transportation system by promoting alternatives to driving alone, shifting trips out of peak travel periods or eliminating the need for trips.

The Washington State Legislature passed the Commute Trip Reduction Law in 1991, as part of the Washington Clean Air Act. The goals of the program are to reduce traffic congestion, air pollution, and petroleum consumption through employer-based programs that decrease the number of commute trips made by people driving alone. The program encourages workers to ride the bus, vanpool, carpool, walk, bike, work from home, or compress their work week. Central Puget Sound employees covered by this law made more than 14,200 fewer vehicle trips each weekday morning in 2005 than they did when their employers entered the program. It is estimated that this reduced delay by 11.6 percent during the peak travel period on average mornings in the region.

The 2006 Legislature enacted changes that are intended to make the CTR program more effective and efficient by focusing investments in urban growth areas and centers where they are expected to have the greatest potential effect. It also enables the program to be tailored to meet local needs by requiring planning, goal-setting, program implementation and monitoring on a regional basis. Washington State Department of Transportation has a Transportation Demand Management Resource Center that works to expand regional mobility options, studies transportation demand management innovations and efficiencies for congested corridors, such as State Route 520 and Interstate 405; integrates land use with transportation plans; and provides resources on transportation demand management efforts and impacts throughout the region.

Destination 2030 planned investments. PSRC’s Transportation and Growth Management Policy Boards endorsed the Transportation Demand Management Action Strategy for the central Puget Sound region in 1998. This strategy, developed by the 23-member Transportation Demand Management Advisory Committee, identified the following guiding principles to manage transportation demand:

- Transportation demand management strives to change people’s travel behavior by encouraging people to consider alternatives or to travel at a different time of day.
- Mutually supportive techniques should be used together in a coordinated approach.
- Transportation demand management is aimed at motivating and reinforcing changes in travel.
- The use of transportation demand management incentives and disincentives can change individual travel behavior.
- Transportation demand management includes providing alternatives to driving alone, whether by carpool, vanpool, transit, bicycling, walking, tele-work, or compressed work schedules.
- Future transportation demand management activities must be broadened to face the challenge of non-work trips in addition to commute trips.

The plan calls for the following transportation demand management investments:

- Funding and promotion of vanpool programs to double that mode’s 2001 share of work trips by 2010.
- Investments to support tax credits, public/private partnerships, innovative new strategies, and technical assistance to employers and other implementors.

5.3.2 Analysis of Alternatives (Long-Term Impacts)

Between 2000 and 2040, the region’s population is forecast to grow by 1.7 million residents (an increase of 52 percent) and the region’s employment base is forecast to expand by 1.2 million jobs (an increase of 69 percent). This growth is estimated to create additional demand for the region’s transportation system. The total number of miles the region’s vehicles are estimated to drive on an average weekday is expected to increase by 57 percent and, with the continued expansion of Sound Transit and other transit systems, daily transit ridership is expected to more than double (an increase of 115 percent).

Set against the backdrop of a planned 12 percent expansion of the region’s freeway and arterial lane miles, the additional regional growth and travel demand could impact the overall performance of transportation systems, mainly in the form of increased congestion and delay.

In this section, the four growth alternatives are analyzed for their varying impacts on travel behavior and on the performance of the transportation system. The Growth Targets Extended Alternative is compared to the base year (2000) to set a context for analyzing the three remaining alternatives. The three remaining alternatives — Metropolitan Cities, Larger Cities, and Smaller Cities — are then compared to the Growth Targets Extended Alternative.

Note: Complete tables comparing various measures across alternatives and geographical subareas can be found in *Appendix E*. In this chapter, a number of summary figures are provided for some of the transportation indicators.

Measures

The measures of travel behavior and transportation system performance included in the analysis are:

- **Trip distance** — average length (in miles) between the trip origin and destination.
- **Trip time** — average duration (in minutes) between the trip origin and destination.
- **Accessibility** — percent of regional employment within 10-minute walk, 20-minute bicycle ride, or 30-minute transit ride.
- **Mode share (Mode split)** — number or percentage of person trips made by single-occupancy vehicles, carpool, transit, and nonmotorized travel modes.
- **Vehicle miles traveled** — total miles traveled by all vehicles of a given area and for a specified period.



- **Vehicle hours traveled** — total hours traveled by all vehicles of a given area and for a specified period.
- **Delay** — additional travel time experienced as a result of traffic congestion (measured in total hours and seconds per vehicle mile).

To model travel in the year 2040, the planned transportation system (as described in *Destination 2030*) is assumed to be in place for all four of the alternatives. This provides a backdrop from which to compare the effects of the four land use alternatives on the transportation system.

The following sections provide a comparison of the four alternatives based on the performance measures described above. Impacts common to all four alternatives are described first, followed by a more detailed analysis of each alternative. The analysis of each alternative includes a comparison of the effects of the proposed land use changes to the current condition (year 2000) or to the Growth Targets Extended Alternative, at the regional and sub-regional level.

Figures

The horizontal bar charts accompanying the following sections provide baseline comparisons for key transportation system measures. In each figure, the vertical line at 100 percent is the baseline to which the each alternative is compared. The baseline for the Growth Targets Extended Alternative is the year 2000 condition; the Growth Targets Extended Alternative, in turn, is the baseline for the remaining three other alternatives.

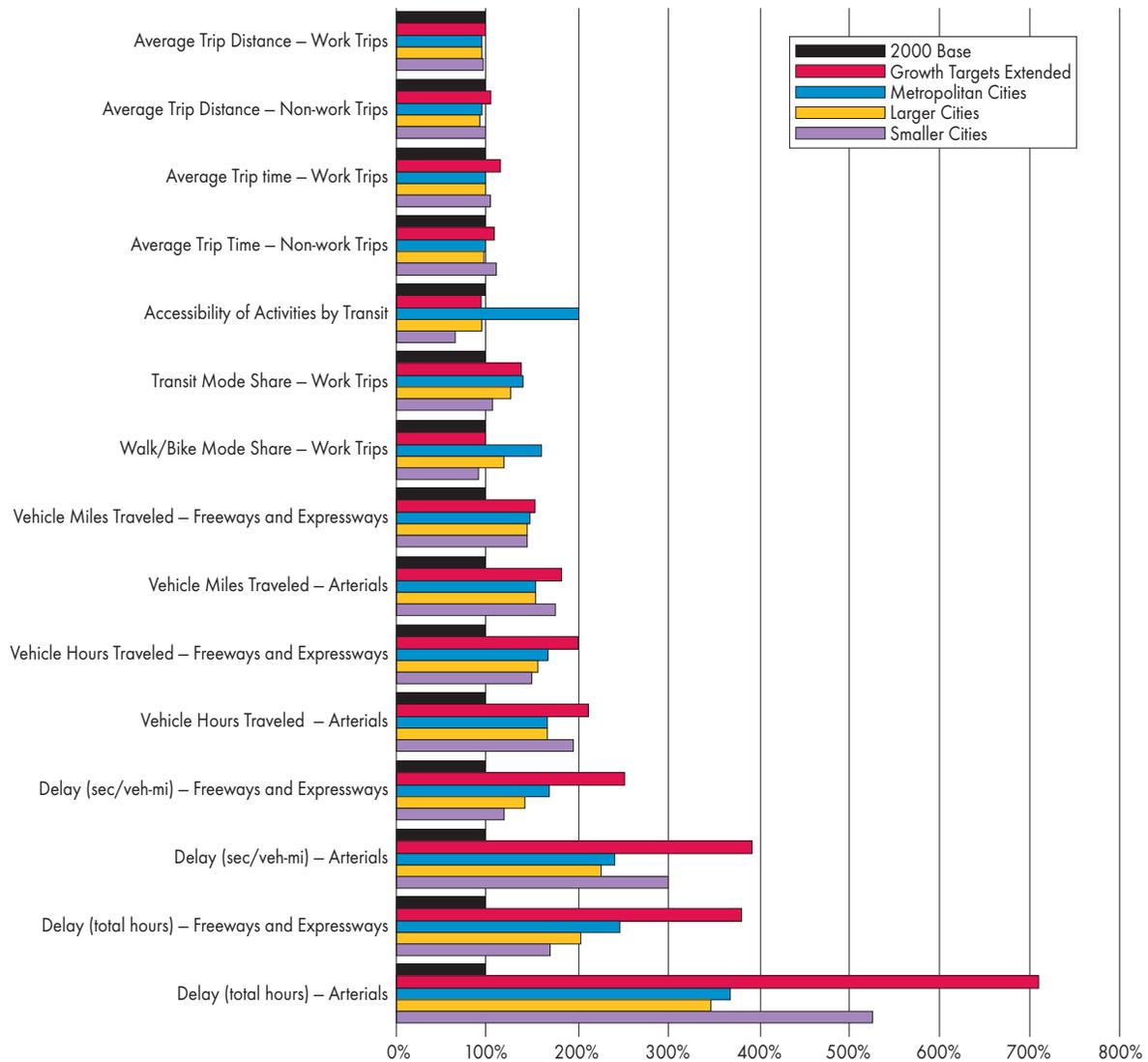
A. IMPACTS COMMON TO ALL ALTERNATIVES

With the region’s population and economic base projected to expand by 1.7 million residents and 1.2 million jobs between 2000 and 2040, there could likely be significant impacts to the regional transportation system, regardless of how the growth is distributed within the region. The following points provide an indication of the scale of the impact at the regional level:

- **Overall trip-making** is estimated to increase by approximately 72 percent.
- **Single-occupancy vehicle trips** are estimated to increase 63 – 72 percent.
- **High-occupancy vehicle trips** are estimated to increase 66 – 75 percent.
- **Transit trips** is estimated to increase 76 – 146 percent.
- **Biking and walking trips** are estimated to increase 66 – 115 percent.
- **Vehicle miles traveled on the freeway system** are estimated to increase 43 – 53 percent.
- **Vehicle miles traveled on the arterial system** are estimated to increase 53 – 81 percent.
- **Vehicle hours traveled on the freeway system** are estimated to increase 48 – 99 percent.
- **Vehicle hours traveled on the arterial system** are estimated to increase 66 – 111 percent.
- **Delay on the freeway system** is estimated to increase 18 – 150 percent.
- **Delay on the arterial system** is estimated to increase 126 – 292 percent.

To help illustrate these percentages, the following figure provides an overview comparison all the alternatives to the base year 2000 and to one another.

FIGURE 5-3-3: SUMMARY COMPARISON OF ALL 2040 ALTERNATIVES AND BASE YEAR 2000: REGIONAL LEVEL INDICATORS



Note: 100 percent means the indicator is the same as it would be for base year 2000. For example, Accessibility of Activities by Transit under the Metropolitan Cities Alternative is 200 percent. Therefore, the amount of accessibility for that alternative is double what it would be for base year 2000.

At the regional level, the following summary comparison between the alternatives can be made:

- **Average trip distances (work and non-work):** Growth Targets Extended Alternative has the longest average trip distances of any of the alternatives.
- **Average trip times (work and non-work):** Growth Targets Extended Alternative has the longest average trip time for work trips. For non-work trips, Smaller Cities Alternative has the longest average trip time.
- **Accessibility of activities to transit:** Metropolitan Cities Alternative has a significantly higher percentage of activities in proximity to transit than any of the other alternatives.
- **Transit mode share:** Metropolitan Cities Alternative has a higher share of trips being made by transit than any of the other alternatives.
- **Walk/bike mode share:** Metropolitan Cities Alternative has a much higher share of trips being made by walk/bike than any of the other alternatives.
- **Vehicle miles traveled (freeways, expressways, and arterials):** Growth Targets Extended Alternative has the highest vehicle miles traveled on freeways, expressways, and arterials.



- **Vehicle hours traveled (freeways, expressways, and arterials):** Growth Targets Extended Alternative has the highest vehicle hours traveled of any of the alternatives on freeways, expressways, and arterials.
- **Delay (freeways, expressways, and arterials):** Growth Targets Extended Alternative has the most delay, by a significant amount, on freeways, expressways, and arterials.

B. ANALYSIS OF EACH ALTERNATIVE

The previous section highlighted some of the overall similarities among the alternatives. This section focuses on the differences between the regional growth alternatives and how those differences could vary at the regional and sub-regional levels. To set the context for the remainder of this section, Figure 5-3-4 provides a regional overview of how the alternatives compare to one another for key transportation measures and indicators.

**FIGURE 5-3-4: SUMMARY COMPARISON OF ALL 2040 ALTERNATIVES:
VALUE OF EACH ALTERNATIVE BY REGIONAL TRANSPORTATION INDICATORS**

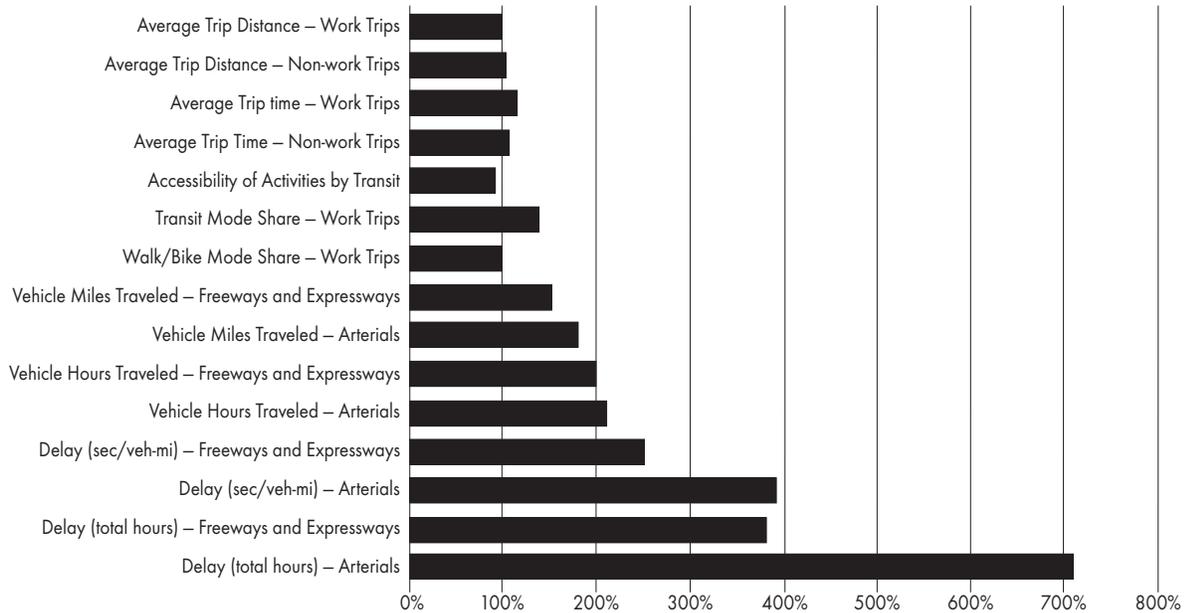
Performance Measure	Base Year (2000) Alternative	Growth Targets Extended Alternative	Metropolitan Cities Alternative	Larger Cities Alternative	Smaller Cities Alternative
Average Trip Distance (miles)					
Work Trips	13.1	13.1	12.1	12.0	12.3
Non-work Trips	6.5	6.6	6.1	5.9	6.4
Average Trip Time (minutes)					
Work Trips	25.4	29.1	25.4	25.4	26.2
Non-work Trips	14.5	15.5	14.3	14.2	15.7
Accessibility					
Transit Access to Work	.70%	.65%	1.52%	.70%	.48%
Transit Access to Non-work	.84%	.73%	1.69%	.77%	.53%
Selected Mode Share – Work Trips					
% Single-occupancy vehicle	79.5%	76.2%	73.6%	76.5%	79.3%
% Transit	8.4%	11.6%	11.7%	10.5%	8.9%
% Walk/Bike	4.5%	4.5%	7.2%	5.3%	4.1%
Selected Mode Share – Non-work Trips					
% Single-occupancy vehicle	46.2%	45.5%	44.8%	45.7%	46.1%
% Transit	2.1%	2.5%	3.1%	2.6%	2.1%
Vehicle Miles Traveled					
Total vehicle miles traveled	81,383,000	137,104,400	122,230,200	121,397,600	131,058,400
Freeway vehicle miles traveled	35,589,000	54,301,800	52,090,000	50,974,200	50,838,600
Arterial vehicle miles traveled	45,794,000	82,802,600	70,140,200	70,423,400	80,219,900
Vehicle Hours Traveled					
Total vehicle hours traveled	2,426,000	5,025,900	4,026,900	3,950,700	4,378,200
Freeway vehicle hours traveled	766,000	1,522,800	1,274,700	1,189,200	1,132,300
Arterial vehicle hours traveled	1,660,000	3,503,100	2,752,200	2,761,500	3,245,900
Delay (seconds/vehicle-mile)					
Total Delay	10.9	32.4	21.0	18.6	20.3
Freeway Delay	15.6	39.0	26.2	22.0	18.4
Arterial Delay	7.2	28.1	17.2	16.2	21.5
Delay (total hours)					
Total Delay	245,300	1,235,300	713,900	628,400	739,600
Freeway Delay	154,100	588,700	378,500	311,500	260,200
Arterial Delay	91,200	646,600	335,400	317,000	479,400

Note: For the geographical area listed in the figure title, the mode share and average time data refer to “trips attracted to” the geographical area; the vehicle miles traveled and delay data refer to “roadways within” the geographical area; and the accessibility data refers to “people living within” the geographical area.

GROWTH TARGETS EXTENDED ALTERNATIVE

The following figure (Figure 5-3-5) compares this alternative to the 2000 base year for a few representative indicators.

FIGURE 5-3-5: GROWTH TARGETS EXTENDED ALTERNATIVE: COMPARISON TO BASE YEAR (2000), REGIONAL LEVEL INDICATORS



Note: 100 percent means the indicator for this alternative is the same as it would be for base year 2000. For example, Vehicle Hours Traveled – Freeways and Expressways is at 200 percent. Therefore, vehicle hours traveled are double under the Growth Targets Extended Alternative what they would be for base year 2000.

Region

The Growth Targets Extended Alternative continues the current pattern of more centralized employment growth and more dispersed population growth. As a result, workers throughout the region must travel farther to reach their jobs, and households must travel farther for other activities (shopping, entertainment, etc.) than in the base year (2000). An increased share of trips is made by transit, with the highest share for trips into regional centers. Although the *number* of “accessible” job and activity opportunities increases, the accessible *share* of the region’s jobs and activity opportunities decreases. Total vehicle miles traveled and vehicles hours of travel are much higher than in 2000, as is average delay.

Compared to base year 2000, and from one alternative to the next, there are slight differences in the high-occupancy vehicle shares for both work and non-work trips. This reflects the fact that high-occupancy vehicle usage is primarily a factor not of land use but related more to the presence of high-occupancy vehicle lanes, household composition, and programs such as Commute Trip Reduction at the employment site — none of which changes across the alternatives.

Counties

The pattern of changes from 2000 to the Growth Targets Extended Alternative is generally the same in all counties: more trips, greater vehicle miles traveled, and more delay. Work trips into King County are much longer in distance than into any other county, despite the slower speeds due to higher congestion. Work and non-work trips into Kitsap, Pierce, and Snohomish counties are generally shorter in length in the Growth Targets Extended Alternative than in 2000 because a greater proportion of the population growth is expected to occur in those three counties than in King County. However, even these shorter trips take more time, and many residents of these three counties could travel into King County for work and other activities, making the regional average trip length longer.



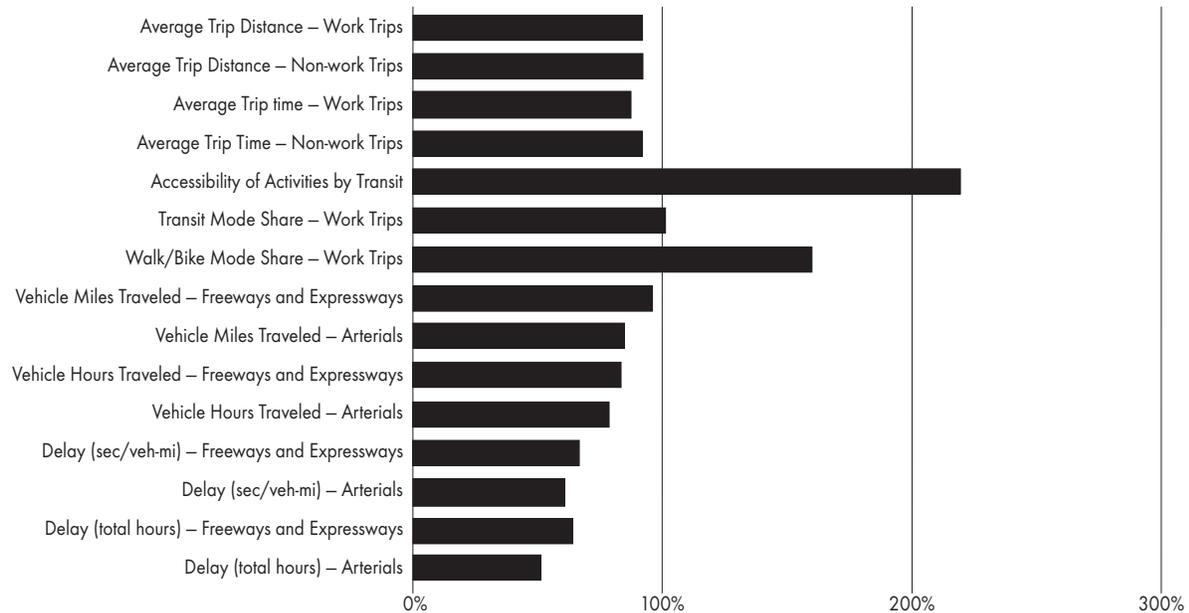
Regional Geographies

- **Designated Regional Centers.** Because they are generally better served by transit and are more densely developed, regional centers have higher transit and nonmotorized mode shares than any other geography. Except for the nonmotorized trips into King County, these shares are also higher in the Growth Targets Extended Alternative than in 2000. Both work and non-work trips into centers are longer in the Growth Targets Extended Alternative than in 2000.
- **Metropolitan Cities.** The metropolitan cities include the larger regional centers, so their mode shares and trip lengths are similar. Metropolitan cities accounted for 33 percent of the freeway vehicle miles traveled in 2000 and 23 percent of the vehicle miles traveled on other roads. With a regionwide vehicle miles traveled increase of about 70 percent throughout the region, the shares within metropolitan cities drop to 30 percent and 20 percent, respectively, with the Growth Targets Extended Alternative. People living in metropolitan cities are estimated to have about twice the accessibility to jobs and other activities compared to the regional average.
- **Core and Larger Suburban Cities.** In 2000 and with the Growth Targets Extended Alternative, the core and larger suburban cities, together with the smaller suburban cities and the remainder of the urban growth area, are the destinations for as many work trips as the metropolitan cities. The non-work trips to the core and larger suburban cities almost equal the non-work trips to metropolitan cities. Transit and nonmotorized trips to core and larger suburban cities are one-third and one-half, respectively, of the number of transit and nonmotorized trips to metropolitan cities. The high-occupancy vehicle mode share in the core and larger suburban cities is about the same as in the metropolitan cities. Because many of the trips into the metropolitan cities begin in these areas of the urban growth area, well over half the region's vehicle miles traveled occur inside the urban growth area (but outside metropolitan cities). In all counties, the average delay on all roads inside the urban growth area (but outside metropolitan cities) is three times as high with the Growth Targets Extended Alternative as in 2000, and twice as high with the Growth Targets Extended Alternative as compared to the other three alternatives.
- **Smaller Suburban Cities and Unincorporated Urban Growth Area.** The smaller suburban cities and unincorporated urban growth area attract about 13 percent of the region's work trips and about 20 percent of the non-work trips. They have a greater share of single-occupancy vehicle trips and smaller share of transit trips than the core and larger suburban cities.
- **Rural Areas.** The rural areas have the highest single-occupancy vehicle mode share in the region, although this drops slightly between 2000 and the Growth Targets Extended Alternative. The rural areas also have the lowest transit and nonmotorized mode shares in the region. The rural areas' share of the region's freeway and arterial vehicle miles traveled increases from 6 percent and 27 percent in 2000 to 7 percent and 28 percent, respectively, with the Growth Targets Extended Alternative.

METROPOLITAN CITIES ALTERNATIVE

The following figure (Figure 5-3-6) compares this alternative to the 2000 base year for a few representative indicators.

**FIGURE 5-3-6: METROPOLITAN CITIES ALTERNATIVE:
COMPARISON TO GROWTH TARGETS EXTENDED ALTERNATIVE, REGIONAL LEVEL INDICATORS**



Note: 100 percent means the indicator for this alternative is the same as it would be for the Growth Targets Extended Alternative. For example, Accessibility of Activities by Transit is over 200 percent. Therefore, the amount of accessibility under the Metropolitan Cities Alternative is more than double what it would be for the Growth Targets Extended Alternative.

Region

By focusing both population and employment growth in metropolitan cities, the Metropolitan Cities Alternative allows for average trip lengths to be shorter than with the Growth Targets Extended Alternative. More trips with the Metropolitan Cities Alternative are made by nonmotorized means than with any other alternative. Because the metropolitan cities have the most transit service, there is higher accessibility by transit to both jobs and other activities. Both vehicle miles traveled and delay are lower than with the Growth Targets Extended Alternative.

Counties

Because of the distribution of metropolitan cities within the counties, King County attracts more work and non-work trips with the Metropolitan Cities Alternative than with any other alternative, Kitsap and Snohomish counties attract fewer work and non-work trips than with any other alternative, and Pierce County attracts the second lowest number of work and non-work trips. With the exception of Growth Targets Extended Alternative, transit trips and mode shares to work are higher in all counties than with any other alternative. This can be attributed to higher numbers of nonmotorized trips in Metropolitan Cities Alternative.

Regional Geographies

- **Designated Regional Centers.** Regional centers are estimated to experience the highest levels of transit and non-motorized use under this alternative. Due to a high growth allocation, they are estimated also to experience the highest levels of single-occupancy vehicle and high-occupancy vehicle trips. With more residences located close to employment locations, average trip lengths are the lowest of all alternatives.
- **Metropolitan Cities.** This alternative would direct 40 percent of new residential growth and 45 percent of new employment growth to metropolitan cities. The employment allocation is identical to the Growth Targets Extended Alternative and, as such, the modal profiles are similar for the two alternatives, with the exception being that trip making within the nonmotorized modes is significantly higher than with the Growth Targets Extended Alternative. The Metropolitan Cities Alternative is estimated also to result in the lowest average trip lengths and



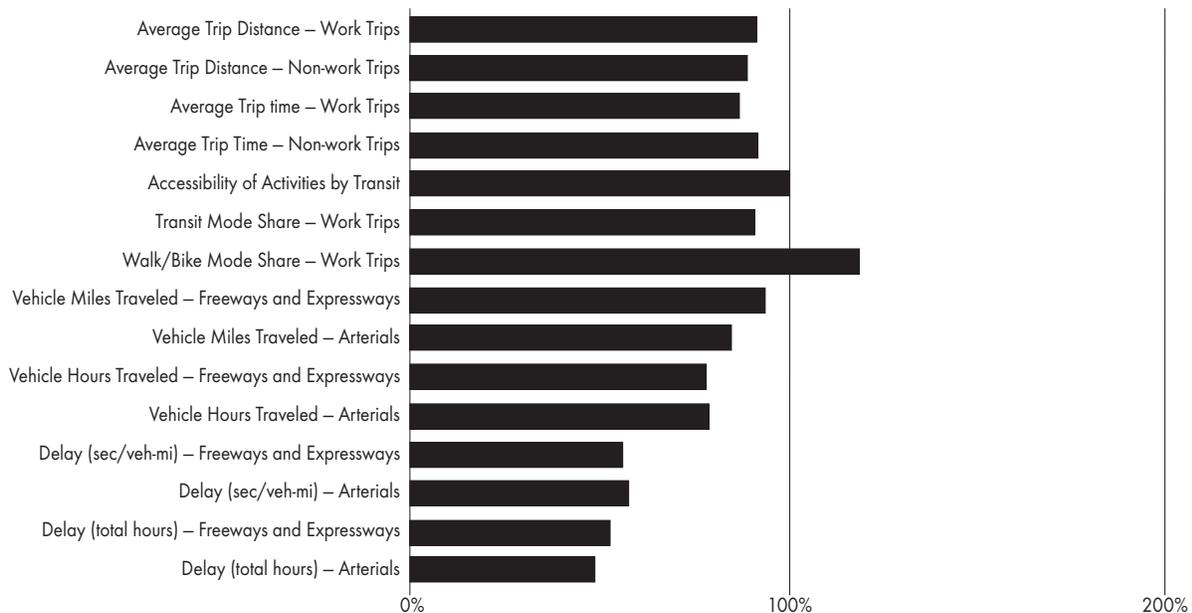
highest accessibility to work and non-work activities among the four alternatives. Vehicle miles traveled and delay levels are estimated to be lower in the metropolitan cities than with the Growth Targets Extended Alternative; however, because of the high number of trips being made within metropolitan cities, vehicle miles traveled and delay levels are estimated to be higher than with the Larger Cities and Smaller Cities alternatives.

- **Core and Larger Suburban Cities.** The Metropolitan Cities Alternative would direct 40 percent of new residential and employment growth to core and larger suburban cities. These allocations are second only to the Larger Cities Alternative in order of magnitude and, as such, the impact pattern is similar. Compared to the Larger Cities Alternative, there are fewer trips across all mode categories, average trip lengths are slightly longer, and work locations and other activities are less accessible by transit.
- **Smaller Suburban Cities and Unincorporated Urban Growth Area.** Compared to the Growth Targets Extended Alternative, the Metropolitan Cities Alternative would direct less of the new growth to smaller suburban cities and the unincorporated urban growth area. Compared to all other alternatives, this alternative is estimated to result in the fewest trips across all mode categories, the longest average trip lengths, and the fewest number of locations accessible by transit.
- **Rural Areas.** This alternative would direct 5 percent of new residential and employment growth to the rural areas — the lowest level among all of the alternatives. With this allocation, trips in rural areas are estimated to be lowest across all modes, average trip lengths are estimated to be longer, the fewest number of locations are estimated to be accessible by transit, and vehicle miles traveled and delay levels are estimated to be lower than the other alternatives.

LARGER CITIES ALTERNATIVE

The following figure (Figure 5-3-7) compares this alternative to the 2000 base year for a few representative indicators.

FIGURE 5-3-7: LARGER CITIES ALTERNATIVE: COMPARISON TO GROWTH TARGETS EXTENDED ALTERNATIVE, REGIONAL LEVEL INDICATORS



Note: 100 percent represents conditions in the Growth Targets Extended Alternative. See the note accompanying Figure 5-3-6 which explains the percentage scale.

Region

Under this alternative, 80 percent of the region’s growth would occur in metropolitan, core, and larger cities, with over half of the growth directed to the core and larger cities. Compared to the Growth Targets Extended Alternative, transit trips is estimated to be lower, while walking and biking are estimated to increase at the regional level. Transit accessibility is estimated to be about the same as the Growth Targets Extended Alternative; average trip lengths (time and distance) are estimated to be the shortest and overall vehicle miles traveled and delay are estimated to be lower than the other alternatives.

Counties

Although the distribution of growth at the county level is quite similar to the Metropolitan Cities Alternative, there are noteworthy differences in some of the indicators, particularly in King County. Because growth is shifted away from metropolitan cities, transit trips and biking and walking in King County decrease from the levels found in the Metropolitan Cities Alternative, and locations are less accessible via transit.

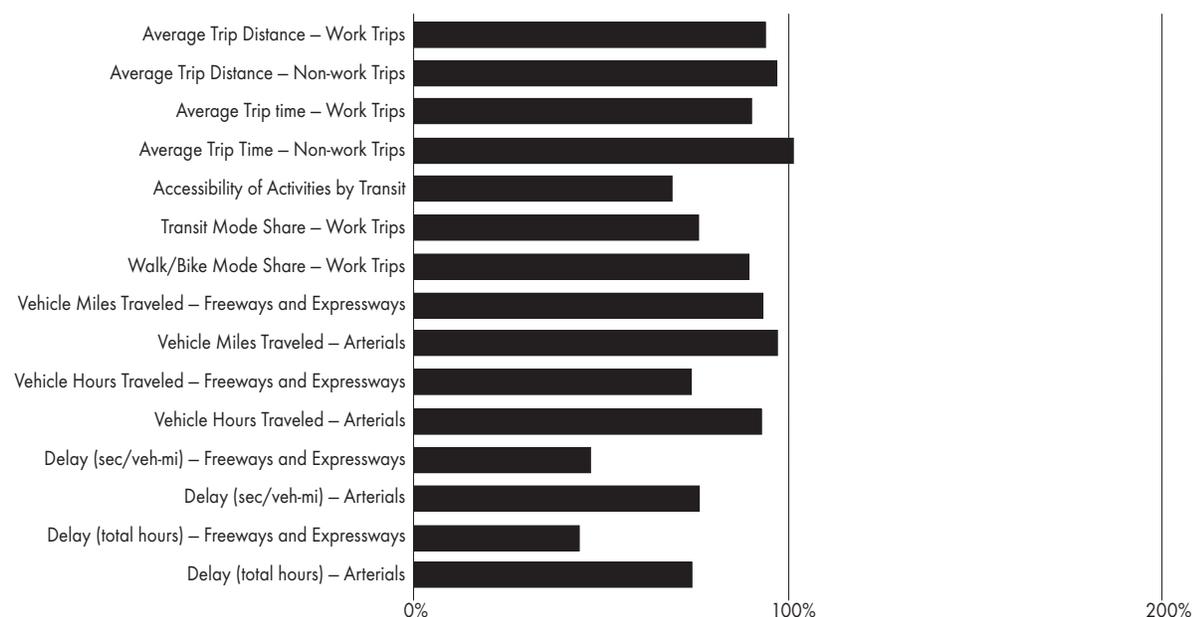
Regional Geographies

- **Designated Regional Centers.** With less growth directed to cities with regional centers than under the Metropolitan Cities Alternative, transit and nonmotorized modes shares and usage are lower. Average trip lengths are slightly longer than with the Metropolitan Cities Alternative, but shorter than with the Growth Targets Extended and Smaller Cities alternatives.
- **Metropolitan Cities.** This alternative would direct the second smallest amount (20 percent) of new residential and employment growth to the metropolitan cities. Compared to the Metropolitan Cities Alternative, trip making is lower across all modes, average trip lengths are longer, fewer people live or work in locations that are easily accessible by transit, and vehicle miles traveled and delay levels are lower.
- **Core and Larger Suburban Cities.** This alternative would direct the highest level (60 percent) of new growth to core and larger suburban cities. Compared to all other alternatives, trip making is the highest in all mode categories, average trip lengths are the shortest, and the greatest number of work and other activity locations are accessible by transit.
- **Smaller Suburban Cities and Unincorporated Urban Growth Area.** This alternative would direct the second smallest amount of the new residential and employment growth to smaller suburban cities (5 percent) and the unincorporated urban growth area (10 percent). Compared to the Smaller Cities Alternative, trip making is significantly lower across all modes, average trip lengths are equal or slightly longer, and transit accessibilities are lower.
- **Rural Areas.** This alternative would direct 5 percent of the new residential and employment growth to rural areas, identical to the amount under the Metropolitan Cities Alternative. Compared to the Metropolitan Cities Alternative, trip making in the rural areas is similar across all modes, trip lengths are slightly shorter, transit accessibilities are generally equal, and delay and vehicle miles traveled are slightly lower.

SMALLER CITIES ALTERNATIVE

The following figure (Figure 5-3-8) compares this alternative to the 2000 base year for a few representative indicators.

**FIGURE 5-3-8: SMALLER CITIES ALTERNATIVE:
COMPARISON TO GROWTH TARGETS EXTENDED ALTERNATIVE, REGIONAL LEVEL INDICATORS**



Note: 100 percent represents conditions in the Growth Targets Extended Alternative. See the note accompanying Figure 5-3-6 which explains the percentage scale.



Region

Under this alternative, growth would be directed away from the region's larger cities as 75 percent of the new residential and employment growth would occur in smaller suburban cities, the unincorporated urban growth area, and rural areas. With less extensive transit and nonmotorized networks in these areas, transit trips, biking and walking, and transit accessibilities are at their lowest levels among all alternatives. Due to increased employment growth directed to rural areas, average trip lengths and vehicle miles traveled are slightly lower than Growth Targets Extended, while overall delay is significantly lower.

Counties

Of all alternatives, this alternative would direct the most growth away from King County to Kitsap, Pierce, and Snohomish counties. With a lower growth allocation in King County, there are fewer trips across all modes, and transit accessibility, vehicle miles traveled, and delay in King County are at their lowest levels among all alternatives. Total trips across all modes are higher in Kitsap, Pierce, and Snohomish counties than with the other alternatives.

Regional Geographies

- **Designated Regional Centers.** This alternative results in the fewest trips across all mode categories in designated regional centers and, next to the Growth Targets Extended Alternative, the longest average trip lengths.
- **Metropolitan Cities.** This alternative would direct 10 percent of the residential and employment growth to metropolitan cities — the lowest percentage of all alternatives. Although the mode shares are generally consistent with the other alternatives, there are significantly fewer trips across all mode categories. With the exception of the Growth Targets Extended Alternative, average trip times are the highest by a slight margin and are traceable to lower transit accessibility for work and other activities. Consistent with reduced trip making, both vehicle miles traveled and delay are estimated to be at their lowest levels relative to the other alternatives.
- **Core and Larger Suburban Cities.** This alternative would direct the lowest percentage (15 percent) of residential and employment growth to core and larger suburban cities. Compared to the other alternatives, the Smaller Cities Alternative is estimated to result in the fewest trips across all modes, the longest average trip times (with the exception of Growth Targets Extended Alternative), and the lowest transit accessibility for work and other activities.
- **Smaller Suburban Cities and Unincorporated Urban Growth Area.** This alternative would direct the highest level of new growth to smaller suburban cities (30 percent) and the unincorporated urban growth area (35 percent). With this growth allocation, there could be more trips in all mode categories than with the other alternatives, although the mode share profile remains relatively similar. Transit and nonmotorized accessibility to work and other activities is the highest when compared to the other alternatives.
- **Rural Areas.** Next to Growth Targets Extended, this alternative would also direct the highest level (10 percent) of new residential and employment growth to rural areas. Trip making in all mode categories is estimated to be higher than with the other alternatives, with the single-occupancy vehicle and high-occupancy vehicle modes capturing most of the new trips. Transit and nonmotorized accessibility to both work and non-work purposes is highest with the Smaller Cities Alternative; however, this increased accessibility does not translate into shorter average trip lengths. Consistent with increased trip making, both vehicle miles traveled and delay are at their highest levels relative to the other alternatives.

5.3.3 Cumulative Effects

Historically, vehicle miles traveled has continually increased in the Puget Sound region and could continue to do so into the year 2040. The construction of transportation facilities has not kept up fully with demand, leading to increased vehicles hours traveled, hours of delay, congestion, and longer travel times throughout the region. The transportation analysis included in this Draft Environmental Impact Statement is a cumulative analysis based on the results of travel demand modeling for the year 2040. The analysis incorporates past and future actions as well as projected population and employment growth expected for the central Puget Sound region. Many of the specific major transportation investments that are proposed over the next 40 years are described in the *Destination 2030* and shown in Figure 5-3-2. These planned transportation investments are incorporated into the transportation analysis.

While regional vehicle miles traveled and vehicle hours traveled is estimated to continue to increase over existing conditions, regardless of which alternative is chosen, the Metropolitan Cities and Larger Cities alternatives are estimated to result in lower vehicle miles traveled, vehicle hours traveled, delay, shorter trip lengths, fewer single-occupancy vehicle and high-occupancy vehicle trips, and more transit and walk/bike trips than the Growth Targets Extended or Smaller Cities alternatives.

5.3.4 Potential Mitigation Measures

All alternatives could result in substantial increases in delay throughout the four-county region by the year 2040. With any of the alternatives, transportation infrastructure improvements could likely be needed beyond those in the currently defined *Destination 2030* to reduce congestion and to increase mode availability. Such improvements could include the following:

- New signals and/or improvements to existing traffic signal systems. Alternatives that add growth to the metropolitan and larger suburban cities (Metropolitan Cities and Larger Cities alternatives) could probably require fewer new signals and more improvements to existing signal software and hardware. Alternatives that add growth to smaller cities and unincorporated urban growth areas (Growth Targets Extended and Smaller Cities alternatives) might require more new signal installations.
- Additional lanes could be needed on roadways in smaller cities and unincorporated urban growth areas under the alternatives that emphasize growth in the rural areas (Growth Targets Extended and Smaller Cities alternatives). Adding turn lanes at intersections and two-way, left-turn lanes through developed areas could probably be the most cost effective way to improve traffic flow and keep collisions from increasing.
- Additional transit service and improved vanpool and carpool programs to smaller cities and unincorporated urban growth areas could likely be required with alternatives that add growth in rural areas. However, the cost and efficiency of additional service would have financial implications for regional transit agencies.
- Incident response programs would likely need to be expanded to cover more than just the freeway system. Counties and cities may need to participate with Washington State Department of Transportation in providing this service.

Regardless of which alternative is chosen, local jurisdiction concurrency standards may need to be adjusted to allow higher traffic congestion levels in order to meet growth goals associated with the four alternatives. More specific mitigation recommendations are intended to be identified as part of the update to *Destination 2030*, scheduled to follow the update of VISION 2020.

5.3.5 Significant Unavoidable Adverse Impacts

The Growth Targets Extended Alternative, by definition, would focus employment growth in metropolitan and core suburban cities, while it would result in population growth in these same cities, as well in the unincorporated urban and rural areas. This alternative has the greatest mismatch between where population and employment growth is allocated. To some extent, this mismatch results in Growth Targets Extended having the highest performance results on a variety of regional indicators (such as total vehicle miles traveled, total vehicle hours traveled, and total hours of delay).

The Smaller Cities Alternative, by definition, would focus employment and housing growth in smaller suburban cities and unincorporated areas within the urban growth area, with access provided almost exclusively by automobile. This alternative disperses automobile trips to areas where additional roadway capacity can be provided; however, it appears that the associated increases to vehicular travel demand could result in significant impacts to existing and planned transportation infrastructure.

If additional roadway capacity beyond *Destination 2030* is not provided or is shifted from investments in the core areas, significant traffic congestion could occur with the Growth Targets Extended and Smaller Cities alternatives.





Air Quality

Air pollution comes from many different sources, including industry, transportation and agriculture. It affects both human health and the environment, including plants, animals, and visibility, as well as the built environment. Airborne pollutants interplay in complex ways. This chapter discusses the impacts of the four growth distribution alternatives to air quality in relation to a number of pollutants, including particulate matter, carbon monoxide, ozone, toxics, and greenhouse gases.

5.4.1 Affected Environment

This chapter draws on air quality modeling and other relevant information obtained from the Puget Sound Regional Council, the Puget Sound Clean Air Agency, the United States Environmental Protection Agency, the Washington State Department of Ecology, the Washington State Department of Transportation, and King, Kitsap, Pierce and Snohomish counties.

A. PHYSICAL SETTING

Puget Sound Region

Air quality in the Puget Sound region is affected by several factors, including the geography, climate and urban environment. The region is located between the Cascade and Olympic mountain ranges and is bisected by Puget Sound. Largely surrounded by mountains and water, the region's land is further restricted by steep hills and environmentally sensitive areas. Most of the urban development in the region has occurred near sea level, adjacent to Puget Sound. Correspondingly, most of the air pollution in the region comes from the urban areas and transportation corridors through this north/south geography.

The Puget Sound region has a modified marine climate. Temperatures are generally moderate with few extremely cold or hot days throughout the year. Generally, clean ocean air combined with wind disperses air pollutants in the region. When that onshore airflow is interrupted, the combined effects of urban development, geography and weather can result in stagnating air and an increase in air pollution. In particular, the mountains on both the east and the west create a bowl, trapping pollution in the urban basin.

This section describes the pollutants of concern in the Puget Sound region. Further information on the regulatory background of these pollutants is provided in the next section (regulatory setting).



Particulate Matter

Particulate matter is the term for small particles of dust, soot, and organic matter suspended in the atmosphere. Coarse particulate matter has a diameter of less than 10 micrometers and is referred to as PM₁₀. Fine particulate matter has a diameter of 2.5 micrometers or smaller, and is referred to as PM_{2.5}. Sources of particulate matter include motor vehicles, industrial boilers, wood stoves, open burning, and dust from roads, quarries, and construction activities. Relating to transportation sources, road and construction dust is often in the larger PM₁₀ range, while vehicle exhaust emissions are generally in the smaller PM_{2.5} range. In particular, diesel exhaust is a significant source of fine particles.

Health effects of particulate matter include respiratory illness such as aggravated asthma, chronic bronchitis, and decreased lung function. Fine particulates can pose more serious health risks, as they are easily inhaled and have the ability to penetrate deeper into lung tissue. As with many pollutants, sensitive populations such as children and the elderly are more susceptible to these health risks.

Particulate matter can also cause environmental damage. Particles can be carried by the wind for long distances before being deposited on the ground or in the water. Water bodies may become acidic, changes may occur to the nutrient balance in both water and in the soil, forests and crops may be damaged, and the diversity of ecosystems may be affected. Particulate matter is also the primary cause of reduced visibility, or haze, affecting in particular national parks and wilderness areas. In addition, particulates can cause aesthetic damage to buildings and stone, such as staining and accelerated decay.

Particulate emissions from diesel exhaust are of particular concern due to their toxicity. After reviewing available carcinogenicity studies, the Environmental Protection Agency concluded that diesel exhaust is a probable human carcinogen, and diesel particulate matter is the most likely portion of the exhaust to pose a risk (EPA, 2002b). The latest information available supports the link between diesel particulate matter and cancer risk, but the relationship between the concentration and duration of diesel particulate matter exposure and cancer risk continues to be uncertain (EPA, 2004). This topic is discussed further in this section (in Hazardous Air Pollutants, or Air Toxics) and in the next section (in Current Conditions and Trends).

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas produced when carbon-containing fuel is not burned completely. Motor vehicles are the primary source of carbon monoxide, but other sources include industry, outdoor burning, and non-road mobile sources such as off-road vehicles and lawnmowers. Areas of high carbon monoxide concentrations are usually localized, occurring near congested roadways and intersections. These localized areas of elevated carbon monoxide levels are referred to as *carbon monoxide hot spots*. High levels generally occur in autumn and winter months during conditions of light winds and stable weather, which prevent dispersion of the emissions.

Carbon monoxide reduces the blood's oxygen-carrying capability. Acute health effects include headaches, slowed reflexes, weakened judgment, and impaired perception. Chronic effects include aggravation of pre-existing cardiovascular disease and increased heart disease risk in healthy individuals. After extended exposure, individuals become nauseated and collapse, and at very high levels carbon monoxide is poisonous and can be fatal.

Ozone

Ozone in the upper atmosphere provides protection from harmful ultraviolet radiation from the sun; ozone in the lower atmosphere, referred to as ground-level ozone, poses numerous health and environmental risks. Hereafter, the term *ozone* refers to ground-level ozone.

Ozone is a highly toxic form of oxygen and a major component in the formation of smog. Ozone is formed when emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOCs) chemically react in the presence of sunlight. Peak ozone levels occur during the warmer summer months.

Ozone is a regional concern because, along with its precursors, it can be carried hundreds of miles from its origins. Maximum ozone levels generally occur at locations several miles downwind from the sources. Sources of the precursor pollutants to ozone — volatile organic compounds and nitrogen oxides — include mobile sources, industry, commercial solvents and wood burning, as well as natural (biogenic) sources such as forests.

Ozone is an eye and respiratory tract irritant and increases the risk of respiratory and heart diseases. Ozone reduces the lung function of healthy people during exercise, can cause breathing difficulty for susceptible populations (e.g., asthmatics and the elderly), and damages crops, trees, paint, fabric, and synthetic rubber products. The severity of the health effects is related to both the dose and the duration of exposure (National Research Council, 1992). Ozone can also affect the environment, causing damage to crops and other plant life, waterways and ecosystems.

Hazardous Air Pollutants, or Air Toxics

Hazardous air pollutants (HAPs), also referred to as air toxics, are chemicals emitted into the atmosphere that cause or are suspected to cause cancer or other severe health effects, such as birth defects or reproductive problems. At the state and regional level, the Department of Ecology and the Puget Sound Clean Air Agency list 400 pollutants as air toxics. This list includes the 188 national hazardous air pollutants set by the Environmental Protection Agency as well as additional pollutants believed to be harmful. Hazardous air pollutants are a subset of air toxics, but the terms are often used interchangeably. Examples of air toxics include benzene, perchlorethylene, methylene chloride, formaldehyde and asbestos, as well as diesel particulate matter and woodsmoke.

Air toxics are emitted by a variety of sources, including industry, small facilities such as dry cleaners, motor vehicles, non-road mobile sources (such as trains, boats, lawnmowers, etc.), and outdoor and indoor burning. In the Puget Sound region, particulate matter from diesel exhaust represents more than 70 percent of the potential cancer risk from air toxics. This topic is discussed further in the next section (in Current Conditions and Trends).

As mentioned above, air toxics are pollutants that are known or suspected to cause cancer and other serious health effects. These health effects include respiratory illness such as asthma and reduced lung function, damage to the immune system, neurological problems and reproductive problems such as reduced fertility. Once deposited into the soil and waterways, air toxics can build up in the food chain, resulting in human consumption of contaminated plants, fish and other animals.

Greenhouse Gases and Climate Change

Some greenhouse gases occur naturally in the atmosphere, trapping solar energy and warming the earth's surface. These gases include carbon dioxide (CO₂), nitrous oxide, and methane. However, human activities over the last century have contributed to increases in greenhouse gases, resulting in an increase in average global temperatures. According to the National Academy of Sciences, the Earth's surface temperature has risen by about 1 degree Fahrenheit in the past century, with accelerated warming during the past two decades. There is evidence that most of the warming over the last 50 years is attributable to human activities (IPCC, 2001).

The primary source of greenhouse gases is the burning of fossil fuels to generate electricity and power engines. Other sources include industry, agriculture and landfills. In the Puget Sound region, 50 percent of the emissions are attributable to transportation sources, including motor vehicles, aircraft, construction equipment, and boats (Puget Sound Clean Air Agency).

Expected consequences from climate change include an increase in global temperatures, resulting in a rising of the sea level. Other effects include a change in precipitation and impacts to local climates, which could alter forests, crop yields, and water supplies. Climate change may also affect human health, animals, and many types of ecosystems. For example, deserts may expand into existing rangelands, and features of some national parks may be permanently altered. The Puget Sound region may experience warmer summers and longer, wetter winters. Such effects could reduce forests in the Cascade Mountains by 20 to 50 percent and reduce snow packs. Reduced snow packs are likely to drastically change water availability in the region, which in turn will require a change in the way current water demands for agriculture, salmon populations and energy uses are managed. Climate change is also likely to result in more winter floods, higher water temperatures that would further stress salmon populations, and perhaps increase heat-related pollution such as ozone (UWCIG, 2005).



B. REGULATORY SETTING

There are numerous federal, state and local regulations related to air quality in the Puget Sound region, including those under the federal Clean Air Act and the Washington Clean Air Act. For example, there are controls on industrial emissions, indoor and outdoor burning, and vehicle engines and fuels. The state of Washington recently passed legislation adopting clean car standards, and the Governor signed the bill into law on May 6, 2005. Clean car standards require better pollution controls on vehicles and are more stringent than existing federal standards.

This section focuses on those regulations pertinent to the scope of the Vision 2020 Update document and the alternatives being considered, relating to the pollutants discussed in the previous section (in Physical Setting).

National Ambient Air Quality Standards

Under the federal Clean Air Act, the Environmental Protection Agency established National Ambient Air Quality Standards for six principal, or criteria, pollutants considered harmful to public health and the environment. Primary standards set limits to protect public health; secondary standards set limits to protect the environment, including protection against decreased visibility and damage to wildlife, plants and buildings. The six criteria pollutants are carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur oxides.

Air quality is monitored and areas are designated according to whether or not they meet the National Ambient Air Quality Standards for each pollutant. Geographic regions that meet the National Ambient Air Quality Standards are referred to as attainment areas; areas that do not meet the National Ambient Air Quality Standards are designated *nonattainment* to that standard. Once designated nonattainment, the Clean Air Act requires the preparation of an attainment plan to demonstrate how an area will thereafter meet and maintain the National Ambient Air Quality Standards. Once a nonattainment area has subsequently met the National Ambient Air Quality Standards for a period of time, the area may be redesignated as a maintenance area. A maintenance plan is required for these areas, to demonstrate that the National Ambient Air Quality Standards will continue to be met into the future. Maintenance and attainment plans for individual regions comprise the State Implementation Plan for Air Quality for a given state. The terms maintenance plan, attainment plan, and State Implementation Plan for Air Quality are often used interchangeably.

Maintenance plans will often contain control strategies to ensure attainment to the standards, related to the sources of the pollutants. Depending on the pollutant, these sources can include transportation, industry and wood smoke. An emissions inventory will be prepared, estimating the emissions from each of these sources. This inventory will be used to identify the appropriate level of emissions from each source that will ensure the region will maintain the standards. As an example, a motor vehicle emissions “budget” may be prepared for certain pollutants, which is a ceiling of total emissions from on-road mobile sources in the region that cannot be exceeded.

In 1978, the central Puget Sound region was classified as a nonattainment area for carbon monoxide and ozone. In 1987, the industrial areas of the Seattle Duwamish River, Kent Valley and Tacoma Tidelands were classified as nonattainment areas for PM₁₀. The Seattle and Tacoma industrial areas include the ports of both those cities. In 1996, having met the federal standards for several years, the region was redesignated by the Environmental Protection Agency as a maintenance area for carbon monoxide and ozone; the three PM₁₀ nonattainment areas were redesignated as maintenance areas in 2001. As required, each of these areas has approved maintenance plans in place. Approval of both the carbon monoxide and ozone maintenance plans occurred in 1996, with subsequent updates to both plans approved in 2004; approval of the PM₁₀ maintenance plan occurred in 2000, with the plan becoming effective in 2001. Figure 5-4-1 illustrates the region’s maintenance area boundaries.

In June 2004 the Environmental Protection Agency officially designated areas to a new ozone standard, and in April 2005, to a new particulate matter standard. The original ozone standard for which the Puget Sound region was in maintenance was based on a one-hour concentration. The new standard is based on an eight-hour average concentration and replaced the one-hour standard as of June 15, 2005. The new particulate matter standard is for PM_{2.5}, and is in addition to the existing PM₁₀ standard, which remains in place. At this time, the region is designated as in attainment to both the new eight-hour ozone and the PM_{2.5} standards. Figure 5-4-2 identifies the National Ambient Air Quality Standards for each of the criteria pollutants; units of measurement are parts per million (ppm) by volume, milligrams per cubic meter of air (mg/m³), and micrograms per cubic meter of air (µg/m³).

FIGURE 5-4-1: OZONE, CARBON MONOXIDE, AND PM₁₀ MAINTENANCE AREAS¹



¹ Note that the entire Puget Sound region is in attainment for the current eight-hour ozone standard. The ozone maintenance areas on the map refer to the one-hour ozone standard. To prevent deterioration in air quality, many of the maintenance area policies and programs will remain in place.



FIGURE 5-4-2: NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Primary Standards	Averaging Times	Secondary Standards
Carbon Monoxide	9 ppm (10 mg/m) ³ 35 ppm (40 mg/m) ³	8-hour ¹ 1-hour ¹	None None
Lead	1.5 µg/m ³	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µg/m) ³	Annual (Arith. Mean)	Same as Primary
Particulate Matter (PM ₁₀)	50 µg/m ³ 150 µg/m ³	Annual ² (Arith. Mean) 24-hour ¹	Same as Primary
Particulate Matter (PM _{2.5})	15.0 µg/m ³ 65 µg/m ³	Annual ³ (Arith. Mean) 24-hour ⁴	Same as Primary
Ozone	0.08 ppm	8-hour ⁵	Same as Primary
Sulfur Oxides	0.03 ppm 0.14 ppm -----	Annual (Arith. Mean) 24-hour 3-hour	----- ----- 0.5 ppm (1300 µg/m) ³

¹ Not to be exceeded more than once per year.

² To attain this standard, the three-year average of the weighted annual mean PM₁₀ concentration at each monitor within an area must not exceed 50 µg/m³.

³ To attain this standard, the three-year average of the weighted annual mean PM_{2.5} concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m³.

⁴ To attain this standard, the three-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 µg/m³.

⁵ To attain this standard, the three-year average of the fourth-highest daily maximum eight-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

Source: Environmental Protection Agency, 2005

Transportation Conformity

Transportation conformity is a mechanism for ensuring that transportation activities — plans, programs and projects — are reviewed and evaluated for their impacts on air quality prior to funding or approval. The intent of transportation conformity is to ensure that new projects, programs and plans do not impede an area from meeting and maintaining air quality standards. Specifically, regional transportation plans, improvement programs and projects may not cause or contribute to new violations, exacerbate existing violations, or interfere with the timely attainment of air quality standards or the required interim emissions reductions towards attainment. Positive findings of conformity are required by the federal Clean Air Act, the Clean Air Washington Act, and the federal transportation act (the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users), to allow regions to proceed with implementation of transportation projects in a timely manner.

A regional transportation conformity analysis must show that the total regional emissions produced by projects in the long-range transportation plan and the short-range transportation improvement program, plus activity on the existing travel network, do not exceed the motor vehicle emissions budget identified in the maintenance plan for each respective criteria pollutant (refer to the discussion in the Physical Setting previously). In the Puget Sound region, based on the pollutants for which the region is in maintenance to the standard, conformity is demonstrated to carbon monoxide and PM₁₀. Since the one-hour ozone standard has been revoked and the region is in attainment to the eight-hour ozone standard, demonstrations of conformity are no longer required for this pollutant.

C. CURRENT CONDITIONS AND TRENDS

National Pollutant Trends

About 140 million tons of pollution is emitted into the atmosphere each year in the United States. However, between 1970 and 2004, total emissions of the six criteria pollutants decreased by 54 percent. During that same period, gross domestic product increased 187 percent, vehicle miles traveled increased 171 percent, energy consumption increased 47 percent and the U.S. population grew 40 percent. From 1990 to 1999, air toxics emissions declined by 30 percent (EPA, 2004a). These trends illustrate the effectiveness of past and current regulations and programs. Alternatively, total

emissions of greenhouse gases increased 13 percent between 1990 and 2003. This is primarily due to carbon dioxide emissions from the combustion of fossil fuels (EPA, 2005).

Regional Pollutant Trends

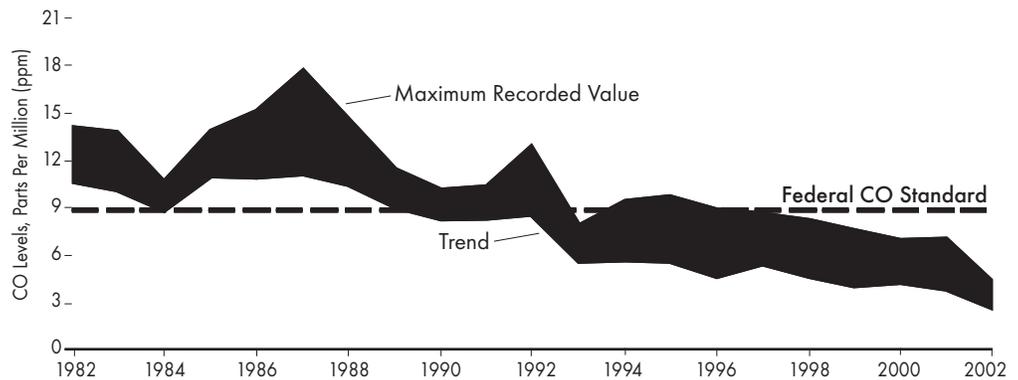
Regional air pollution trends have generally followed national patterns over the last 20 years, with the level of criteria air pollutants decreasing over the last decade to levels below the federal standards. Levels of carbon monoxide in particular have decreased substantially in the region (Figure 5-4-3). On-road gasoline vehicles represent over 70 percent of carbon monoxide emissions in the region, and decreases in carbon monoxide concentrations have resulted in large part due to federal emission standards for new vehicles and the gradual replacement of older, more polluting vehicles. Local oxygenated fuels programs, inspection and maintenance programs, and traffic control measures have also played a role in the declining trend in carbon monoxide emissions.

While ozone levels have remained below the national standard, in the past several years there has been a slight upward trend in emissions, and on hot summer days the region comes close to exceeding the eight-hour standard (Puget Sound Clean Air Agency, 2005). This is demonstrated on Figure 5-4-4. While the emissions are originating primarily in the urban area, the highest concentrations of ozone are measured

in communities 10 to 30 miles downwind from the source, in areas such as North Bend and Enumclaw. Because of the complex chemical reactions occurring in the formation of ozone, the reduction of the precursor pollutants volatile organic compounds and nitrogen oxides does not produce proportional reductions in ozone. In the Puget Sound region it has been determined that, at a certain level, reducing nitrogen oxides emissions may actually increase ozone concentrations. Reducing volatile organic compounds will be the most effective way to reduce ozone. The sources on which to focus, as identified by the Puget Sound Clean Air Agency, include motor vehicles, boats, lawnmowers, gasoline stations and architectural coatings.

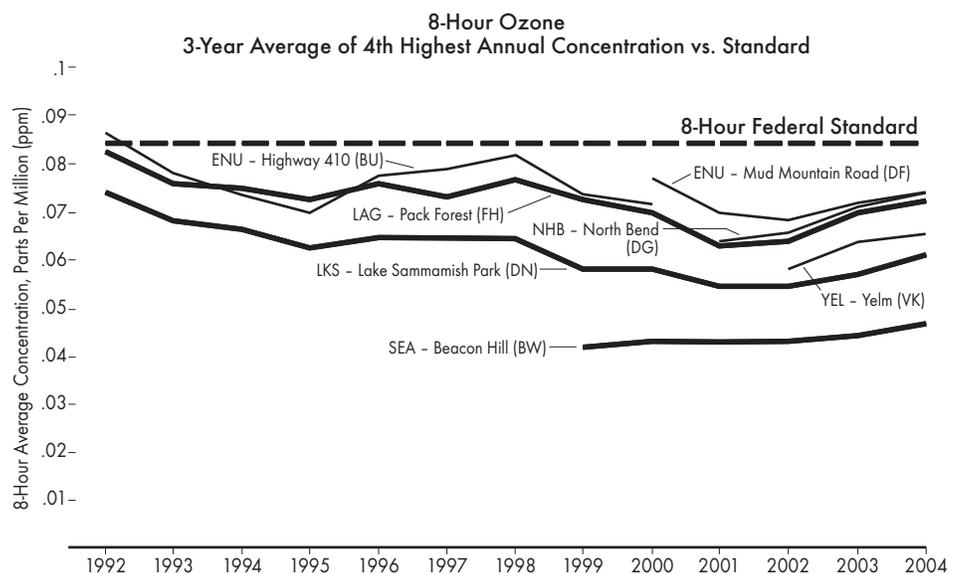
Similarly, emissions of fine particulates have not yet reached the existing standard; however, the levels have exceeded the local health goal adopted by the Puget Sound Clean Air Agency for this pollutant. The Environmental

FIGURE 5-4-3: CARBON MONOXIDE TREND IN PUGET SOUND



Notes: The trend line represents the average of the carbon monoxide values that fall within the upper one percent of the observations. Data for 2002 is incomplete and has not been validated. Source: Department of Ecology, 2003

FIGURE 5-4-4: OZONE TREND IN PUGET SOUND



Source: Puget Sound Clean Air Agency, 2003



Protection Agency is now proposing a revision to the PM_{2.5} standard, which aligns more closely with the Puget Sound Clean Air Agency's local goal. Early indications are that the region will be in violation of this new standard, which is expected to be finalized in late 2006 (Puget Sound Clean Air Agency). In the Puget Sound region, indoor and outdoor wood burning contribute almost half of the emissions of fine particulates (Puget Sound Clean Air Agency, 2004); 31 percent comes from road and construction dust, and mobile sources (both on-road and non-road) contribute 20 percent of the emissions. PM₁₀ emissions in the region have remained below the federal standard since the early 1990s.

According to the Puget Sound Clean Air Agency, air toxics are present in the region at levels posing a health risk, and the Environmental Protection Agency has placed the region in the top 5 percent of the country for potential cancer risk from air toxics (Puget Sound Clean Air Agency, 2005; EPA, 1996). Diesel particulate matter from diesel-fueled vehicles and equipment accounts for more than 70 percent of the potential cancer risk from all air toxics in the Puget Sound region. At 6 percent, particulate matter from wood smoke represents the second-highest potential cancer risk in the region (Puget Sound Clean Air Agency, 2003).

Finally, while transportation sources account for 50 percent of the greenhouse gas emissions in the Puget Sound region, emissions from natural gas and coal-based electricity generation are expected to increase the most between 2000 and 2020. According to the 2004 Puget Sound Clean Air Agency report, *Roadmap for Climate Protection: Reducing Greenhouse Gas Emissions in Puget Sound*:

Data collection stations across the Pacific Northwest region have recorded a 1.5 degrees average temperature increase over the last 80 years in both urban and rural areas. In fact, the 1990s was the warmest decade on record. Across much of the region, spring snowmelt now occurs 10-30 days earlier than it did 50 years ago and April 1 snowpack levels below 6,000 feet have shown approximately 30 percent declines. Research also indicates that the region's glaciers have lost some 30 percent of their girth in the last century. For example, the South Cascade Glacier outside of the North Cascades National Park has lost a third of its mass in 45 years. The Nisqually glacier on Mt. Rainier has drawn back nine-tenths of a mile since the early 1900s.

5.4.2 Analysis of Alternatives (Long-Term Impacts)

A. IMPACTS COMMON TO ALL ALTERNATIVES

Methodology

Nitrogen oxides, volatile organic compounds, ozone, carbon monoxide, PM₁₀, and PM_{2.5} emissions for each of the alternatives were modeled using PSRC's travel demand model and the Environmental Protection Agency's MOBILE6.2 vehicle emissions modeling software. Emissions were calculated on an individual link basis, based on the vehicle miles traveled and speed of each link. This calculation was performed separately for each of five time periods (a.m. peak, midday, p.m. peak, evening, and nighttime). The calculated emissions of individual links were then summed for each of the five time periods, which in turn were summed for the total daily emissions. MOBILE6.2 was not used to model CO₂ emissions (CO₂ is used as the representative pollutant for greenhouse gases). These emissions can be approximated based on regional vehicle miles traveled, and the estimate that vehicles emit 0.92 pound of CO₂ per vehicle mile traveled. There is a greater level of uncertainty in calculating CO₂ than in calculating other pollutants, but the relative comparison of emissions from each alternative is valid. No modeling was performed for air toxics. Although the Environmental Protection Agency has not provided guidance for modeling air toxics, emissions are expected to vary between the alternatives similarly to the other pollutants.

Ozone, carbon monoxide, and PM₁₀ emissions were modeled only within their respective maintenance areas, as opposed to the entire region (the ozone maintenance area used is the original maintenance area for the one-hour ozone standard, which was revoked in 2005). This approach allows modeled emissions under each alternative to be compared to the motor vehicle emissions budget for each maintenance area. With the exception of PM₁₀, emissions for the entire Puget Sound region are expected to vary between the alternatives in a similar pattern to the emissions within the maintenance areas (the PM₁₀ maintenance areas are three relatively small industrial areas and may not be representative of the entire region). Since there are no designated maintenance or nonattainment areas in the Puget Sound region for CO₂ and PM_{2.5}, emissions of these pollutants were modeled for the entire region.

The results of this analysis are shown on the following figure for all pollutants and all alternatives.

FIGURE 5-4-5: PROJECTED POLLUTANT EMISSIONS (TONS/DAY) ¹

Pollutant	Emissions Budget ²	Growth Targets Extended Alternative	Metropolitan Cities Alternative	Larger Cities Alternative	Smaller Cities Alternative
Carbon Monoxide	2510.00	1231.13	1151.08	1147.59	1155.85
Volatile Organic Compounds	248.20	61.24	54.20	53.78	58.70
Nitrogen Oxides	263.01	45.13	41.06	40.87	44.68
PM ₁₀					
Kent	0.12	.07	.08	.08	.06
Duwamish	0.42	.19	.23	.18	.16
Tacoma	0.23	.14	.15	.11	.13
PM _{2.5}	N/A ³	2.09	1.91	1.91	2.08
CO ₂	N/A ⁴	64,138	58,736	58,588	63,756

¹ Due to technological improvements assumed in forecast years in MOBILE6.2 (e.g., cleaner fuels and vehicles), emission factors in forecast years are lower than current emission rates.

² From the Central Puget Sound Region Maintenance Plans for the National Ambient Air Quality Standards, 2004.

³ There is no emission budget for PM_{2.5} because the Puget Sound region has never been designated nonattainment for PM_{2.5}.

⁴ CO₂ is not one of the six criteria pollutants to which areas are designated attainment/nonattainment; therefore, there is no motor vehicle emissions budget for this pollutant.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

Growth Targets Extended would extend currently adopted plans and targets to the year 2040. Growth under Growth Targets Extended would be more evenly distributed among geographies than under existing conditions. In comparison to the other alternatives, this alternative would have the second most growth in rural areas, as well as a substantial amount of growth in unincorporated urban growth area. Due to this dispersal of growth, Growth Targets Extended would result in greater vehicle miles traveled throughout the region than the other alternatives, which focus growth more centrally in cities. Growth Targets Extended would result in greater carbon monoxide, nitrogen oxides, and VOC emissions than any of the other alternatives (Figures 5-4-6 through 5-4-7). Emissions of all pollutants, however, are expected to be within the regional motor vehicle emissions budgets (Figure 5-4-5).

There is greater variation among the alternatives when analyzing PM₁₀ emissions. Emissions in the Kent PM₁₀ area are the second lowest under Growth Targets Extended. In the Duwamish and Tacoma areas, PM₁₀ emissions are the second highest among the four alternatives (Figure 5-4-8). Since the region's three PM₁₀ maintenance areas encompass industrial locations, the variation in emissions reflects expected growth in employment, as well as a more general shift in development patterns around these areas.

FIGURE 5-4-6: CARBON MONOXIDE EMISSIONS IN 2040 (TONS/DAY)

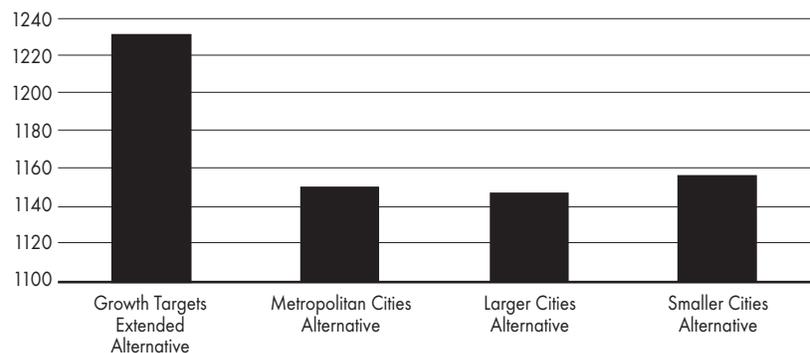


FIGURE 5-4-7: OZONE EMISSIONS IN 2040 (TONS/DAY)

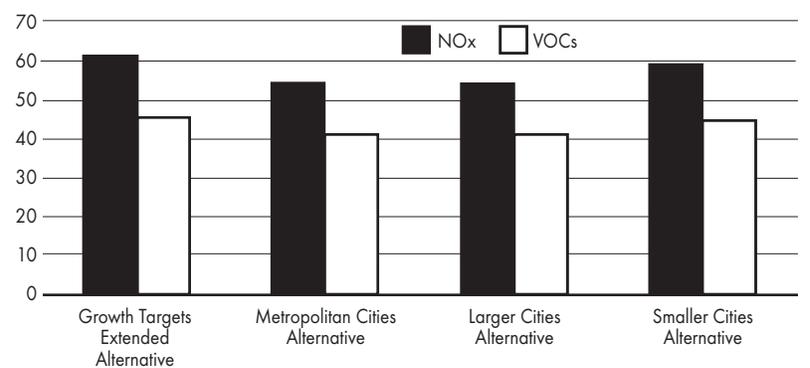
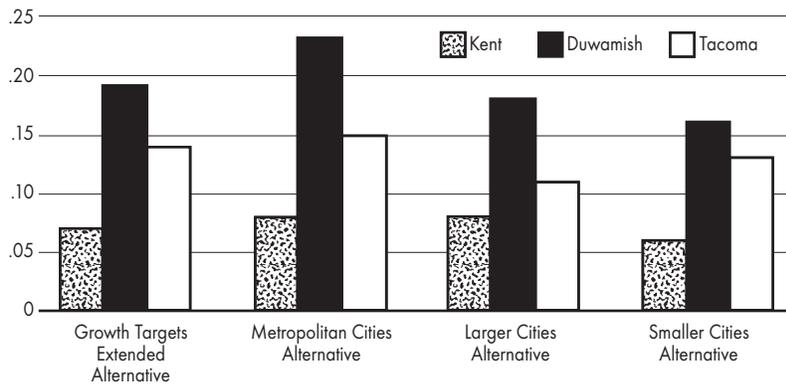


FIGURE 5-4-8: PM₁₀ EMISSIONS IN 2040 (TONS/DAY)

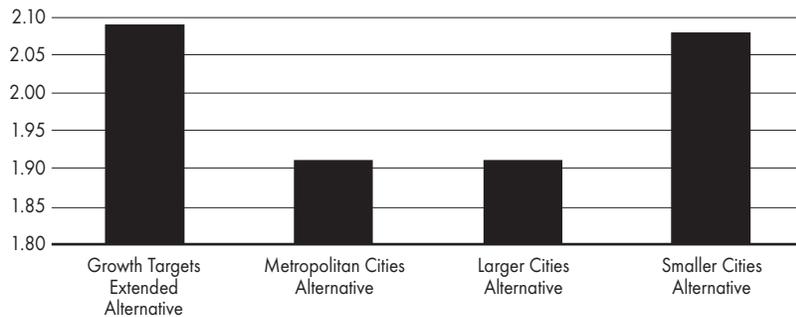


Regional vehicle miles traveled projections are greater under Growth Targets Extended than under the other alternatives, resulting in the highest level of forecasted PM_{2.5} emissions (Figure 5-4-9). Based on regional vehicle miles traveled projections, over 64,000 tons of CO₂ (Figure 5-4-10) would be emitted under Growth Targets Extended. This estimate is higher than the other alternatives, where growth would be more centrally focused and regional vehicle miles traveled would be lower.

METROPOLITAN CITIES ALTERNATIVE

Under the Metropolitan Cities Alternative, growth would be focused in metropolitan cities and core suburban cities. The densities associated with this growth pattern would result in the lower range of emissions for carbon monoxide, nitrogen oxides, and volatile organic compounds among the four alternatives. The Metropolitan Cities Alternative results in slightly higher emissions of these three pollutants than the Larger Cities Alternative, but lower than the Growth Targets Extended and Smaller Cities alternatives.

FIGURE 5-4-9: PM_{2.5} EMISSIONS IN 2040 (TONS/DAY)



All three of the PM₁₀ maintenance areas fall within the metropolitan and core suburban cities. The growth of population, employment, and commercial activity concentrated in these areas that is associated with the Metropolitan Cities Alternative would result in the highest PM₁₀ emissions of all of the alternatives. The Duwamish industrial area in particular, due to its location in the City of Seattle, shows a more substantial increase in PM₁₀ emissions under this alternative. Regional emis-

sions of PM_{2.5} and CO₂ are less under this alternative than Growth Targets Extended and the Smaller Cities Alternative; as with emissions of carbon monoxide, nitrogen oxides, and volatile organic compounds, the Metropolitan Cities and Larger Cities alternatives produce similar levels of these pollutants.

LARGER CITIES ALTERNATIVE

Growth under the Larger Cities Alternative would be focused primarily in core suburban and larger suburban cities, with some growth in metropolitan cities. Growth would be more concentrated than under Growth Targets Extended, but not as centrally focused in metropolitan cities as under the Metropolitan Cities Alternative. Projected vehicle miles traveled throughout the region and in the carbon monoxide and ozone maintenance areas are only slightly lower under the Larger Cities Alternative than under the Metropolitan Cities Alternative. Forecasted emissions of carbon monoxide, nitrogen oxides, and volatile organic compounds are generally similar to projected emissions under the Metropolitan Cities Alternative.

The Larger Cities Alternative would focus less growth in metropolitan cities (e.g., Tacoma and Seattle) than the Metropolitan Cities Alternative. Therefore, projected vehicle miles traveled and PM₁₀ emissions in the Duwamish and Tacoma maintenance areas are lower than under both the Growth Targets Extended and Metropolitan Cities alternatives. Because the Kent PM₁₀ maintenance area lies in a core suburban city, the PM₁₀ emissions in this area are slightly higher than in Growth Targets Extended, but still less than under the Metropolitan Cities Alternative. Vehicle miles traveled throughout the region is comparable to the Metropolitan Cities Alternative, resulting in projected PM_{2.5} and

CO₂ emissions that are only slightly lower than the Metropolitan Cities Alternative.

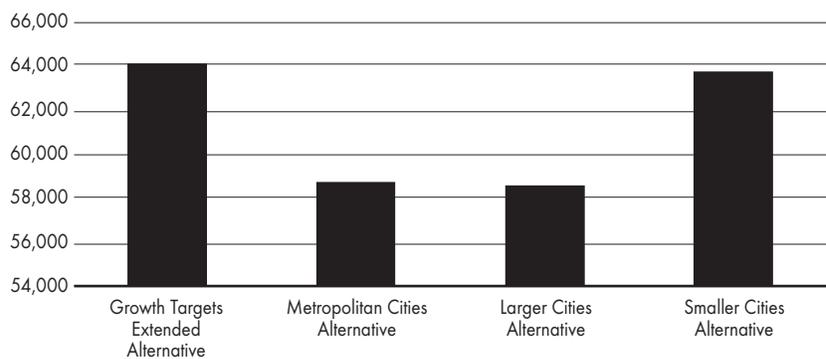
SMALLER CITIES ALTERNATIVE

The Smaller Cities Alternative would disperse growth throughout the urban growth area. A large amount of growth would be focused in smaller suburban cities and unincorporated urban growth area. Emissions of all pollutants under this alternative would be

lower than under Growth Targets Extended. The Growth Targets Extended and Smaller Cities alternatives are both projected to result in larger concentrations of carbon monoxide and ozone than the Metropolitan Cities and Larger Cities alternatives.

The Smaller Cities Alternative would draw growth away from the larger cities, resulting in the lowest PM₁₀ emissions in the Duwamish and Kent industrial areas; the PM₁₀ emissions in Tacoma are the lowest under the Larger Cities Alternative, due to changed development patterns in that area. Regional PM_{2.5} and CO₂ emissions are also lower under this alternative than under Growth Targets Extended, although higher than both the Metropolitan Cities and Larger Cities alternatives.

FIGURE 5-4-10: CO₂ EMISSIONS IN 2040 (TONS/DAY)



5.4.3 Cumulative Effects

Beyond the transportation-related impacts described previously, all of the alternatives would result in development and construction activity in various areas throughout the region. Construction would likely generate localized dust and exhaust emissions from vehicles and other equipment. In addition, these construction activities will likely contribute to localized traffic congestion, which may worsen localized emissions. The potential quantities of generated dust and exhaust emissions would depend on the amount of construction activity associated with each alternative. Specific impacts would be analyzed and addressed by project-level analysis of individual projects.

In addition, as discussed in the report, “*At The Microscale: Compact Growth and Adverse Health Impacts*” (contained in *Appendix E*), there may be localized impacts to air quality and public health from the compact growth patterns described in some of the alternatives. While not a requirement, strategies to mitigate these potential impacts may be considered at both the regional and local levels. One example would be to give greater consideration to proximity to sensitive populations (such as children and the elderly) in the siting of land use developments.

- Trees and natural vegetation help absorb some kinds of pollutants, and can improve localized conditions (EPA, 2004).
- The surface transportation-based forecasts used for the air quality analysis do not attempt to predict other changes in regional and external pollution that would aggravate air quality concerns in the region. Recent reports by the Environmental Protection Agency identify marine shipping as a major source of pollutants, which tends to have the highest impact in waterfront areas, where most of the region’s highest concentrations of housing and jobs are. Increases in the levels of shipping activity could worsen conditions for the region. Changes in regional aviation activity could have similar effects (see next section on ferry emissions).
- Growth outside of the region could also increase vehicle emissions in nearby metropolitan areas; farming, industrial, and other activities in these surrounding areas could increase airborne pollutants in the Puget Sound basin.
- While the Puget Sound Clean Air Agency has placed legal limits on smoke from wood stoves and fireplaces, and burn bans are also in effect when air quality conditions worsen, these limits do not apply outside of the area. Within the region, monitoring and enforcement of individual violations is also difficult, and wood stoves and fireplaces remain a source of pollution.



5.4.4 Potential Mitigation Measures

Individual development projects may require mitigation, which would be identified during future project-level planning and environmental review. Each of the alternatives is estimated to result in emissions well below the motor vehicle emissions budget for each pollutant; therefore, mitigation to reduce these emissions would not be required.²

However, given that certain pollutants are still a concern in the region (e.g., ozone and PM_{2.5}), existing programs and measures to ensure the region's continued attainment and maintenance status should continue. Among others, these programs include the state's emission check program, the truck idling reduction program and the Clean Car Standards; Puget Sound Clean Air Agency's Diesel Solutions/Clean School Bus Program; efforts by the Washington State Ferries and transit agencies to update their fleets to clean fuels such as natural gas, hybrid technologies, and biodiesel; and efforts by the Puget Sound Maritime Air Forum to quantify Port emissions. A few of these measures are briefly discussed below.

Diesel Retrofits

In 2001, Puget Sound Clean Air Agency partnered with the Environmental Protection Agency to launch the Diesel Solutions Initiative. The goal of the initiative was to reduce ambient levels of air toxics, especially diesel particulate matter. The initiative enlists public and private fleets to use cleaner fuels or to retrofit fleet vehicles. Engine retrofits include the addition of better pollution control equipment (such as diesel particulate filters) or the early replacement of older engines with newer, cleaner engines. Currently, almost 50 percent of the public fleet and 30 percent of the private fleet have been retrofitted. Beginning in 2007, all new vehicles will have diesel particulate filters. By 2040, nearly 100 percent of the fleet will be retrofitted or replaced, resulting in an approximately 90 percent reduction in particulate matter emissions. Any activities (e.g., retrofits) that speed the implementation of the cleaner technologies will bring air quality benefits to the region sooner than would normally occur (Carr, 2005).

Fuel Technology

Transit agencies are also introducing cleaner fuels such as natural gas, ultra-low-sulfur diesel, and biodiesel. According to the Environmental Protection Agency, the use of compressed natural gas in vehicles can reduce carbon monoxide emissions 90 to 97 percent, nitrogen oxides 35 to 60 percent, volatile organic compounds 50 to 75 percent, and CO₂ emissions up to 25 percent. The combustion of natural gas also produces fewer air toxics and little to no particulate emissions (EPA, 2002). The most commonly used biodiesel is known as B20, which blends 80 percent conventional diesel and 20 percent biodiesel. In comparison to conventional diesel, B20 produces 12 to 20 percent fewer emissions of volatile organic compounds, carbon monoxide, and PM, although nitrogen oxides emissions tend to increase by about 2 percent (EPA, 2002a). While the primary purpose of ultra-low-sulfur diesel is to improve the performance of retrofit technologies such as particulate filters, the use of ultra-low-sulfur diesel alone can reduce PM emissions 5 to 9 percent. Extensive emission reductions can result if an entire fleet is fueled with ultra-low-sulfur diesel (EPA, 2005a).

Ferry Emissions

Washington State Ferries is also working to reduce air pollution in the region by improving air emissions from its ferry fleet. This year, they will convert their entire fleet to run on low-sulfur diesel, resulting in a 30 percent annual reduction of particulate matter. Washington State Ferries is also testing the use of ultra-low-sulfur diesel and biodiesel in several vessels.

Other Approaches

To reduce cumulative effects from marine sources, the region could seek higher standards for marine vessels through legislation. To reduce cumulative effects from wood-burning, continued or expanded education in and beyond the region, and incentives to convert wood burning devices would reduce smoke emissions.

² Some individual projects, however, may require project-level carbon monoxide modeling to ensure that there would not be a localized exceedance of the National Ambient Air Quality Standards. Evaluation of appropriate mitigation measures would be made during future project-level planning and review.

5.4.5 Significant Unavoidable Adverse Impacts

Future project-level environmental review would determine if applicable air quality standards would be exceeded at specific locations. Where this occurs, potential mitigation for such impacts would be evaluated and implemented as appropriate to address the impact. If all proper mitigations are required as part of subsequent project-level actions, no significant unavoidable adverse air quality impacts are expected under the Growth Targets Extended, Metropolitan Cities, Larger Cities, and Smaller Cities alternatives.







Ecosystems

This chapter summarizes existing ecosystem conditions and features in the region, and refers to natural resource features and conditions, specifically vegetation, wetlands, streams, lakes, and other waterbodies, marine resources, fish, and wildlife. The chapter describes areas identified as having regionally significant habitats and discusses the potential impacts of each of the growth distribution alternatives on these areas as well as on the overall functioning of the region’s ecosystems.

5.5.1 Affected Environment

Land Use

Of the approximately 6,300 square miles that make up the four-county region, the vast majority of land remains designated for non-urban uses, including resource lands such as farms and forests (roughly 3,800 square miles, or 60 percent of the total land area in the region) or relatively less developed rural “non-resource” lands (more than 1,500 square miles, or 24 percent). Much of this land already enjoys some protection from urban levels of development because of its ownership (e.g., national and local parks, public working forests, agriculture) or because of regulation on the Washington State Growth Management Act (e.g., critical areas ordinances, designations as rural land).

Inside the region’s urban growth area (which is 980 square miles, or about 16 percent of the region’s total land area), much of the land consists of developed areas where most of the original land cover and vegetation has been removed or altered over time. In many areas, new vegetation has been introduced that is not native to the region. Similarly, new fish and wildlife species have been introduced, and some native species now flourish in areas where they once occurred only in small numbers. Common wildlife species in urbanized areas include American robins, house sparrows, black-capped chickadees, American crows, eastern gray squirrels, and Norway rats.

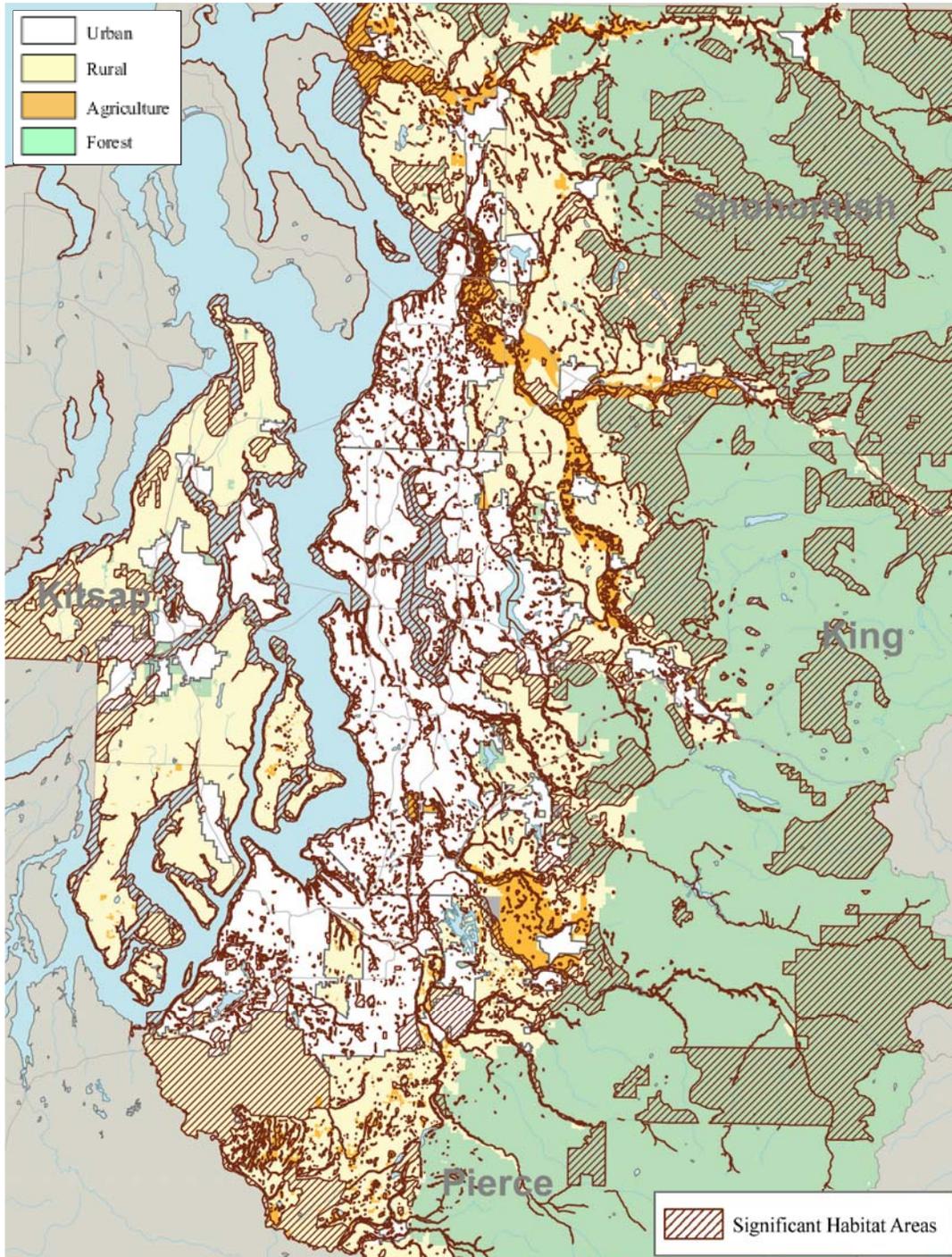
Notably, the urban growth area also contains a few large blocks of relatively undeveloped areas that support a more diverse assemblage of plant and animal species. Non-native species are also present in these areas, but do not dominate the landscape as much as in the rest of the urbanized area. Examples of relatively undeveloped areas inside the urban growth area include Discovery Park, Magnuson Park and Saint Edwards State Park in King County, Fay Bainbridge State Park in Kitsap County, and Point Defiance Park in Pierce County. Significant habitat types in these areas include conifer and mixed conifer-hardwood forests, wetlands, and meadows.

Other potentially higher-quality habitat areas in the region include major waterways and their valleys, including rivers (e.g., Snohomish River) and creeks, as well as lakes (e.g., Lake Washington and Lake Sammamish), wetlands, and green spaces (e.g., parks, cemeteries, or trails). The Puget Sound and its many estuaries comprise a large high quality habitat area that is central to the region. Many of the areas that provide higher-quality habitat have been identified by various



agencies and organizations as having a high priority for conservation. These areas are depicted in Figure 5-5-1 and discussed in greater detail in the subsequent pages.

FIGURE 5-5-1: AREAS IDENTIFIED AS HAVING REGIONALLY SIGNIFICANT HABITAT IN THE REGION

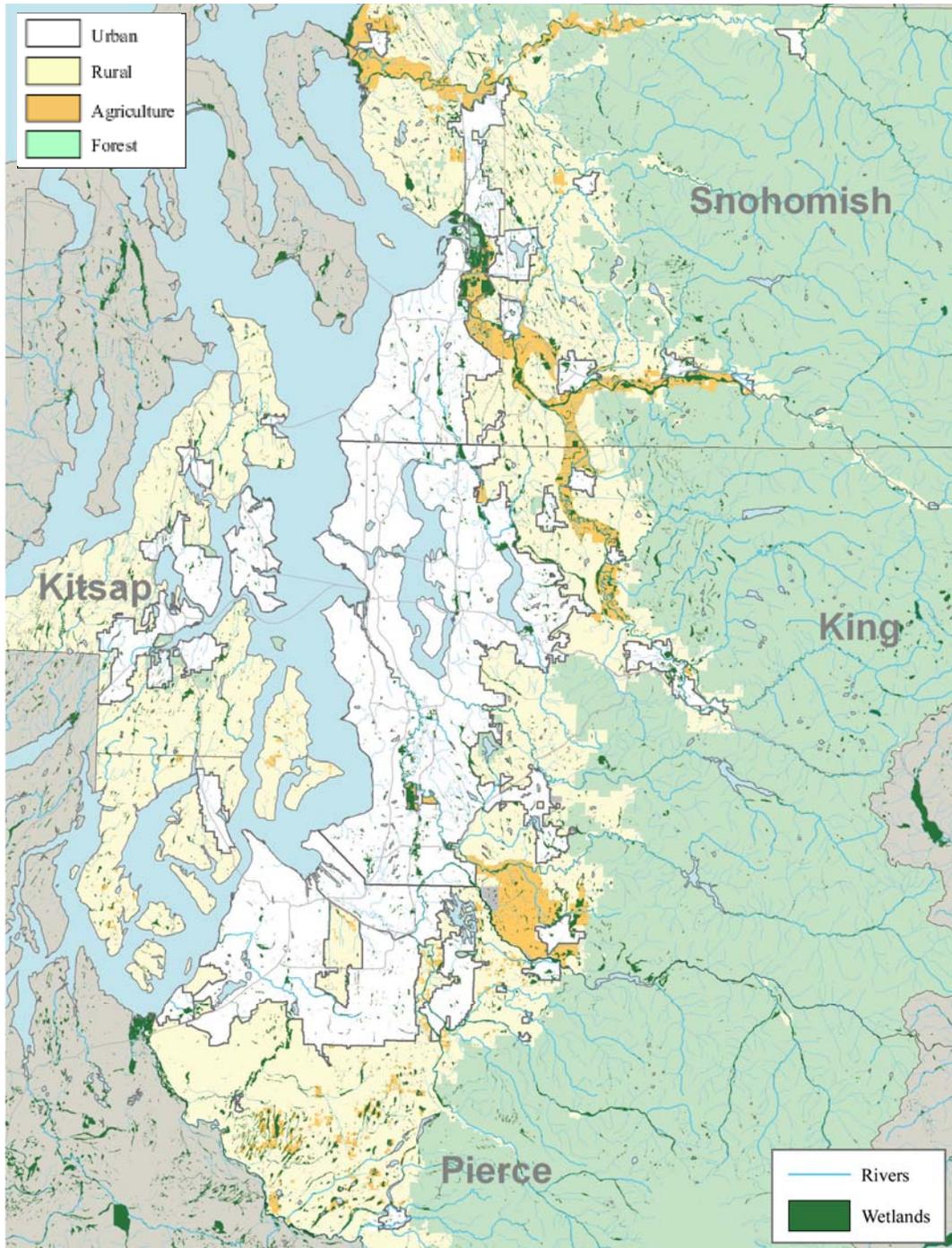


Source: National Oceanic and Atmospheric Administration, Washington State Department of Fish and Wildlife and Department of Natural Resources, The Nature Conservancy

Wildlife species present in these higher-quality habitats include great blue herons, bald eagles and other raptors, a variety of songbirds, coyotes, deer, mice, voles, pocket gophers, western gray squirrels, garter snakes, and treefrogs, and other amphibians. Important aquatic species include salmon, orcas, and others.

Wetlands, lakes, streams, and Puget Sound itself are central elements to the Puget Sound area’s ecosystem (Figure 5-5-2). These water resources affect the climate, support numerous ecosystem functions including habitat for aquatic species and riparian travel corridors for terrestrial species and provide drinking water to sustain the human population throughout the region. The network of freshwater resources also links inland ecosystems with the marine ecosystem of Puget Sound, which features such diverse habitats as coastal lagoons, kelp and seagrass beds, rocky shores, sandy beaches and spits, and salt marsh wetlands. These habitats and surrounding forests support an intricate web of plants, fish, and other organisms. Federal, state, and local regulations intended to protect regional water resources are described in *Chapter 5.6 – Water Quality and Hydrology*.

FIGURE 5-5-2: MAJOR WETLANDS, LAKES, RIVERS, AND STREAMS IN THE REGION



Source: Puget Sound Regional Council, National Wetlands Inventory, County-level Wetlands Data



Biological Diversity

Rapid, sustained population growth since the end of World War II has resulted in substantial losses of fish and wildlife habitat in urbanizing areas of the state, particularly in the Puget Sound region (WDFW 2005). The Comprehensive Wildlife Conservation Strategy for Washington State identified nine major influences that have the greatest impact on fish and wildlife species, as well as the habitats they need.¹ Two of these — habitat loss and invasive species — are related to urban development and were identified as the most serious threats to Washington’s native species, habitat, and biodiversity (WDFW 2005). Habitat loss through conversion, fragmentation, and degradation have resulted in the loss of more than half of the state’s highest priority functioning habitats since Washington gained statehood in 1889 (WDFW 2005). Many invasive species, introduced both intentionally and unintentionally, are out-competing native species and adversely changing native ecosystems.

One indicator of the threat to biodiversity posed by urbanization is the number of species with a regulatory status indicating particular concern for their viability in the region. Based on listings by state agencies,² between four and seven species have been extirpated (locally extinct), 11 are endangered to become extinct, 15 are threatened, 42 are sensitive, 55 are candidates for listing, and 13 more are being monitored, for a total of 143 species that are classified as facing some level of threat of extinction. Species in the area that are currently listed as threatened or endangered under the Federal Endangered Species Act include the orca whale in marine habitats; chum salmon, Chinook salmon, and bull trout in streams; and marbled murrelet in both terrestrial and marine habitats.

One organization, the Center for Biological Diversity, has a much larger listing, finding that as of the year 2005, 957 of 7,013 species in the Puget Sound are imperiled, including 519 plants, 296 animals, 129 fungi, and 13 marine algae; an additional 14 species are believed to have vanished from the region altogether. See *Chapter 5.6 – Water Quality and Hydrology* for additional discussion of the conditions in these water bodies, which also support populations of threatened and endangered species.

Impervious Surfaces

Another indicator of ecosystem health is impervious surface. Currently, no detailed information or reliable source data exists for the region, but some proxies are available. One is the “urban footprint” presented in the Regional Environmental Baseline (*Chapter 2 – Figure 2-16*). That figure includes two maps of the Seattle area, one for 1950 and the other for the year 2000, showing the extent of population and employment growth over that time period, with the urban footprint both filling in and spreading. Another figure (*Chapter 5.6 – Figure 5.6.2*) shows areas in the region with 15 percent or greater impervious coverage. As noted in that chapter, ecosystem functions begin to decline once an area exceeds certain levels of imperviousness. For additional discussion of impervious surfaces, see *Chapter 5.6 – Water Quality and Hydrology*.

Invasive Species

Invasive species constitute a severe and growing threat to the stability and integrity of local ecosystems. The following discussion, drawn from the Washington State Department of Fish and Wildlife’s Comprehensive Wildlife Conservation Strategy for Washington State, provides some background on the issue, including the significance of invasive species in the region and recent efforts to address the problem.

Throughout the region, aggressive non-native plants and animals are displacing native species, altering natural systems, and affecting the economy and human health. The effect of invasive species is especially severe in the inland marine waters of Puget Sound. Examples include cord grasses (*Spartina*), Japanese eelgrass, oyster drill, varnish or dark mahogany clam, and the European green crab.

In freshwater habitats, the proliferation of non-native bullfrogs has had a severe impact on declining species such as western pond turtles, northern leopard frogs, and other native species. Many freshwater aquatic invasive plants found in the area were originally brought here as ornamental plants for aquariums or water gardens. These ornamentals are often

¹ The nine major influences identified in the Comprehensive Wildlife Conservation Strategy were (1) habitat loss through conversion, fragmentation, and degradation, (2) invasive alien plant and animal species, (3) water quantity — allocation and diversion of surface water, (4) water quality issues, (5) salmon recovery, (6) forest conservation and management practices, (7) agricultural and livestock grazing practices, (8) disease and pathogens, and (9) inadequate data on wildlife species, populations, and habitat.

² Sources of listings: Washington State Department of Fish and Wildlife (from the Washington Administrative Code and the department’s Comprehensive Wildlife Conservation Strategy, 2005), Washington State Department of Natural Resources.

hardy species which, when introduced to local waters, often thrive and outcompete native plants. Eurasian water milfoil is a particularly problematic aquatic weed. It reproduces by fragmentation and proliferates to form dense mats of vegetation in the littoral zone of lakes and reservoirs, where it crowds out native aquatic vegetation, reduces dissolved oxygen, and can severely degrade the ecological integrity of a water body in just a few growing seasons.

The problem of invasive species is currently being addressed at many different levels in the region. Examples include Washington's Noxious Weed Control Board, which serves as the state's noxious weed coordination center for the activities of county noxious weed control boards and districts. The Washington Department of Agriculture also has a lead role in coordinating an aggressive state/federal/private effort to eradicate or at least stop the spread of invasive cordgrass (*Spartina*), which has taken over much of Willapa Bay and is spreading throughout Puget Sound. In 2000, the Washington Legislature passed a ballast water management law that requires oceangoing vessels and vessels involved in coastal trade to conduct any ballast water exchange at least 50 miles offshore and to report all ballast water discharges to the Coast Guard or the state. (WDFW, 2005)

A. AREAS IDENTIFIED AS HAVING REGIONALLY SIGNIFICANT HABITAT

While the way all land is used has an impact on the ecosystem, several agencies and organizations have identified specific areas of concern for the maintenance of healthy ecosystems in the region. These high-quality ecosystems would be considered vulnerable to land use changes associated with human population growth.

These ecosystems include areas identified by:

1. Washington Department of Natural Resources — Natural Heritage Program
2. Washington Department of Fish and Wildlife (WDFW) — Priority Habitats and Species List
3. Willamette Valley–Puget Trough–Georgia Basin Ecoregional Assessment
4. Critical Habitat designated for Endangered Species Act-listed species by the National Oceanic and Atmospheric Administration and the United States Fish and Wildlife Service

These data sets focus on high-quality ecosystems and areas that have been identified as high priorities for conservation, rather than reflecting individual species of concern, or individual resources such as a specific wetland, smaller fragmented ecosystems, or buffers designated as central areas. The assessment of critical habitat is based on a systems-level approach that considered factors such as connectivity and overall function. Figure 5-5-1 shows the general location of these regionally significant habitats in the region, and all are described in more detail on the following pages.

1. The Washington Department of Natural Resources Natural Heritage Program³ collects and distributes information about native ecosystems and rare species to provide an objective, scientific basis from which to prioritize conservation actions (WDNR, 2005). A basic assumption of this approach is that by protecting examples of all the various ecosystem types, most of the common species will gain protection as well.

- For terrestrial ecosystems, the Natural Heritage Program uses a vegetation-based classification to identify significant ecological features of the state. The terrestrial ecosystems classification provides an objective framework upon which to base conservation efforts.
- Natural Heritage Program geographic information system data also identify relatively undisturbed, high-quality wetlands.
- Other Natural Heritage Program geographic data reviewed for this analysis included the oak and grasslands geographic data set, with the following cover types included for analysis: native grassland, oak-conifer forest or woodland canopy, oak-dominant forest or woodland canopy, scattered oak canopy, semi-native grassland, shrubland potentially restorable to grassland, and urban oak canopy.

Figure 5-5-3 shows the distribution of high-quality native ecosystems identified by the Natural Heritage Program. Due to the number of individual sites identified in the planning area, the terrestrial and wetland ecosystem data have been summarized into ecosystem types, based on the dominant vegetation species. These types were named for the habitat associations described for the dominant species by Pojar and McKinnon (1994).

³ Web site link: <http://www.dnr.wa.gov/nhp/>



In many areas, Natural Heritage Program data identify multiple ecosystems or habitat types that overlap at a single site. In calculating the total acreage of high-quality ecosystems, these multiple overlapping polygons were summed separately; that is to say, the acreage values in Figure 5-5-3 represent double counting of some areas that occur in more than one ecosystem polygon.

**FIGURE 5-5-3: WASHINGTON DEPARTMENT OF NATURAL RESOURCES
– NATURAL HERITAGE PROGRAM HIGH-QUALITY NATIVE ECOSYSTEMS BY COUNTY**

Ecosystem Type	Acres Inside UGA	Acres Outside UGA	Total Acres
KING COUNTY			
Conifer forest	120	0	120
Dry conifer forest	0	40	40
Moist conifer forest	0	3,244	3,244
Conifer/hardwood	0	523	523
Deciduous forest	109	338	447
Bog	825	1,235	2,060
Pond/marsh	0	703	703
Freshwater wetland	340	809	1,149
Wet meadow	0	365	365
Shrubby wetland	340	677	1,017
Conifer wetland	231	118	349
King County Subtotal	1,965	8,052	10,017
KITSAP COUNTY			
Dry conifer forest	18	2,042	2,060
Deciduous forest	0	9	9
Bog	0	42	42
Pond/marsh	0	126	126
Freshwater wetland	0	181	181
Shrubby wetland	0	148	148
Estuarine wetland	0	242	242
Coastal/tideland	0	484	484
Kitsap County Subtotal	18	3,274	3,292
PIERCE COUNTY			
Conifer forest	91	0	91
Dry conifer forest	8	2,598	2,606
Moist conifer forest	0	707	707
Conifer/hardwood	35	139	174
Deciduous forest	0	2,921	2,921
Oak/grassland	69	2,086	2,155
Dry meadow	6	12,497	12,503
Native grassland*	0	2,022	2,022
Oak-conifer forest*	547	1,972	2,519
Oak-dominant forest*	583	1,151	1,734
Scattered oak canopy*	274	337	610
Semi-native grassland*	0	6,593	6,593
Shrubland potentially restorable to grassland*	130	1,359	1,489
Urban oak canopy*	2,175	21	2,196
Pond/marsh	0	728	728
Freshwater wetland	0	1,508	1,508
Conifer wetland	0	30	30
Deciduous wetland	0	7	7
Estuarine wetland	0	1,128	1,128
Coastal/tideland	0	1,310	1,310
Pierce County Subtotal	3,918	39,114	43,031

**FIGURE 5-5-3: WASHINGTON DEPARTMENT OF NATURAL RESOURCES
 – NATURAL HERITAGE PROGRAM HIGH-QUALITY NATIVE ECOSYSTEMS BY COUNTY – *continued***

Ecosystem Type	Acres Inside UGA	Acres Outside UGA	Total Acres
SNOHOMISH COUNTY			
Alpine meadow	0	25	25
Conifer forest	0	4,171	4,171
Dry conifer forest	0	8,089	8,089
Moist conifer forest	0	24,389	24,389
Deciduous forest	87	4,640	4,727
Bog	0	1,747	1,747
Pond/marsh	0	1,472	1,472
Freshwater wetland	0	654	654
Wet meadow	0	4,208	4,208
Shrubby wetland	0	311	311
Conifer wetland	0	3,598	3,598
Deciduous wetland	0	2,160	2,160
Estuarine wetland	0	4,655	4,655
Coastal/tideland	0	1,488	1,488
Snohomish County Subtotal	87	61,607	61,694
FOUR-COUNTY TOTAL	5,988	112,047	118,034

* Data from the Natural Heritage Program oak and grasslands data set.
 Source: Washington Department of Natural Resources, 2005

The data shown in Figure 5-5-3 shows the vast majority of land being outside the UGA, with the most in Snohomish and Pierce counties. Land inside the UGA is mostly in Pierce and King counties.

2. The Washington Department of Fish and Wildlife — Priority Habitats and Species List⁴ is a catalog of those species and habitat types identified by the Washington Department of Fish and Wildlife as priorities for management and preservation. Priority habitats include those with unique or significant value to many species (WDFW, 1999). An area identified and mapped as priority habitat has one or more of the following attributes:

- Comparatively high fish and wildlife density.
- Comparatively high fish and wildlife species diversity.
- Important fish and wildlife breeding habitat.
- Important fish and wildlife seasonal ranges.
- Important fish and wildlife movement corridors.
- Limited availability.
- High vulnerability to habitat alteration.
- Unique or dependent species.

A priority habitat may be described by a unique vegetation type or by a dominant plant species that is of primary importance to fish and wildlife (e.g., oak woodlands, eelgrass meadows). A priority habitat may also be described by a successional stage (e.g., old growth and mature forests). Alternatively, a priority habitat may consist of a specific habitat element (e.g., consolidated marine/estuarine shorelines, talus slopes, caves, snags) of key value to fish and wildlife. Figure 5-5-4 shows the distribution of significant habitat areas identified by the Washington Department of Fish and Wildlife Priority Habitat and Species List.

Similar to Natural Heritage Program data, Priority Habitats and Species data often identify multiple ecosystems or habitat types that overlap at a single site. In calculating the total acreage of priority habitats, these multiple overlapping polygons were summed separately; that is to say, the acreage values in Figure 5-5-4 represent double counting of some areas that occur in more than one ecosystem polygon.

⁴ Web site link: <http://wdfw.wa.gov/hab/phspage.htm>



FIGURE 5-5-4: WASHINGTON DEPARTMENT OF FISH AND WILDLIFE – PRIORITY HABITATS THAT OCCUR BY COUNTY

Priority Habitat Type	Acres Inside UGA	Acres Outside UGA	Total Acres
KING COUNTY			
Alpine areas	0	7	7
Caves/cave-rich areas	0	0.1	0.1
Cliffs/bluffs	0	43	43
Estuarine zone	653	4,327	4,980
Old-growth/mature forest	0	1	1
Riparian zones	2,199	11,584	13,782
Snag-rich areas	0	1,748	1,748
Talus slopes	0	1	1
Urban natural open space	12,587	10,722	23,308
Wetlands	9,303	18,937	28,241
King County Subtotal	24,742	47,370	72,111
KITSAP COUNTY			
Cliffs/bluffs	0	15	15
Estuarine zone	31	2,903	2,934
Lagoons	12	277	290
Slough	0	4	4
Urban natural open space	23	0	23
Wetlands	27	349	376
Kitsap County Subtotal	93	3,548	3,642
PIERCE COUNTY			
Cliffs/bluffs	14	90	103
Estuarine zone	408	2,104	2,512
Islands	0	95	95
Lagoons	43	506	549
Oak woodland	30	0	30
Old-growth/mature forest	25	730	755
Riparian zones	1,658	11,399	13,058
Slough	0	2	2
Snag-rich areas	0	1,711	1,711
Urban natural open space	14,018	23,433	37,451
Wetlands	3,989	16,887	20,876
Pierce County Subtotal	20,185	56,957	77,142
SNOHOMISH COUNTY			
Cliffs/bluffs	4	1,745	1,749
Estuarine zone	0	1,665	1,665
Islands	33	509	541
Meadows	0	1	1
Riparian zones	2,234	15,347	17,581
Slough	0	12	12
Snag-rich areas	0	274	274
Urban natural open space	5,457	1,636	7,093
Wetlands	4,579	24,370	28,949
Snohomish County Subtotal	12,307	45,559	57,865
FOUR-COUNTY TOTAL	57,327	153,434	210,760

Source: Washington Department of Fish and Wildlife, 2005

This data includes almost twice the acreage as the previous one. Interestingly, it contains much more land inside the UGA (with most categorized generally as “urban natural open space”). Most of the inside-the-UGA land is in King, Pierce, then Snohomish counties. Outside the UGA, the land is fairly evenly split among these same counties.

3. The Willamette Valley–Puget Trough–Georgia Basin Ecoregional Assessment⁵ was a joint effort led by The Nature Conservancy and the Washington Department of Fish and Wildlife. The assessment used a prioritization process to identify the most important places for conserving native species and ecosystems in the region (Floberg et al., 2004). Science teams identified species, communities, and ecological systems that characterize the biological diversity of the ecoregion. Then, with the aid of a site selection algorithm known as *Sites* (Andelman et al., 1999), the assessment team identified priority conservation areas (including prairies, forests, river corridors, wetlands, and nearshore marine waters) that represent the smallest number of places necessary to capture the greatest amount of biological diversity in the ecoregion.

- The ecoregion is defined as the lowlands flanked by the Cascade and coastal mountain ranges of British Columbia, Washington, and Oregon, extending from the northern end of the Strait of Georgia south to the vicinity of Eugene, Oregon.
- One of the central assumptions in the prioritization process was that rural areas are more suitable for conservation than urban areas. The intensive use of land in urban areas is considered incompatible with large-scale conservation of native biodiversity. Efficient and effective conservation of most native species would most likely occur outside of urban areas (Floberg et al., 2004).
- Sites within or close to urban growth boundaries, therefore, were given a lower priority for conservation. As such, many areas of high-quality habitat within the urban growth area — almost all of which falls within the Puget Trough ecoregion — were not assigned a high priority for conservation.

Figure 5-5-5 shows the distribution of significant habitat areas identified by the Ecoregional Assessment.

FIGURE 5-5-5: HIGH-PRIORITY CONSERVATION AREAS IDENTIFIED BY THE ECOREGIONAL ASSESSMENT BY COUNTY

Area Name	Acres Inside UGA	Acres Outside UGA	Total Acres
KING COUNTY			
Black Diamond Lake	1,108	744	1,853
Buckley Hills	0	6,875	6,876
Cedar River	3	11,828	11,831
Cougar Mountain	962	3,003	3,965
Covington Creek	383	6,015	6,398
East Fork Issaquah Creek	757	4,457	5,214
East Side Vashon	0	310	310
Green River	423	9,310	9,734
Issaquah Creek Riparian	0	326	326
Otter Lake - Desire Lake	16	490	506
Point Robinson, Maury Island	0	433	433
Quartermaster Harbor	0	1,322	1,322
Raging River Forest	191	2,089	2,280
Redondo	75	332	406
Seola Beach, Burien	31	87	118
Snoqualmie Foothill Forest	0	45,086	45,086
Snoqualmie Riparian	833	2,429	3,262
White River Riparian	299	2,447	2,746
County Subtotal	5,081	97,583	102,666
KITSAP COUNTY			
Bangor	0	3,997	3,997
Blake Island	0	452	452
Camp Wesley Harris	0	2,084	2,084
Coulter Creek	2,189	5,666	7,855
Dyes Inlet - Silverdale	68	257	324
Indianola Forest	4	1,578	1,582
Liberty Bay - Agate Pass - Port Orchard	218	2,822	3,039
Ostrich Bay, Bremerton	60	614	673
Point Julia Forest	0	2,172	2,172
Port Gamble	0	6,384	6,384
Rich Passage, Bainbridge Island	78	948	1,026
Seabeck Bay	0	1,109	1,109
Western Kitsap Peninsula	6,583	32,161	38,744
County Subtotal	9,200	60,244	69,441

⁵ Web site link: <http://nature.org/aboutus/howwework/cbd/>



FIGURE 5-5-5: HIGH-PRIORITY CONSERVATION AREAS IDENTIFIED BY THE ECOREGIONAL ASSESSMENT BY COUNTY – continued

Area Name	Acres Inside UGA	Acres Outside UGA	Total Acres
PIERCE COUNTY			
Buckley Hills	0	4,069	4,069
Carbon River Plateau	5,847	1,541	7,388
Drayton Passage – Filucy Bay	0	923	923
Fort Lewis – McChord	4,418	55,887	60,305
Horn Creek	0	2,483	2,483
McNeil Island	0	3,422	3,422
Nisqually	83	10,710	10,793
North Bay	0	315	315
Puyallup River Riparian	0	1,165	1,165
Sequalitchew Marshes	371	607	978
Solo Point – Farrell Marsh	149	2,128	2,277
South Prairie Riparian	12	503	516
Tanwax Creek	0	7,482	7,482
The Narrows	928	948	1,876
Weir Prairie and Forest	0	4	4
White River Riparian	292	1,557	1,850
County Subtotal	12,100	93,744	105,846
SNOHOMISH COUNTY			
Edmonds Point	31	178	208
Gedney Island	0	523	523
Lord Hill	0	4,201	4,201
Pilchuck Riparian	39	3,018	3,056
Skagit	9	5,676	5,685
Skykomish Riparian	934	7,240	8,174
Snoqualmie Foothill Forest	0	19,517	19,517
Stillaguamish River – Port Susan	361	31,252	31,613
Sultan Foothill Forest	0	39,853	39,853
Tulalip	0	5,662	5,662
County Subtotal	1,374	117,120	118,492
FOUR-COUNTY TOTAL	27,755	368,891	396,445

Source: The Nature Conservancy, 2004

This data set falls in the middle of the other two for land inside the UGA and has the most for land outside the UGA. Whereas the other identified little land in Kitsap, this data has the second largest amount in Kitsap, with only King having more. Outside the UGA, the land is fairly evenly split between Snohomish, Pierce, and King counties.

4. National Oceanic and Atmospheric Administration and U.S. Fish and Wildlife Service. Under the Endangered Species Act, the federal government is required to designate critical habitat for any species it has listed as threatened or endangered. Critical habitat is defined as (1) specific areas within the geographical area occupied by a species at the time of listing, if (a) such areas contain physical or biological features essential to conservation, and (b) those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. All federal agencies must ensure that any actions they authorize, fund, or carry out are not likely to destroy or adversely modify any designated critical habitat. A critical habitat designation does not set up a preserve or refuge, and applies only when federal funding, permits, or projects are involved. Critical habitat requirements do not apply to citizens engaged in activities on private land that does not involve a federal agency.

NOAA Fisheries and the U.S. Fish and Wildlife Service have designated critical habitat for five of the Endangered Species Act-listed species in the four-county region:

- Northern spotted owl
- Marbled murrelet
- Bull trout
- Chinook salmon (Puget Sound evolutionarily significant unit)
- Chum salmon (Hood Canal summer-run evolutionarily significant unit)

All critical habitat for spotted owls and marbled murrelets falls outside the urban growth area, primarily in the Cascade Mountains (these are shown in Figure 5-5-1). Several streams that pass through the urban growth area, including the Puyallup and Duwamish Rivers, have been designated as critical habitat for bull trout and Chinook salmon. Portions of the Union River on the Kitsap Peninsula pass through the urban growth area for the city of Bremerton and have been designated as critical habitat for chum salmon.

It is worth noting that some areas have been identified as significant habitats by more than one of the agencies or organizations described above. Within the urban growth area, many such areas occur along streams, particularly those that have been designated as critical habitat for Endangered Species Act-listed fish species. Areas that have been singled out by several different organizations for independent reasons can be especially valuable to the maintenance of biological diversity in the region and may be considered a high priority for protection. In many cases, such protection is already afforded by existing policies and regulations, for example, critical areas regulations.

B. POLICIES AND REGULATIONS

At the end of this chapter, a supporting figure is included that lists some of the permits and approvals potentially needed for development and infrastructure projects. These ecosystem-related regulations and permits and approval processes associated with planning and development activities are the processes through which ecosystem protection will be implemented. Additional information on policies and regulations related to stormwater is provided in *Chapter 5.6 – Water Quality and Hydrology*.

The primary ecosystem-related regulations include the Endangered Species Act and the Clean Water Act at the federal level, and the Shoreline Management Act at the state level. These regulations govern the use of a wide variety of lands and resources, including water use, water discharges, wetlands, and development or use of shorelines, aquatic lands, or critical habitat for endangered species.

Growth Management Act and Critical Areas

Local sensitive area ordinances and other ecosystem-related municipal regulations and policies also govern activities associated with specific projects in the plan area. In many cases, these ordinances and policies supplement federal and state regulations. Habitats and features typically protected in these local ordinances and policies include erosion-prone areas (see *Chapter 5.13 – Earth*), wetlands, streams, riparian corridors, and habitat for threatened and endangered species (see *Chapter 5.2 – Land Use*). Buffers around features such as streams and wetlands provide protection from flooding, filtration of sediments, nutrients, and pollution, maintenance of water temperatures, and habitat for fish and wildlife. Critical area regulations have the most influence in non-resource areas — that is, within the urban growth area or in rural areas that are not designated as resource lands such as farms and forests.

Critical area regulations are designed to maintain ecosystem integrity by requiring the identification and protection of key areas and adjacent buffers during the development or redevelopment process. Since the regulations apply only to new development, critical area regulations do not provide a means of mitigating or reversing the effects of existing development in key areas or buffers. Landowners considering redevelopment may choose not to redevelop in cases where a significant proportion of their developable land falls within a critical area buffer and where construction activities may be restricted or prohibited.

5.5.2 Analysis of Alternatives (Long-Term Impacts)

This section analyzes the four alternatives and describes their potential long-term impacts. They include impacts that could result from anticipated levels of residential and commercial land development (e.g., reduction of habitat quality and quantity), the infrastructure associated with those developments (e.g., disturbance of a functioning ecosystem, roads crossing through riparian or terrestrial habitats, or increased alteration of vegetative cover), and other human activities, including manufacturing, recreation, and consumption of natural resources.

As the human population in a particular area grows, so does the pressure to convert existing natural areas to sites that support residential or commercial uses, including roads. The alternatives have different proportions of population growth directed into the different geographic classes (e.g., metropolitan cities, suburban cities, unincorporated urban growth areas, rural areas). An alternative that directs a greater proportion of growth into rural areas, for example, could



be expected to pose a greater risk of adverse effects to regionally significant habitat in rural areas compared to an alternative that emphasizes growth in urbanized areas, where remaining ecosystems tend to be more limited.

A. IMPACTS COMMON TO ALL ALTERNATIVES

Development

Development affects ecosystem functions in several ways, including through fragmentation, isolation, and degradation of natural habitats, simplification and homogenization of species composition, disruption of hydrological systems, and modification of energy flow and nutrient cycling (Alberti et al., 2003). Such effects can result from clearing and grading for the construction of residential or commercial structures and from the development of associated infrastructure such as expanded water supply, wastewater treatment, power, transportation, and other utilities and public services. Relative adverse impacts are likely to be greater if development occurs in pristine areas than if it occurs in already impacted urban areas.

Land Cover

Alternatives that result in increased amounts of impervious surface in areas with the highest sensitivity to such changes would be anticipated to have the greatest risk of adverse effects on habitat quality for fish and other aquatic species in those areas. *Chapter 5.6 – Water Quality and Hydrology* discusses the impacts to hydrology and water quality related to the amount of impervious surface in a given area in greater detail. Generally, the majority of ecological damage to any area occurs with the initial clearing and grading and as impervious surfaces are built. After this initial change, incremental impervious surfaces still affect water quality and quantity, but the majority of ecosystem impacts have already occurred. For this analysis, increased development at urban levels is assumed to alter existing land cover, and therefore all of the alternatives would likely affect vegetation and increase imperviousness to some degree. Alternatives that have the most growth in or adjacent to more pristine areas would be anticipated to have a greater overall impact.

Transportation

Based on an analysis of development patterns in the Puget Sound lowlands, Alberti et al. (2003) found that transportation networks contribute more than any other land use to the transformation of forested areas to paved areas. Roads were identified as a key stressor in urbanizing landscapes. Alberti et al. (2003) suggested that urban planning strategies that work to condense development and minimize the extent of land surface devoted to road networks could decrease the cumulative impacts of roads. In any given area, alternatives that could result in a greater amount of road construction, therefore, could be expected to result in more adverse effects on ecosystem functions.

The four alternatives are based on the same transportation system (as defined in *Destination 2030*) being in place by the year 2030. All four show increased amounts for vehicle miles and vehicle hours traveled, which could be expected to lead to greater pressure for road construction (at a minimum, construction of local streets to provide access to new homes and businesses), with the associated risk of adverse environmental effects due to increased impervious surfaces and increased potential for run-off.

Habitats

Adverse effects associated with development are expected to have the greatest influence on ecosystem functions in areas where development activities would occur within or adjacent to habitats that make significant contributions to local or regional biodiversity — that is, sites that have been identified as regionally significant habitat areas.

Under all alternatives, specific impacts to regionally significant habitat areas associated with individual projects or localized actions would be determined through project-level planning and any impacts could be avoided or minimized through mitigation. In many cases, regionally significant habitat areas are protected by critical area ordinances and other regulations that directly or indirectly restrict the implementation of development projects in ecologically sensitive areas. Such restrictions are not absolute, however, and project- and site-specific waivers and variances are not uncommon.

Figure 5-5-6 shows how the identified regionally significant habitats are distributed among the regional geographies. Values in the figure show the percentage proportion of each habitat type that falls within the different geographies. As discussed in the Affected Environment section above, some areas identified as regionally significant habitat by one organization may overlap those identified by other organizations. Also, some sites have been identified by a single

organization for multiple regions. Thus, the acreage values that were used to calculate the percentage values in the bottom row of Figure 5-5-6 represent some double-counting, and the total acreage values in the right-hand column of the figure also represent double-counting of some areas.

The values in Figure 5-5-6 serve as an indicator of the comparative likelihood that a particular geography may support regionally significant habitats. They do not represent the proportion of any given geography that has been identified as regionally significant habitat. If the percentage value for a particular habitat in a particular geography is greater than the proportion of that geography in the total land area, then that habitat type can be said to have an elevated likelihood of occurring in that geography.

FIGURE 5-5-6: PERCENTAGE OF AREAS IDENTIFIED AS HAVING REGIONALLY SIGNIFICANT HABITAT WITHIN THE VISION UPDATE'S REGIONAL GEOGRAPHIC CLASSES

	Metropolitan Cities	Core Suburban Cities	Larger Suburban Cities	Smaller Suburban Cities	Unincorp. UGA	Rural Non-Resource	Natural Resource Areas	Total Acres
Total Land Area	3%	3%	2%	2%	4%	19%	67%	4,399,000
Ecoregional Assessment High-Priority Conservation Areas	2%	0%	0%	1%	4%	18%	75%	396,000
Washington Natural Heritage Program High-Quality Ecosystems of Special Concern*	0%	1%	0%	1%	0%	6%	92%	101,000
Washington Natural Heritage Program Oak and Grassland Habitat	1%	10%	1%	2%	8%	5%	7%	17,000
Washington Department of Fish and Wildlife Priority Habitats*	5%	4%	3%	4%	11%	36%	37%	211,000
All Identified Regionally Significant Habitat Areas*	2%	2%	1%	2%	5%	21%	66%	725,000

* See text for discussion of double-counted areas and calculation of percentage values.

Sources: The Nature Conservancy (2004), Washington Department of Natural Resources (2004), WDFW (2005)

Overall, about 84 percent of the land in the four counties lies outside the urban growth area boundary (i.e., consists of rural and natural resource areas); 87 percent of all identified regionally significant habitat areas also fall outside this boundary. Much of the 12 percent of significant habitat areas within the urban growth boundary are areas identified as urban natural open space on the Washington Department of Fish and Wildlife Priority Habitat and Species List (note that values in the figure do not add to 100 percent in all cases due to rounding). Most areas of high quality habitat tend to be in areas outside major cities. While 8 percent of the region consists of areas in the three largest geographic classes (metropolitan, core suburban, and larger suburban cities), only 5 percent of the total area of regionally significant habitats occurs in these areas.

As regionally significant habitat areas tend to occur more in rural areas than in cities, alternatives that minimize growth in the rural area and adjacent to resource lands (by concentrating growth into the contiguous urban area) could have fewer impacts on identified regionally significant habitats and species, depending on the specific distribution and type of land development.

Regional Geographies

- Population and job growth in *metropolitan and core suburban cities* likely pose fewer impacts to the function and connectivity of major ecosystems both because there is relatively less identified regionally significant habitat in these areas, and those areas are more likely to be already degraded. Areas with the greatest potential of contributing to regional ecosystem functions occur in designated park, open space, and critical areas, which are protected from development. Nearly all growth in these cities is anticipated to be accommodated through infill on currently undeveloped or underdeveloped parcels (i.e., redevelopment of existing properties). Growth-related impacts could result primarily from additional impervious surface and increased levels of transportation-related pollution. In many of these areas, ecosystem resources may already be degraded to a point that the resources are less susceptible to increases in impervious surface and polluted runoff.



- Development in the **larger suburban cities** could likely cause a proportionally larger increase in impervious surface and transportation-related pollution compared to metropolitan and core suburban cities (because of their less developed state), and could likely require additional infrastructure such as roads and sewer/water service. Still, as larger suburban cities have relatively lower levels of regionally significant habitats, growth in these areas could still have moderate to low levels of ecosystem impacts.
- **Smaller cities** vary widely in size and in existing levels of development. As a group, however, they are much less built out than other cities. Growth in these areas could require redevelopment, infill, and densification. As such, development in these areas could likely cause a proportionally larger alteration in land cover and vegetation than in other urban types, and could be expected to require proportionally more infrastructure development, including roads and sewer/water service. The most likely impacts of growth could come from additional impervious surfaces, increased levels of transportation-related pollution, and expanded infrastructure including roads and sewer/water facilities. Compared to the situation in larger cities, added infrastructure in smaller cities could pose a greater risk of bisecting currently intact functioning ecosystems, habitats, and wildlife migration corridors. The cities and towns in the region that are surrounded by rural lands as stand-alone communities also have a greater probability of being adjacent to regionally significant environmental lands; increased development in these areas is more likely to impact ecosystem functions.
- **Unincorporated urban areas** are designated for urban levels of development under the Growth Management Act. The current level of development, however, varies from some fairly urban subareas to other areas that are still undeveloped. Similar to smaller suburban cities, accommodating growth in most unincorporated areas could require redevelopment, infill, and densification. In general, growth in these areas is likely to have a relatively greater impact on ecosystems, given their likelihood of proximity to functioning habitat areas. Compared to other geographies within the urban growth area, identified regionally significant habitats have the highest probability of occurring in unincorporated areas, indicating a higher risk of growth-related impacts.

Development in unincorporated urban areas is likely to cause a proportionally larger increase in impervious surface than in cities, and could require additional infrastructure such as roads and sewer/water facilities. New road development would be especially likely under alternatives that result in a mismatch between population and employment — for example, a significant number of new jobs but only a slight increase in population in these areas. More than in cities, development in unincorporated areas has potential for habitat fragmentation and isolation due to the impacts caused by infrastructure development.

- Growth and associated land development in **rural areas**, similar to unincorporated urban areas, could be expected to result in clearing, grading, and increased amounts of impervious surfaces. Because much of the land in rural areas is currently undeveloped, development is likely to cause some of the largest alteration of vegetation and land cover. As shown in Figure 5-2-7 (in the land use chapter), a small percent of parcels in the rural area is above 10 acres. However, those larger parcels make up half of the land area. Alternatives that place higher amounts of growth in the rural area have more potential to impact and perhaps fragment these parcels. The requirements for additional infrastructure such as roads and sewer/water facilities could exceed those in unincorporated portions of the urban growth area (where new infrastructure could more likely to take the form of upgrades and retrofits to existing facilities), and therefore, growth in rural areas could have the highest potential to contribute to habitat fragmentation and isolation.
- Direct impacts to **natural resource lands** from population and employment growth would likely be minimal under all four alternatives. These areas are protected by specific policies and regulations (e.g., the Forest Practices Act) that, among other things, prohibit residential and commercial land development. However, potential risks for impacts could come from development near these lands, and the pressure that the growth might lead to conversion of these lands to different land use types (see *Chapter 5.2 – Land Use*). All alternatives could also require the addition or expansion of major regional facilities such as transportation and electrical grid connections to eastern Washington, water storage and conveyance facilities, and resource extraction to support 1.7 million additional residents.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

Under this alternative, growth would be highest in metropolitan cities and unincorporated areas within the urban growth area. Compared to other alternatives, Growth Targets Extended would result in the second-most growth

(measured as the combined increase in population and employment) in smaller suburban cities, rural areas, and unincorporated portions of the urban growth area. As noted above, rural and unincorporated areas have the greatest likelihood of supporting native habitats and open space. Compared to the Metropolitan Cities and Larger Cities alternatives, this alternative could be expected to pose an elevated risk to these ecosystem resources.

Population growth and development could be expected to result in increased amounts of impervious surfaces in rural and unincorporated areas, which are the most sensitive to such changes (see *Chapter 5.6 – Water Quality and Hydrology*). Among the four alternatives, Growth Targets Extended could be expected to result in the second-highest increases (after the Smaller Cities Alternative) in impervious surface in rural areas and unincorporated portions of the urban growth area, as well as in areas around smaller suburban cities. Such increases could pose a greater risk of adverse effects to aquatic habitats and the species that depend on them, compared to the Metropolitan Cities and the Larger Cities alternatives. Also, Growth Targets Extended could be expected to result in a greater need than the Metropolitan Cities and the Larger Cities alternatives for road construction in the planning area, leading to more adverse effects on ecosystem functions overall. Overall, Growth Targets Extended could be expected to result in the second-greatest level of adverse effects on ecosystem functions.

METROPOLITAN CITIES ALTERNATIVE

Under the Metropolitan Cities Alternative, more than half of population growth would be in the metropolitan cities and the core suburban cities. Combined with larger suburban cities, these geographic areas would account for 80 percent of the anticipated growth. Regionally significant habitat areas make up a smaller proportion of the total land area in these geographies, compared to rural and unincorporated areas. Compared to other the alternatives, the Metropolitan Cities Alternative could be expected to result in the least growth in unincorporated portions of the urban growth area, and the second-least growth in rural areas (tied with the Larger Cities Alternative). As such, this alternative could be expected to pose a lower risk to ecosystem resources in these areas, which also have the greatest likelihood of supporting native habitats and open space. The Metropolitan Cities Alternative has the lowest potential to fragment and isolate habitat, as the more limited increases in population and employment could likely require fewer infrastructure projects in rural lands and the unincorporated urban growth area.

Much of the anticipated population growth would be directed into extensively urbanized areas, where in many cases impervious surface levels already exceed 40 percent (see *Chapter 5.6 – Water Quality and Hydrology*). Many water resources and related habitat in such areas may already be degraded to a point that the resources are less susceptible to increases in impervious surface. Compared to other alternatives, the Metropolitan Cities Alternative could be expected to result in the smallest increases in rural and unincorporated areas, where aquatic species and habitat are typically more sensitive to changes in land cover and bisection of ecologically significant areas. Finally, among the four alternatives, the Metropolitan Cities Alternative could be expected to result in the least need for new road construction in the planning area. As such, the Metropolitan Cities Alternative could be expected to pose the least risk of road-related adverse effects on ecosystem functions. Overall, the Metropolitan Cities Alternative could be expected to result in the fewest adverse effects on ecosystem functions.

LARGER CITIES ALTERNATIVE

The Larger Cities Alternative would be expected to result in greater population increases in core suburban cities and larger suburban cities than any other alternative. Similar to the Metropolitan Cities Alternative, 80 percent of anticipated population growth would occur in the three largest geographic classes. In contrast to the Metropolitan Cities Alternative, however, much less growth would occur in the metropolitan cities and much more would occur in the larger suburban cities, with core suburban cities getting nearly the same amount as in the Metropolitan Cities Alternative. The amount of growth assigned to the smaller suburban cities, unincorporated urban area, and rural areas could be nearly the same as in the Metropolitan Cities Alternative. As such, this alternative could be expected to pose a relatively similar risk to ecosystem resources as the Metropolitan Cities Alternative.

Similar to the Metropolitan Cities Alternative, much of the anticipated population growth would be directed into the most urbanized areas, where water resources are likely less susceptible to increases in impervious surface (see *Chapter 5.6 – Water Quality and Hydrology*). The shift in growth from the fully urbanized metropolitan cities to the less intensely developed larger suburban cities could likely result in potentially greater increases in impervious surfaces from infrastructure and development than under the Metropolitan Cities Alternative.



Compared to other alternatives, the Larger Cities Alternative could be expected to result in the second-smallest increases in impervious surface levels in rural and unincorporated areas, where aquatic species and habitat are typically more sensitive to changes. Finally, the Larger Cities Alternative could be expected to result in less need for road construction in the planning area than the Growth Targets Extended and the Smaller Cities alternatives, but more than the Metropolitan Cities Alternative. As such, the Larger Cities Alternative could be expected to pose a relatively low risk of road-related adverse effects on ecosystem functions. Overall, the Larger Cities Alternative could be expected to have a similar but slightly greater risk of adverse impacts on the region's ecosystem, compared to the Metropolitan Cities Alternative.

SMALLER CITIES ALTERNATIVE

Under the Smaller Cities Alternative, more than half of anticipated population growth would be expected in smaller suburban cities and unincorporated portions of the urban growth area. Compared to the other alternatives, the Smaller Cities Alternative would be expected to result in the greatest amount of job and population growth in rural areas and unincorporated portions of the urban growth area, and the smallest increases in the three most urbanized geographic classes. The primary area in which the Smaller Cities Alternative would differ the most from the other alternatives is in the smaller cities (with more than triple the growth to these cities as compared to any of the other alternatives) and employment growth in the unincorporated urban growth area (with more than triple than the other alternatives). This growth could result in the greatest amount of new development at the fringe of the contiguous urban growth area and beyond, in less developed areas with the most identified regionally significant habitat. As such, this alternative could be expected to pose the greatest risk to ecosystem resources in both unincorporated and rural areas outside of the urban growth area boundary.

Increased growth in rural and unincorporated areas under the Smaller Cities Alternative could likely require the greatest amount of development, infrastructure, and road-related investments in these areas, and could therefore pose the greatest risk of fragmenting and isolating identified regionally significant habitats, as well as habitat in general. Much of the anticipated population growth could be directed into areas where water resources, including aquatic habitats and species, may be most susceptible to alteration in land cover and vegetation, including increases in impervious surface. The Smaller Cities Alternative could be expected to result in the greatest need for road construction in the planning area, leading to the greatest risk of road-related adverse effects on ecosystem functions. Overall, the Smaller Cities Alternative could be expected to result in the greatest risk of adverse effects on ecosystem functions.

5.5.3 Cumulative Effects

For the past 150 years or more, urban development and other human activities have dramatically altered the landscape and the way ecosystems function in the central Puget Sound region. In the time scale in which regional land-use planning efforts can operate, such changes are largely irreversible in the areas where development has already occurred. Urban development is expected to continue into the future, although environmental standards, if correctly implemented, could be expected to limit the impacts to ecosystems. Activities outside of the urban growth area (e.g., timber harvest, agricultural production) can affect natural resources in the urban growth area, for example, through impacts to water quality and quantity. Such effects are often short-term and reversible and do not affect overall ecosystem function as profoundly as urban development. However, other effects of urban growth, including water withdrawal, energy consumption, and the burning of fossil fuels, can increase impacts to ecosystems that exist beyond the urban area.

Differences in the cumulative effects of the alternatives could derive from differences in their direct and indirect effects. The Metropolitan Cities Alternative could be most supportive of land use policies that facilitate protection and preservation of important ecosystems and habitats in the region by encouraging compact urban development within urban growth areas. Thus, the Metropolitan Cities Alternative could be expected to have the least adverse cumulative effects on ecosystem functions, followed by the Larger Cities, Growth Targets Extended, and the Smaller Cities alternatives.

Throughout the region, numerous ecosystem restoration efforts are planned or underway. These efforts offer the hope that some of the damage caused by past development can be ameliorated, or possibly reversed. Planning alternatives that direct anticipated population and job growth into areas with the least potential to contribute to environmental degradation — the Metropolitan Cities and the Larger Cities alternatives, for example — may facilitate such restoration efforts. Alternatives that encourage growth where development poses a greater risk of adverse impacts to functioning ecosystems — the Smaller Cities Alternative, and to a lesser extent, Growth Targets Extended — may impede restoration efforts and could exacerbate existing problems.

5.5.4 Potential Mitigation Measures

Development conducted under each alternative would be required to comply with applicable regulations and permit conditions, which could be expected to minimize but not eliminate impacts. Mitigation measures would be determined by the lead review agencies for individual projects.

Depending on the alternative, the most valuable mitigation measures may vary. For example, under the Metropolitan Cities Alternative, which puts the most growth into already developed areas, programs that protect and restore urban streams, address polluted stormwater runoff, and conserve water and energy may be the most important. Under the Smaller Cities Alternative, which puts the most growth into current under-developed or undeveloped areas (which are more likely to support regionally significant habitat areas), programs that conserve land or regulations that require low-impact development may be the most important. The Growth Targets Extended and Larger Cities alternatives are likely to be somewhere in the middle of these approaches. Following are examples of potential measures:

- Preservation of green belts and open spaces, shorelines, riparian corridors, and wetlands.
- Green Street strategies and programs, including planting street trees, and improving other key ecosystem resources in the planning area.
- Protecting areas with a high priority through avoidance or replacement.
- Conservation levies to preserve areas identified as having high-priority habitat.
- Critical Area designations.
- Green Development actions and strategies, including Low Impact Development regulations to minimize the impact of new development.
- Urban forestry programs to provide some level of environmental function in urban areas.
- Fish ladders both in urban waterways and to get fish around dams in rural and natural resource areas.
- Removal of non-native species.
- Minimizing new road construction that fragments ecosystems and habitat.
- Salmon-friendly design and construction for all transportation facilities.

In conjunction with project-level planning and environmental review, any new or updated resource studies (e.g., Water Resources Inventory Area plans) could be reviewed for additional mitigation measures that may be applicable to the project.

5.5.5 Significant Unavoidable Adverse Impacts

Any of the alternatives could have significant unavoidable adverse impacts to terrestrial and aquatic ecosystems, depending on project-specific actions and their location. All of the alternatives will require the addition of new residences and commercial buildings and supporting infrastructure. This will lead to some increase in impervious surfaces, alteration of land cover and vegetation, and additional parcel fragmentation. Unless programs are put in place to replace lost habitat and decrease already existing impervious surfaces, there will be some level of adverse impacts.

Ecosystems that extend to Puget Sound through the urbanized portions of the region will continue to be significantly altered from their original conditions. Mitigation and certain restoration treatments can contribute to maintaining and enhancing functions — but are not likely to restore areas to pre-urbanization conditions. Many past efforts that altered the environment are irreversible. These include the alteration of Lake Washington's historical water levels by connecting it to Lake Union and linking it to Puget Sound through the Ballard ship locks, as well as the infill of Elliott Bay and the tideflats in downtown Seattle and to the south.

Future environmental documentation for project-level actions may identify specific areas where sensitive areas may be altered. For specific project actions where this occurs, mitigation measures would be evaluated and implemented to meet applicable federal, state, and local regulations related to the protection of plant and animal species and critical habitat areas.



Supporting Figures

FIGURE 5-5-7: PERMITS AND APPROVALS POTENTIALLY NEEDED FOR DEVELOPMENT AND INFRASTRUCTURE PROJECTS

Permit or Approval	Trigger	Approving Agency	Approval Criteria
National Environmental Policy Act (documentation).	Federal nexus (either federal funding or project requires federal permits).	Depends on federal nexus.	Environmental documentation considering impacts on social and environmental resources and addressing purpose and need.
State Environmental Policy Act (documentation).	State or local agency actions.	Depends on lead agency.	Environmental documentation considering impacts on social and environmental resources and addressing purpose and need.
Federal Endangered Species Act (consultation).	Needed for projects with federal nexus that may impact any listed species.	Lead federal agency initiates consultation with USFWS and NOAA Fisheries.	No jeopardy to the continued existence of federally listed threatened and endangered species.
Migratory Bird Permit and Federal Executive Order 13186.	Needed for projects that may impact any bird species protected under the Federal Migratory Bird Treaty Act.	USFWS.	Demonstration of a valid justification for the permit; project must not threaten a wildlife or plant population.
Essential Fish Habitat (consultation).	Needed for projects with federal nexus that may adversely affect Essential Fish Habitat, as identified in the Sustainable Fisheries Management Act.	Lead federal agency initiates consultation with NOAA Fisheries.	Avoidance, mitigation, or offsetting of project impacts on Essential Fish Habitat.
Fish and Wildlife Coordination Act (consultation).	Needed for projects with a federal nexus that may affect a stream or body of water.	USFWS, NOAA Fisheries, WDFW.	Consultation includes disclosure of proposed action, potential effects, and mitigation; any recommendations from USFWS, NOAA Fisheries, or WDFW are not binding, but lead agency must give them full consideration.
Section 401 Water Quality Certification.	Work in waters of the state, including wetlands.	Ecology.	Protection of water quality; adherence to water quality standards (Clean Water Act, state water quality laws, and any other state aquatic protection requirements).
Hydraulic Project Approval (permit).	Work in the water or adjacent to the water (includes wetlands).	WDFW.	No harm to listed species or their habitat; overall goal is no project or cumulative impacts to fish and wildlife.
Section 402 National Pollutant Discharge Elimination System (permit).	Work that involves discharge of pollutants into waters of the United States.	Ecology.	Permitted discharges must satisfy discharge permit requirements under Section 402 of the Clean Water Act and 90.48 Revised Code of Washington.
Section 404 Nationwide Permit or Individual Permit.	Placing a structure, excavating (including land clearing), or discharging dredged or fill material in Waters of the U.S., including wetlands.	U.S. Army Corps of Engineers.	Protection of water quality; no significant degradation to waters.
Coastal Zone Management Act.	Conducting projects by federal agencies and/or applying for certain federal permits or funding.	Federal permitting agency or Ecology headquarters (Shorelands and Environmental Assistance Program).	Compliance with state and federal Clean Water Act, Clean Air Act, SEPA, Shoreline Management Act, and energy facility site evaluation criteria.
Section 9 of the Rivers and Harbors Act.	Prohibits the obstruction of navigable waterways by bridge construction or replacement.	U.S. Coast Guard.	Avoidance of obstruction of navigable waterways, NEPA compliance, Coastal Zone Management Certification, and water quality certification (401).

FIGURE 5-5-7: PERMITS AND APPROVALS POTENTIALLY NEEDED FOR DEVELOPMENT AND INFRASTRUCTURE PROJECTS – continued

Permit or Approval	Trigger	Approving Agency	Approval Criteria
Section 10 of the Rivers and Harbors Act.	Placement of structures and discharge of material in navigable waters of the U.S., including wetlands; typical activities include boat docks, floats, buoys, etc.	U.S. Army Corps of Engineers.	Avoidance of obstruction or alteration of navigable waters of the U.S., unless a permit from the Corps of Engineers has been granted.
Aquatic Use Authorization (aquatic lease).	Using state-owned aquatic lands (includes harbors, state tidelands, shorelands, and beds of navigable waters).	Washington State Department of Natural Resources.	All required permits must be completed prior to authorization.
Critical Area Alteration Permit.	Impacts to critical areas (e.g., wetlands, streams, geologically hazardous areas and steep slopes, and fish and wildlife habitat conservation areas).	Local jurisdiction (city or county).	Project compliance with city and county codes.
Shoreline Substantial Development Permit.	Activities occurring in the shoreline zone whose value is at least \$5,000.	Local jurisdiction (city or county).	Permitted use identified in the Shoreline Master Program; if project includes only minor shoreline development, a letter of exemption, conditional use permit, or variance may be appropriate.
Federal Executive Orders 11988 and 11990 (Protection of Floodplains and Wetlands).	Activities that could adversely affect floodplains or wetlands.	Council on Environmental Quality.	Appropriate mitigation of wetland impacts.
Governor’s Executive Order 89-10 (Protection of Wetlands).	Activities that could adversely affect wetlands.	Ecology.	Appropriate mitigation of wetland impacts.
Governor’s Executive Order 90-04 (Protection of Wetlands).	Activities that could adversely affect wetlands.	Ecology.	Appropriate mitigation of wetland impacts.

Source: Parametrix, Inc.





Water Quality and Hydrology

Water resources are key elements of this region's setting and overall quality of life. This chapter describes existing water resources and hydrology, and covers five primary topics: (1) impervious surfaces and stormwater runoff, (2) impaired waters, (3) sole source aquifers, (4) large contiguous floodplains, and (5) wetlands, lakes, rivers and streams. Some summary highlights are noted below regarding how these resources could potentially be impacted under the growth distribution alternatives.

5.6.1 Affected Environment

Water resources are comprised of naturally occurring water features including groundwater and surface waters such as streams, rivers, wetlands, lakes, estuaries, and Puget Sound. Water resources are integral to the region's ecosystems and also supply water for municipal, industrial, agricultural and other commercial uses. These resources are discussed on the following pages.

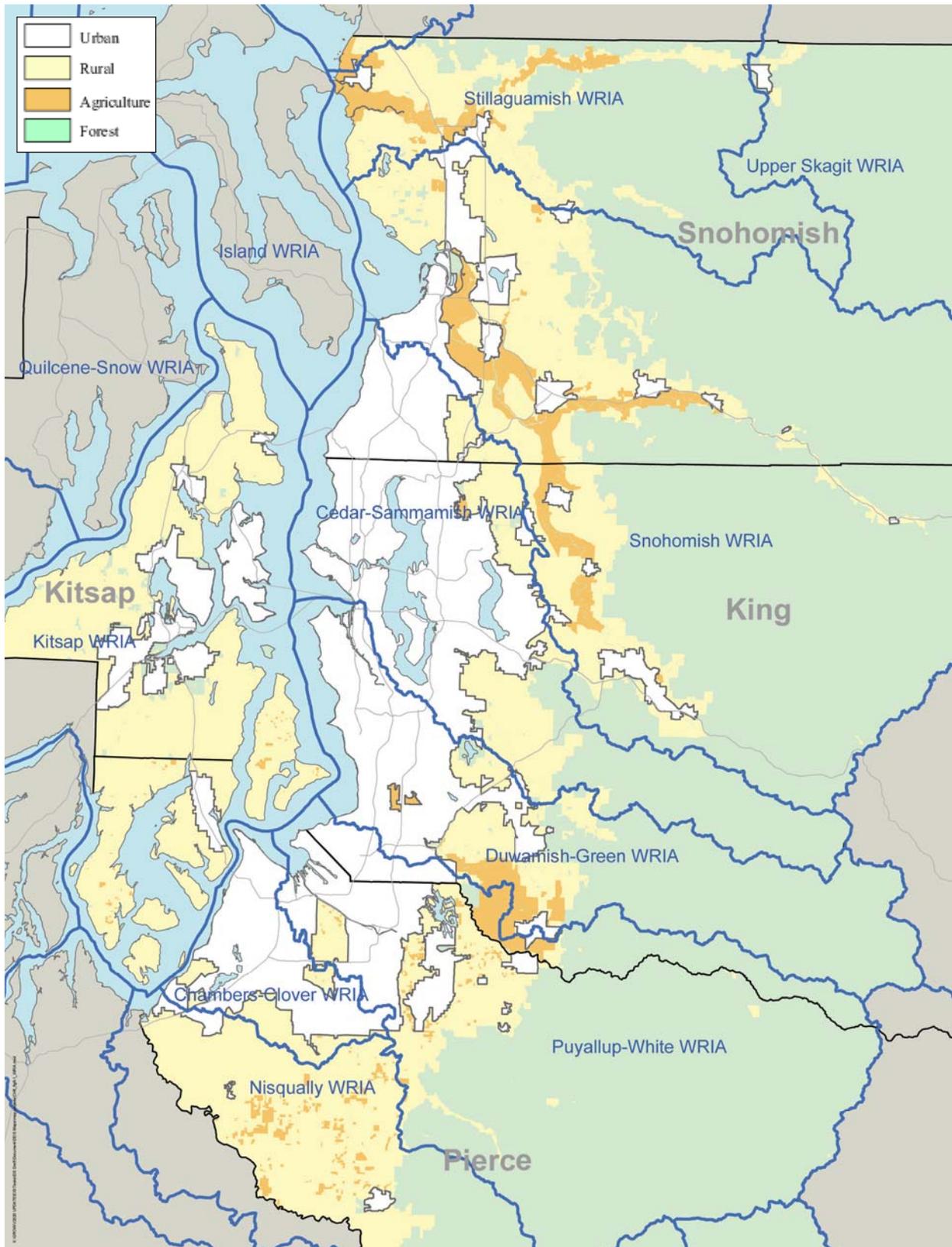
A. SPECIFIC RESOURCES

Water resources in the central Puget Sound region are part of the Puget Sound Basin, which ultimately collects all water runoff from within the region. The Puget Sound is an estuary where the fresh waters from streams and rivers mix with the salt water of the Pacific Ocean. Growth, development, and redevelopment activity around and upstream of the Puget Sound ultimately affect this resource.

The Puget Sound Basin comprises over a dozen major watersheds. A watershed is an area of land where topographic features such as hills and valleys cause water to flow toward a single major river or water body. Washington State Department of Ecology (Ecology) has developed a system to organize major watersheds in the state by Watershed Resource Inventory Areas (WRIAs). The central Puget Sound region contains all or portions of 11 Watershed Resource Inventory Areas (Figure 5-6-1). Each of these Inventory Areas contains numerous subwatersheds and smaller subbasins drained by perennial and intermittent streams, seeps, wetlands, and constructed drainage systems. More information about each WRIA is provided at the end of this chapter.



FIGURE 5-6-1: WATERSHEDS IN THE CENTRAL PUGET SOUND REGION



Source: Puget Sound Regional Council

1. Impervious Surfaces

A key indicator of the health of the region's water resources is the amount of impervious surface in each basin (Schueler, 1994). Prior to development, the mostly forested area absorbed, filtered, and slowed surface water. This reduced flooding and variations in stream flows, turbidity, velocity, flooding, and also recharged groundwater, and provided base flows to streams (Booth et al., 2002). The frequency and intensity of peak flows and the volume of stormwater runoff all increase when natural cover is removed from developing areas and then converted to impervious surfaces, such as pavement, homes, buildings, and non-native landscape like lawns that reduce surface perviousness relative to natural forest cover.

Increases in impervious surface cover reduce aquatic habitat quality because streams must accommodate greater volumes of water, greater flow variability, and higher levels of pollution carried from land surfaces to receiving streams, lakes, and wetlands (Brabec et al., 2002; Booth and Reinelt, 1993; Booth et al., 2002; Center for Watershed Protection, 2003; May et al., 1997; Schueler, 1994; Wang et al., 2001).

Greater volumes and peak flows can degrade streams and wetlands by eroding stream banks, cutting down stream beds, removing woody debris, increasing sediment movement, and changing the amount and seasonal timing of water in wetlands. Impervious surfaces also reduce the amount of rainwater that infiltrates the ground, recharging groundwater and providing base flows to streams (Schueler, 1994).

Water quality is also a concern when new impervious surfaces generate pollution (Brabec et al., 2002). Pollution-generating surfaces are those considered to be a substantial source of pollutants in stormwater runoff and generally include surfaces that are intended for vehicles and industrial use. These surfaces store materials that may be transported from the impervious surface-to-surface water or groundwater during erosion and/or infiltration (Schueler, 1994; Booth and Reinelt, 1993, Booth et al., 2002; Center for Watershed Protection, 2003; May et al., 1997).

Runoff from pollution-generating surfaces can affect the beneficial uses of the receiving water if treatment prior to discharge is not provided (Brabec et al., 2002). Examples of these harmful impacts are a reduction in fish and macroinvertebrate¹ abundance, changes in the species of fish and macroinvertebrate species present, and a reduction in stream productivity. The temperature of receiving waters can rise during warmer summer months. Temperatures increase when stormwater flows over impervious surfaces prior to entering receiving waters. Water temperatures also increase when there is a lack of shade near receiving waters and when there is lower water volume in the receiving waters due to a lack of water retained upstream.

The review of potential impacts to water resources related to impervious surface considers three major factors:

1. Regulations and policies for water resources are intended to prevent or reduce the hydrologic and water quality impacts. These regulations will apply to new development and other urban activities resulting from regional growth. However, the prevailing scientific opinion is that the impacts cannot entirely be mitigated (Brabec et al., 2002; Booth et al., 2002; Center for Watershed Protection, 2003).
2. Existing levels of impervious surface must be included in any evaluation of the impacts of new impervious surface. Existing levels of impervious surface are important because they help determine the type and magnitude of impacts from increasing impervious surface. For example, Schueler (1994) proposed that (1) streams are sensitive to changes in impervious surface when basins vary between 1 to 10 percent impervious, (2) streams are impacted when basin impervious surface is between 11 and 25 percent, and (3) streams in basins with 26 to 100 percent impervious surface are non-supporting. Schueler (1994) characterized non-supporting streams as having highly unstable channels, fair to poor water quality, and poor biodiversity (the types and numbers of species present).
3. New impervious surfaces generally increase in direct correlation with population and employment growth. When basins with low levels of existing impervious surface experience increases in impervious surface, they are much more likely to exhibit the effects of decreased habitat quality than when basins with high levels of impervious surface experience similar increases.

Typical Effects of Impervious Surface Changes. Instream physical habitat conditions and the aquatic community generally show rapid decreases in quality and in the numbers and species of fish and insects as basin impervious surface increases to around 10 percent (May et al., 1997). Above 10 percent impervious surface, habitat quality degrades at a less rapid, more constant rate. Changes in the hydrologic regime — base flows, peak flows, return frequency — are thought to be the leading cause for observed changes in instream physical habitat conditions (May et al., 1997).

¹ Examples of macro-invertebrates are aquatic insects and freshwater clams.



In contrast, adverse effects from increasing water column and sediment metal concentrations are typically associated with much higher levels of basin impervious surface. These start to detectably degrade in basins at approximately 40 percent impervious surface and are consistently affected by increased metal concentrations at levels of 50 percent impervious surface and higher (May et al., 1997).

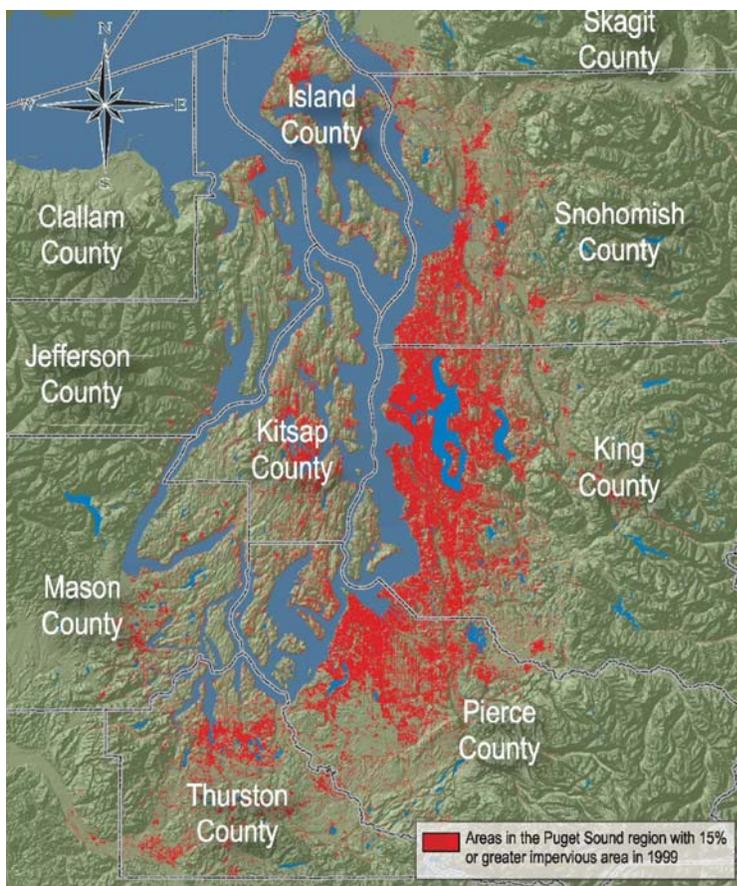
In addition to minimum effect thresholds, it has been proposed that there are thresholds above which further increases in impervious surface are unlikely to contribute to additional aquatic habitat degradation. That is, above certain levels of degradation in the aquatic habitat, there may not be much aquatic life remaining to be harmed (Wang et al. unpublished as cited in Brabec et al., 2002).

Recently, researchers investigating the effects of impervious surface on aquatic habitats have observed that other basin characteristics, such as forest cover, riparian buffers, and limited hydrologic connectivity between impervious surface and water resources, can modify the threshold and magnitude of these effects (Booth et al., 2002, Brabec et al., 2002, Center for Watershed Protection, 2003, Wang et al., 2001). For example, forest areas can potentially mitigate effects of other land uses causing increases in impervious surface by slowing stormwater runoff rates and dampening stream peak flows (Brabec et al., 2002, Center for Watershed Protection, 2003). Booth et al. (2002) noted that the effects of urban development on aquatic habitat are a complex interaction of the amounts of impervious surface and forest cover, the degree of hydrologic connection between impervious surface and affected water resources, levels of stormwater detention, maintenance of riparian buffers, and the protection of wetlands and unstable slopes.

As an example of this effect, studies of salmon streams in the Puget Sound area found that high quality stream buffers could help maintain fish diversity in areas with up to 15 percent impervious surface and good aquatic insect diversity in areas with up to 30 percent impervious surface (Horner and May, 1999 and Horner et al., 2001 as cited in Center for Watershed Protection, 2003). Similarly, riparian buffers in Seattle watersheds had some mitigating effect on increases in impervious surface up to 45 percent, beyond which they were ineffective in further mitigating effects (Horner et al., 1997 as cited in Brabec et al., 2002).

Figure 5-6-2 illustrates those areas in the region that have 15 percent or greater impervious cover.

FIGURE 5-6-2: AREAS IN THE CENTRAL PUGET SOUND REGION WITH 15 PERCENT OR GREATER IMPERVIOUS COVER



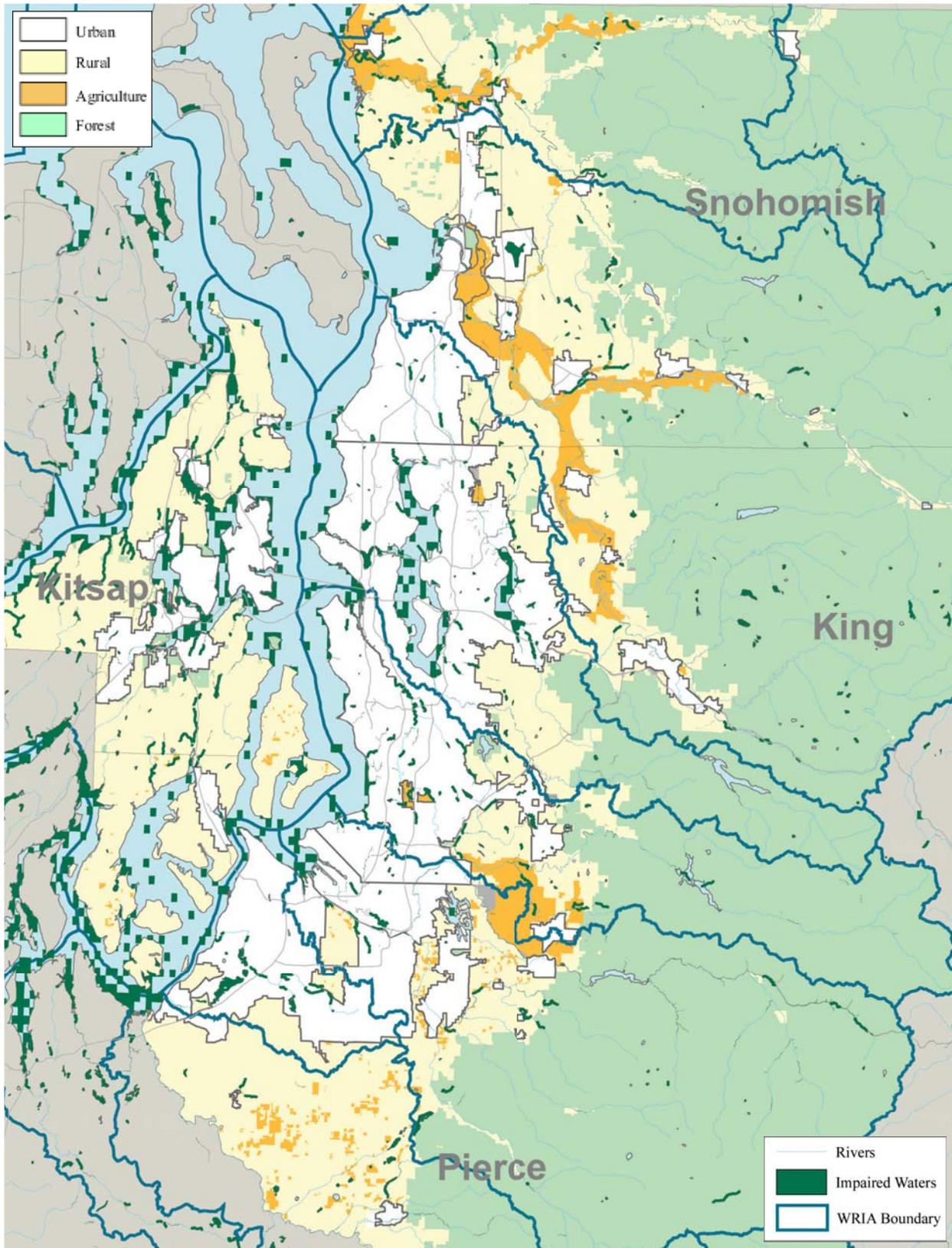
Source: Puget Sound Action Team

2. Impaired Waters

The effect of new development or increased densities on water resources also depends on the existing quality of those water resources. Section 303(d) of the federal Clean Water Act requires Washington state periodically to prepare a list of all surface waters in the state for which beneficial uses of the water — such as for drinking, recreation, aquatic habitat, and industrial use — are impaired by pollutants. These include estuaries, lakes, and streams that fall short of state surface water quality standards and which are not expected to improve within the next two years.

Figure 5-6-3 shows impaired waters across the region.

FIGURE 5-6-3: IMPAIRED WATERS IN AND AROUND THE REGION



Source: Washington State Department of Ecology



In its water quality assessments for each WRIA, Washington Department of Ecology maps the locations of 303(d)-listed waters (Ecology, 1998). Given the scale of the regional map, a call-out map is provided that illustrates impaired waters within WRIA 7 — the Snohomish river drainage.

FIGURE 5-6-4: IMPAIRED WATERS EXAMPLE: SNOHOMISH WRIA # 7



Source: Washington State Department of Ecology

A review of this map, as well as those for the other ten WRIAs, generally shows that impaired waters are more often concentrated in urban areas and near other developed areas.

The primary water quality problems are temperature and fecal coliform bacteria. Both are generally associated with pollution, which comes from many diffuse sources.

- Temperature is significant for the health of aquatic life. Fish, especially salmon, need cooler temperatures to survive and spawn. High temperatures can often occur from loss of vegetation along streams that used to shade the water and from new land uses (such as buildings and pavement) from which rainfall picks up heat before it runs off into the stream.
- Fecal coliform bacteria are significant for human health as an indicator of the presence of disease-carrying organisms. It commonly comes from livestock and failing septic tanks, but can also come from run-off in urban areas due to pets, geese, or other animals. Closures of public beaches and shellfish harvest areas are usually tied to high levels of the bacteria.

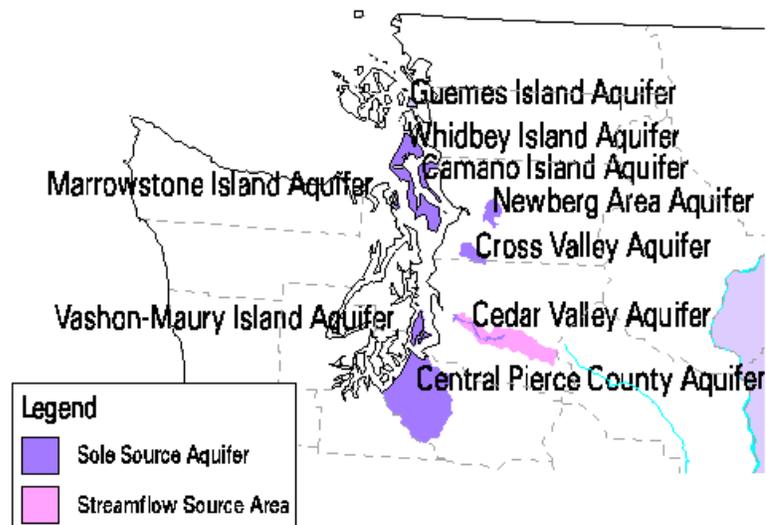
3. Sole Source Aquifers

Growth in the vicinity of sole source aquifers can affect their water quality. Impervious surfaces and other surface changes near the aquifers can reduce their ability to recharge. Areas that rely on aquifers for water supply also have the potential to overuse the resources.

Five sole source aquifers are located in the central Puget Sound region:

- Snohomish County currently has two designated sole source aquifers: the Cross Valley Aquifer, located in the Maltby/Clearview area of south Snohomish County, and the Newberg Area Aquifer, located east and south of the Pilchuck River.
- Two sole source aquifers are also located within King County: the Cedar Valley (Renton) Aquifer and the Vashon-Maury Island Aquifer.
- Finally, the Central Pierce County Aquifer is the largest of the western Washington sole source aquifers and is estimated to occupy the western one-third of Pierce County.

FIGURE 5-6-5: SOLE SOURCE AQUIFERS IN AND AROUND THE REGION



Source: Environmental Protection Agency

These aquifers are illustrated in Figure 5-6-5.

4. Large Contiguous Floodplains

Floodplains occur throughout the region, and are part of a naturally occurring pattern of change in a watershed. Growth that occurs in proximity to these resources has a greater potential to affect these resources. Figure 5-6-6 on the following page depicts the location of large contiguous floodplains in the central Puget Sound region.

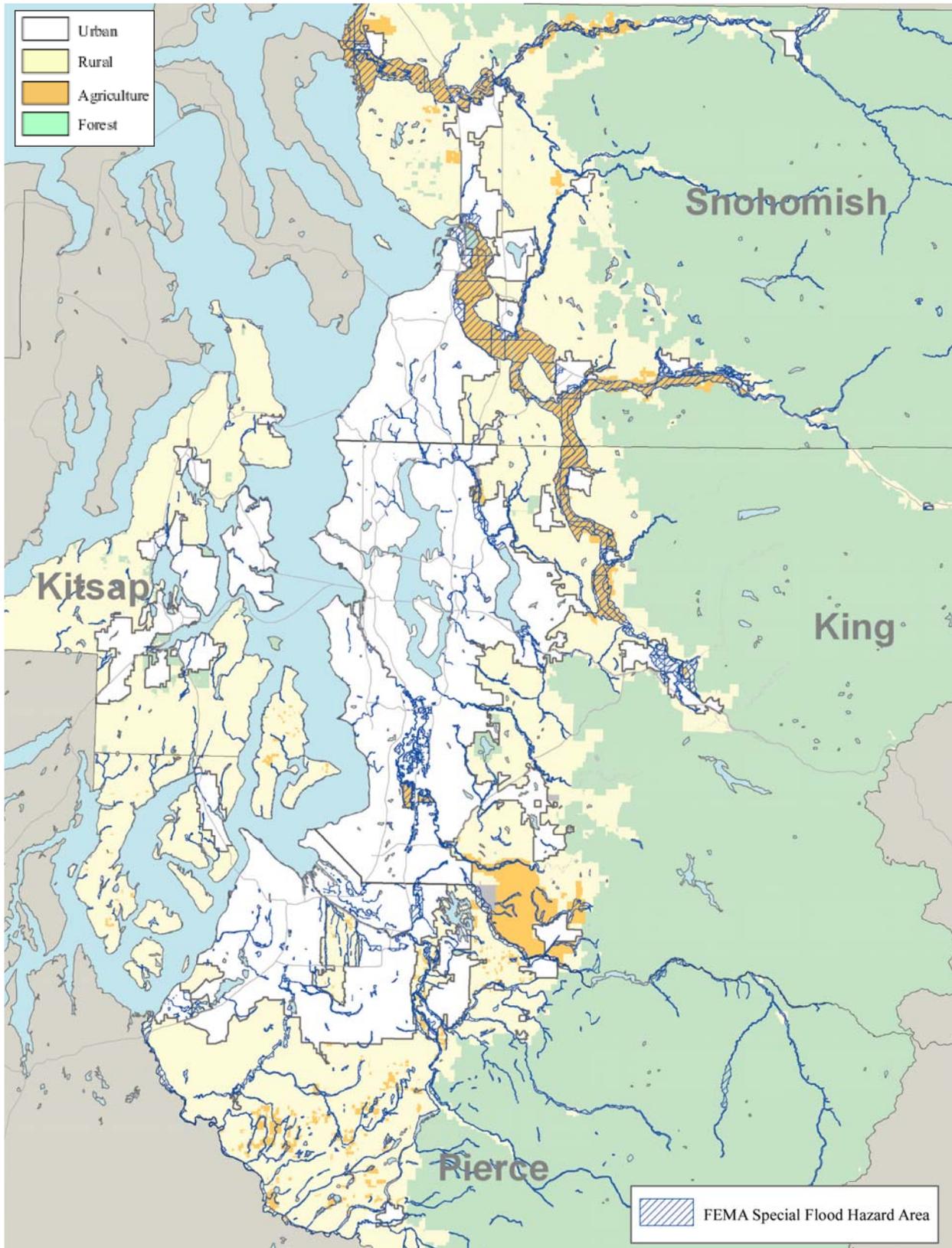
Large contiguous floodplains mapped by the Federal Emergency Management Agency are associated with the following locations:

- Snohomish River, the Skykomish River, and the Snoqualmie River in WRIA 7.
- The north end of Lake Sammamish, along the Sammamish River from its confluence with Bear Creek in Redmond north to its confluence with North Creek in Bothell, at the mouth of the Cedar River, and at the mouths of May, Issaquah, and Tibbetts Creeks in WRIA 8.
- Most of the Green River and portions of the Black River in WRIA 9.
- Hylebos Creek, the Puyallup River, and certain reaches of Des Moines Creek in WRIA 10.
- Nisqually River in WRIA 11; and Clover Creek in WRIA 12.

5. Wetlands, Lakes, Rivers and Streams

Wetland, lakes, rivers and streams occur and are dispersed throughout the entire central Puget Sound region (see *Chapter 5.5 – Ecosystems*, Figure 5-5-2). Because of the number and dispersed location of these resources, this Draft Environmental Impact Statement does not attempt to differentiate impacts to these resources between the various growth distribution alternatives. Instead, all growth distribution alternatives could be expected to have similar impacts to these resources. This analysis is discussed in the next section (5.6.2).

FIGURE 5-6-6: LARGE CONTIGUOUS FLOODPLAINS IN THE REGION



Source: Federal Emergency Management Agency, Puget Sound Regional Council

B. POLICIES AND REGULATIONS

A number of statutes, such as the Clean Water Act, are in place specifically to avoid or mitigate the impacts of growth and development on water quality and hydrology. The Clean Water Act and related regulations govern water supply, discharge, wetlands, and other actions related to water quality and quantity. The shoreline and critical areas requirements under the Growth Management Act and Shorelines Management Act, and conservation requirements under the Endangered Species Act, also provide protections to help reduce the potential for impacts. A variety of federal, state, and local regulations, permits, and approvals would likely be required to support the projected development envisioned in the VISION update.

For urban areas, the Washington Department of Ecology Stormwater Management Manual for Western Washington provides specific guidance for surface water management, during both the construction and operation phases of a project, including flow control and water quality treatment (Ecology, 2005). Each county and local jurisdiction is required to adopt these standards as a minimum or develop equivalent standards for stormwater management. Application of this manual for stormwater management practices protects natural water features from water quality and hydrologic impacts associated with stormwater runoff from impervious surfaces.

Last, a variety of other federal, state, and local regulations are codified that help to protect these water resources — these are described at the end of *Chapter 5.5 – Ecosystems*.

5.6.2 Analysis of Alternatives (Long-Term Impacts)

This section presents impacts common to all growth distribution alternatives, followed by the relative impacts of each alternative. Potential causes of long-term impacts have been divided into general categories: (1) new impervious surfaces including pollution-generating surfaces, (2) proximity to concentrations of impaired waters versus un-impaired waters, (3) proximity to sole source aquifers, (4) proximity to floodplains, and (5) proximity to wetlands, lakes, rivers and streams.

A. IMPACTS COMMON TO ALL ALTERNATIVES

The regulations and policies described and referenced previously (in the Affected Environment section) are intended to prevent or reduce the hydrologic and water quality impacts and will apply to new development resulting from regional growth. However, the prevailing scientific opinion is that the impacts cannot entirely be mitigated (Brabec et al., 2002; Booth et al., 2002; Center for Watershed Protection 2003). Thus, water resources will be impacted to some degree by the projected growth, regardless of the growth distribution alternative selected or mitigation measures implemented.

In developing growth distribution alternatives, the Puget Sound Regional Council has arranged growth into certain types of areas: metropolitan cities, core suburban cities, larger suburban cities, smaller suburban cities, unincorporated portions of the urban growth area, and rural areas. Generally, the rural areas are most likely to have the lowest levels of existing impervious surface and the highest levels of existing forest cover. Conversely, places inside the urban growth area generally have relatively high levels of existing impervious surface and low levels of forest and other vegetative cover. Overall, growth would be expected to cause the least amount of change in already urbanized areas and the most amount of change in sparsely developed areas.

Construction impacts. Development can involve the removal of vegetation and the disturbance of soil during construction and usually creates new impervious surfaces. Construction for new developments would be expected throughout the planning horizon of the VISION 2020 as the region accommodates more people and jobs. Construction can cause erosion by exposing soils and increasing sediment in water. This has the potential to alter nutrients found in receiving waters and can also carry other contaminants into surface waters. Sediment in urban runoff from construction and as a result of increased runoff and higher peak flows is a major pollutant for surface waters and can reduce light penetration, blanket fish spawning habitat and alter benthic ecosystems (the bottom layers of the water bodies, including the beds and sediments).

The alternatives that would focus development in areas that have been previously developed would typically have lower potential for high levels of impacts due to construction, particularly considering the fact that projects would need to meet typical permit requirements and use “best management practices” to control erosion during construction. Development in areas that are currently undeveloped would have the highest potential for both construction and long-term impacts, although, again, typical construction permit requirements to reduce effects would be expected for individual developments.



1. Impervious Surfaces

All of the alternatives anticipate an increase in the amount of impervious surface cover in the region. However, each alternative distributes growth in different ways that create differing amounts of impervious surface expansion. As stated previously, three general thresholds regarding the environmental impacts of impervious surfaces are considered: (1) 1 to 10 percent impervious, (2) 11 percent to 25 percent impervious, and (3) greater than 26 percent impervious. Negative impacts to the region's water resources escalate along with increasing impervious surface coverage, and these thresholds are useful in analyzing the different impacts of varying impervious surface intensity. Impervious surface for the region is estimated and analyzed here using modified thresholds, corresponding to available data (see Figure 5-6-7): (1) 0 percent, (2) 10 percent, (3) 20 percent, and (4) greater than 30 percent imperviousness.

Using the INDEX grid-cell data, Figure 5-6-7 estimates the amount of impervious surface coverage that might occur in each of the alternatives, using the thresholds identified previously. These differences are applied in subsequent sections to gauge the relative impact of each potential growth pattern.

FIGURE 5-6-7: ESTIMATED SQUARE MILES OF IMPERVIOUS SURFACE FOR ALL ALTERNATIVES IN 2040, REGIONAL LEVEL²

	Growth Targets Extended Alternative		Metropolitan Cities Alternative		Larger Cities Alternative		Smaller Cities Alternative	
	Total Sq. Mi. in Category	Impervious Sq. Miles	Total Sq. Mi. in Category	Impervious Sq. Miles	Total Sq. Mi. in Category	Impervious Sq. Miles	Total Sq. Mi. in Category	Impervious Sq. Miles
0 percent	4510	0	4870	0	4880	0	4860	0
10 percent	630	60	520	50	500	50	360	40
20 percent*	170	30	170	30	170	30	170	30
30 percent and greater	1020	470	760	400	780	400	930	470
Impervious Surface Total		560		480		480		540

* The only land use types that received the "20 percent" estimate in the INDEX model were government or military lands. Since no population or employment growth was allocated to these lands, the 20 percent estimate does not change.

Source: Puget Sound Regional Council, 2006

The most dispersed growth alternative, the Smaller Cities Alternative, is estimated to have the most land in the 30 percent or greater category. At the same time, the most concentrated growth alternative, the Metropolitan Cities Alternative, is estimated to have the least land in the 30 percent or greater category. These differences are discussed for each of the alternatives in the subsequent text.

2. Impaired Waters

Given the widespread location of these waters throughout the region, all four of the growth distribution alternatives could likely result in at least some development around both impaired waters and more pristine waters. Impaired waters are waters that fail to meet water quality standards and are the focus of clean-up efforts. Future development around impaired waters may provide an opportunity to retrofit existing developed areas that either lack or have inadequate stormwater treatment facilities so that they are in compliance with newer, more stringent regulatory requirements. While these same regulatory requirements would apply to development around more pristine waters, these waters and the associated beneficial uses and aquatic habitat are arguably more sensitive to changes that affect water quality.

² Impervious surface coverage for the region was calculated at the INDEX 5.5 acre grid cell level. Using information from multiple studies, each cell was assigned an estimated total impervious surface percentage of 0%, 10%, 20%, 30%, 40%, 60%, 75%, 80%, or 85% based on land use classification and intensity. This method, by combining densities and land use classifications into broad categories with a specific impervious surface value, is intended to provide a general idea of what impervious surface conditions will look like under each alternative. Sources used include the following:

- City of Olympia. (1995). Impervious Surface Reduction Study: Final Report. Olympia, WA: Public Works Department, Water Resources Program.
- May, C.W., Horner, R.R., Karr, J.R., Mar, B.W. & Welch, E.B. (1997). The Cumulative Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. Seattle, WA: University of Washington.
- Aqua Terra Consultants. (1994). Chambers Watershed HSPF Calibration. Prepared by D.C. Beyerlein and J.T. Brascher. Thurston County, WA: Thurston County Storm and Surface Water Program.
- Stankowski, S.J. (1972.) Population density as an indirect indicator of urban and suburban land-surface modifications. Prof. Paper 800-B. Washington, DC: Geological Survey, U.S. Department of Interior; 219-224.

3. Sole Source Aquifers

The region's aquifers are located in urban, rural and natural resource areas, which means all of the alternatives will likely have some impacts on one or more the aquifers and could result in development over them. Unregulated development could result in water quality impacts to these aquifers and could affect the long-term hydraulic function of the aquifers. Some of this development would be regulated under the local jurisdictions' critical areas code and, where federal funding or permits are required, would also require EPA approval.

4. Large Contiguous Floodplains

Floodplains are located in urban areas, although the majority of areas are in the rural and natural resources (agricultural) lands. This means that all four of the growth distribution alternatives could result in development within floodplains, although alternatives that locate growth in rural areas and near agricultural areas are more likely to result in floodplain impacts. Unregulated development could reduce the effective base flood storage volume of the floodplain. However, development within the floodplain would be regulated under the local jurisdictions' critical areas code and specific development standards would apply.

5. Wetlands, Lakes, Rivers, and Streams

All four of the growth distribution alternatives could result in growth and development pressure around wetlands, lakes, rivers, and streams. Unregulated development could result in further loss or degradation of these resources, loss or degradation of their buffers, and impacts to the water quality of these resources. Development around these resources would be regulated and impacts mitigated under the local jurisdictions' critical areas code, as well as by the Clean Water Act.

Other sources of water quality impacts to wetlands, lakes, streams, and the Puget Sound include municipal and industrial wastewater discharges, which, while increasingly regulated, still affect water quality. Fertilizers, household and yard chemicals, pets, septic systems, and erosion all also affect water quality. Maritime and boating activities also can degrade water quality, primarily due to the use of fossil fuels and discharges that occur during use, but also due to the potential for accidental discharges. Finally, water withdrawal for drinking water, municipal and industrial uses and for irrigation also affects water resources and can contribute to reduced water quality and hydrology. All of the alternatives are expected to result in increased potential for negative impacts on water quality and hydrology other than those related to imperviousness.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

The Growth Targets Extended Alternative allocates significant growth in both the most urbanized portions of the region (metropolitan cities and core suburban) and the least urbanized portions of the region (unincorporated urban growth areas and rural areas).

1. Impervious Surfaces

Of the four alternatives, Growth Targets Extended is estimated to have the most amount of land in the over 30 percent impervious surface coverage category, with over 1,020 square miles of land in this category. The net effect of this is an estimate of 560 square miles of impervious surfaces in the region — the highest amount among the alternatives. The Growth Targets Extended Alternative distributes growth relatively evenly among the various areas (e.g., from metropolitan to smaller cities and rural areas). Population in rural areas would increase under this alternative more than all but the Smaller Cities Alternative. Rural areas generally have the lowest levels of existing impervious surface and the highest levels of forest cover in the region. Unincorporated areas within the urban growth boundaries generally have the next lowest levels of existing impervious surface and next highest levels of forest cover in the region. While critical areas regulations and other environmental protections could likely reduce the impacts, these areas would still be particularly sensitive to changes in impervious surface levels.

2. Impaired Waters

This alternative has the highest amount of vehicle miles traveled and congestion. Therefore this alternative could conceivably have a relatively large impact on the quality of water resources in these outlying areas, as transportation is a



primary source of non-point pollutants in stormwater. This alternative could put more well-functioning water resources at risk for listing as impaired in the Washington Department of Ecology's 1998 303(d) listing.

3. Sole Source Aquifers

The Growth Targets Extended and Smaller Cities Alternatives would result in the largest amount of growth in areas that are currently undeveloped. Increased impervious surface cover could be more likely in the vicinity of the Central Pierce County Newberg Area and Vashon-Maury Island sole source aquifers.

4. Large Contiguous Floodplains

Many of the smaller suburban cities and unincorporated areas that would experience more growth under this alternative are located along the Snohomish, Skykomish, and Green Rivers, which have large associated floodplains. The rural areas surrounding these small cities could experience substantial development pressure under this alternative. While development within the floodplain would be regulated under the local jurisdictions' critical areas code and specific development standards would apply, increasing urbanization surrounding these floodplains could result in adverse impacts.

METROPOLITAN CITIES ALTERNATIVE

After the Larger Cities Alternative, the Metropolitan Cities Alternative would result in the next highest population increases in core and larger suburban cities and the next highest employment increase in larger suburban cities.

1. Impervious Surfaces

Many water resources in these highly urbanized areas are already degraded to a point that the resources are less susceptible to increases in impervious surface. However, even within these highly urbanized areas, many viable subwatersheds exist, and the adverse impacts from additional impervious surface would still need to be offset or mitigated by the preservation of remaining high-quality riparian corridors and the revitalization of existing impaired ones. Compared to the other alternatives, the Metropolitan Cities Alternative would result in the highest increases in population and employment in the metropolitan cities of Seattle, Everett, Tacoma, Bremerton, and Bellevue. Existing impervious surface levels in most areas of these cities, except parks and open spaces, exceed 25 percent, which indicates a relatively lower potential for additional impacts to water resources compared to growth in currently undeveloped areas.

Under this alternative, growth would be concentrated in already urbanized areas, rather than the outlying areas. This means that the Metropolitan Cities Alternative is estimated have the least amount of land (760 square miles) in the 30 percent impervious category. This is about 260 fewer square miles than the Smaller Cities Alternative in this category. The net effect is an estimate of 480 square miles of impervious surface, which is nearly identical to the Larger Cities Alternative, and the lowest among the alternatives. Growth in imperviousness in and around smaller cities could be lowest in this alternative, and there could be fewer areas of high impervious surface on the urban fringe. As there would be less population and employment growth in smaller suburban cities and unincorporated areas than under the Growth Targets Extended and Smaller Cities Alternatives, the Metropolitan Cities Alternative could have the least effect on the water resources most sensitive to changes in impervious surfaces.

2. Impaired Waters

The metropolitan cities and larger cities also tend to coincide with concentrations of water resources listed on Ecology's 1998 303(d) listing. These impaired waters may be less susceptible to additional degradation from surrounding growth than water resources in the outlying areas. The Metropolitan Cities Alternative is estimated to have the second least total vehicle miles traveled and, together with the Larger Cities Alternative, likely could result in less transportation-related pollution impacts than Growth Targets Extended or the Smaller Cities Alternative.

3. Sole Source Aquifers

The Metropolitan Cities Alternative is estimated to result in the least increase in land use density and impervious surfaces over the Central Pierce County, Cross Valley, and Cedar Valley aquifers. However, land use density increases over the Vashon-Maury Island aquifer could be the second highest after Growth Targets Extended.

4. Large Contiguous Floodplains

The Metropolitan Cities Alternative could result in lower relative growth in the smaller suburban cities located along the floodplains associated with the Snohomish, Skykomish, and Green Rivers. The rural areas typically surrounding these cities could likely experience less development pressure and potential floodplain impacts could be better avoided.

LARGER CITIES ALTERNATIVE

After the Smaller Cities Alternative, the Larger Cities Alternative has the lowest increase in population and employment in the metropolitan cities. Instead, growth is focused on the core and larger suburban cities geographies, where growth in population and employment are the highest among the four alternatives.

1. Impervious Surfaces

As shown in Figure 5-6-7, the Larger Cities Alternative is estimated to result in the second least amount of land with greater than 30 percent imperviousness and has 780 square miles land in this category. The net effect is nearly identical to the Metropolitan Cities Alternative, and about 80 square miles less than Growth Targets Extended. Existing impervious surface levels in portions of the core and large suburban cities already exceed 25 percent; however, some areas of moderate impervious surface cover (11-25 percent) are likely present. Many of these moderate areas could likely be converted to impervious surface, by infilling to accommodate growth. Thus this alternative may have the greatest impact on water resources occurring in these already urban but less dense pockets.

2. Impaired Waters

As with the Metropolitan Cities Alternative, the Larger Cities Alternative would have the lowest levels of population and employment increases in rural areas, where water resources may be most susceptible to increases in impervious surfaces and where fewer concentrations of impaired waters are currently located. The Larger Cities Alternative is similar to the Metropolitan Cities Alternative in terms of potential transportation-related pollution impacts, but could have slightly lower potential impacts as it is estimated to result in less total vehicle miles traveled and less total vehicle delay. The typical impacts to water quality would still be expected, but potentially at lower levels than the Growth Targets Extended and Smaller Cities alternatives.

3. Sole Source Aquifers

The Larger Cities Alternative is estimated to result in the second to lowest increase in land use density and impervious surface over aquifers such as those found in Central Pierce County and Cedar Valley. Impacts to recharge rates and water quality could still occur, but could be comparatively reduced.

4. Large Contiguous Floodplains

The Larger Cities Alternative is estimated to result in relative low growth in the small suburban cities located along the floodplains associated with the Snohomish, Skykomish, and Green rivers. As with the Metropolitan Cities Alternative, development pressure within floodplain areas could likely be less than for the Growth Targets Extended and Smaller Cities alternatives. However, typical impacts as described for all alternatives would be expected.

SMALLER CITIES ALTERNATIVE

The Smaller Cities Alternative would result in the most employment and population growth in the smaller suburban cities and unincorporated areas. It also has the most growth overall in rural areas. Conversely, it would have the least amount of population and employment growth in metropolitan and larger cities.

1. Impervious Surfaces

Of all the alternatives, the Smaller Cities Alternative is estimated to result in the second highest amount of land that crosses the 30 percent impervious threshold, with 930 square miles in this category, which is 90 square miles less than that exhibited by the Growth Targets Extended Alternative, but about 170 square miles more than the Metropolitan Cities alternative in this category. The net effect is for about the same amount of impervious surface coverage in the region as under Growth Targets Extended and about 60 square miles less than under the Metropolitan Cities and Larger Cities Alternatives. This result could occur because of the relatively dispersed nature of growth under the Smaller Cities



Alternative compared to the other alternatives. The largest increases in impervious surface coverage in rural areas, urban unincorporated areas, and smaller suburban cities are possible under this alternative. Thus, while critical areas regulations and other environmental protections could likely reduce and mitigate the impacts, water resources could be most impacted in these areas that are more sensitive to changes in impervious surface levels. Because of the conversion of more land in outlying places from lower levels of impervious surface to higher levels of impervious surface compared to the other alternatives, this alternative could have the most impacts on water resources in the region as a whole.

2. Impaired Waters

The rural and urban unincorporated areas are typically characterized by fewer waters currently listed as impaired in Ecology's 1998 303(d) listing. Water resources in these rural and unincorporated areas are more likely to be more sensitive to the discharge of pollutants from impervious surfaces. Growth under the Smaller Cities Alternative is estimated to result in the second most total vehicle miles traveled, and is therefore likely to have more transportation-related pollution impacts than the Metropolitan Cities and Larger Cities alternatives.

3. Sole Source Aquifers

The Growth Targets Extended and Smaller Cities alternatives are estimated to result in the most increase in land use intensity and impervious surfaces over the Central Pierce County Aquifer. The Smaller Cities Alternative could result in the most increase in land use density over the Cross Valley Aquifer.

4. Large Contiguous Floodplains

Many of the small suburban cities that would experience high growth under this alternative are located along the Snohomish, Skykomish, and Green Rivers, which have relatively large associated floodplains. The effects could be similar to those described for Growth Targets Extended.

5.6.3 Cumulative Effects

Cumulative effects are the incremental effects of growth anticipated by the VISION 2020 update on water quality and hydrology, when combined with other past, present, and reasonably foreseeable actions. Development and human activity over the past 150 years has dramatically changed water resources. It has altered shorelines, river channels, and floodplains. Dams, wells, and other water diversions have altered hydrology. Discharges to water bodies have contaminated rivers, lakes and streams and their beds. The regulations that are currently in place are intended to reduce or eliminate adverse effects of new development and redevelopment. However, the prevailing scientific opinion is that the impacts of new development (especially in relatively undeveloped areas) cannot feasibly be entirely mitigated.

On the other hand, redevelopment in older, already urbanized areas provides the opportunity to retrofit areas that either lack or have inadequate stormwater facilities, improving the existing condition. Thus the cumulative effects of the relatively high growth in outlying areas under the Growth Targets Extended and more so under Smaller Cities Alternatives may be higher than those of the relatively high urban and suburban growth under the Metropolitan Cities and Larger Cities alternatives.

While the primary impacts to rivers, lakes, streams and sole source aquifers in the region are covered in the discussions above, other factors could result in higher cumulative effects for all alternatives. Growth throughout the Puget Sound and western North America has the potential to continue to alter water quality in the central Puget Sound region and elsewhere in the state. Water withdrawals and diversions, including the need for additional drinking water sources and sources for power generation, could affect water resources not only in the central Puget Sound region, but also in other areas of the state. Additional discussion of potential water supply impacts is included in *Chapter 5.7 – Public Services and Utilities*.

At the level that the growth alternatives are defined, the specific sources that could be affected and the level of water supply by specific area is known in only general terms. System level and project level plans would be required to assess detailed demands, impacts, and mitigation.

5.6.4 Potential Mitigation Measures

Numerous actions collectively and individually would be required by jurisdictions adopting updated comprehensive plans and by individual project actions. Development activity will be required to comply with applicable regulations and permit conditions (such as treatment and detention of stormwater runoff or avoidance or mitigation for floodplain fills). Some potential mitigation measures may include the following:

- Improved stormwater detention and treatment systems to address erosion, increased flows and pollution. As many stormwater systems currently discharge directly to water bodies, existing facilities may require improved inspection and maintenance. Additional systems to reduce sediment and pollutant loads and reduce flooding could also minimize impacts. This could include natural systems and measures such as providing wetlands, and measures to restore buffers and natural channels for streams.
- Low-impact design techniques (e.g., protection of wetlands, streams and their buffers, preservation of native soils and vegetation, infiltration of stormwater) could be used to reduce potential impacts associated with new impervious surface.
- Conservation plans and strengthening of critical areas ordinances to add specific measures that could prevent stream and river areas from further development.
- In some locations, restoration of buffers could also be beneficial, although buffers need to be fairly large (100 feet to 200 feet) to have a notable beneficial effect.
- Transfer of development rights to reduce development potential (and other actions to reduce development pressure in the rural areas).
- “Best practice” construction practices.
- Groundwater contamination could be mitigated by controlling land uses allowed within areas susceptible to groundwater contamination.
- Impacts to groundwater and aquifers could be minimized by limiting the development of impervious surfaces over recharge areas, improved groundwater management plans and processes, including wellhead protection programs.
- Water conservation and reuse measures (see *Chapter 5.7 – Public Services and Utilities*).
- Green development standards.
- Measures that reduce vehicles miles traveled and reduce the need for additional or expanded roadways and parking.
- The use of cleaner fuels.

5.6.5 Significant Unavoidable Adverse Impacts

Most if not all of the direct effects discussed above could be considered significant unavoidable impacts because, while the effects can be mitigated to some extent, residual impacts will remain. These include water quality and water quantity (flooding) impacts due to increased impervious surfaces. They also include water quality impacts due to point and non-point discharges of pollutants to receiving waters. Other likely unavoidable impacts could include higher rates of water consumption, causing diversions and water withdrawals from rivers, lakes, and streams, and withdrawals from groundwater sources.

SUPPORTING INFORMATION

Descriptions of Watershed Resource Inventory Areas

Ten of the Watershed Resource Inventory Areas that are present in the central Puget Sound region are described below. [Ecology, source: <http://www.ecy.wa.gov/programs/eap/wrias>]

- **WRIA 03 — Lower Skagit** is primarily located within Skagit County; however, a small portion of northwestern Snohomish County is also included. This portion of Snohomish County is mostly outside the urban growth area. Only a small portion of the UGA around the city of Stanwood (located further south in WRIA 05) overlaps this WRIA. The primarily river draining this watershed is the Skagit River. Land use in the portion of the watershed



occurring in Snohomish County includes barren and grassy areas immediately around the Skagit River estuary, residential areas around Lake Ketchum. Otherwise, land uses are predominantly agricultural and “mixed forest” areas.

- **WRIA 04 — Upper Skagit** is located in the eastern portions of Whatcom, Skagit, and Snohomish counties. The primary river draining the portion of this watershed within Snohomish County is the Sauk River, which flows north to the Skagit River. Except for the small town of Darrington, this portion of the watershed is predominantly forested (including Mount Baker National Forest), interspersed with some “transitional” and agricultural areas. Only Darrington and its immediate surroundings are within the UGA. Outside the river valley, the terrain becomes mountainous and includes Glacier Peak.
- **WRIA 05 — Stillaguamish** is located in South Skagit County and North Snohomish County, west of WRIA 04. The north and south forks of the Stillaguamish River are the major surface water sources in the watershed. These two rivers converge to form the Stillaguamish River approximately 18 miles upstream of the Puget Sound. East of the confluence, the land cover is primarily forest, interspersed with some “transitional” areas. The upper South Fork Stillaguamish River is within the Mount Baker National Forest. Agricultural uses are concentrated around the north fork and mainstem of the Stillaguamish River.

The watershed includes the small city of Stanwood and portions of the smaller cities of Arlington and Granite Falls. Only these cities and their immediate surroundings are within the UGA. No metropolitan or core or major suburban cities are located in this watershed.

- **WRIA 07 — Snohomish** is located in Snohomish and King counties, and includes the metropolitan city of Everett and the major suburban city of Marysville. Smaller cities in this watershed include Snohomish, Monroe, Sultan, Duvall, Carnation, Gold Bar, Skykomish, and North Bend. The Snoqualmie and Skykomish rivers are the major surface water sources in the watershed. These two rivers converge to form the Snohomish River approximately 20 miles upstream of the Puget Sound. Other major tributaries include the Tolt, Sultan, and Pilchuck rivers. The eastern half of the watershed (i.e., east of the Snoqualmie River Valley) is mountainous and, with the exception of a few smaller suburban cities, outside the UGA.

This area is primarily forested, interspersed with some “transitional” areas. The river valleys are interspersed with agricultural uses. The developed areas within the river valleys are small “stand-alone” towns. With the exception of the contiguous UGA connecting Snoqualmie to North Bend, only the suburban towns and their immediate surroundings are within the UGA. The urban areas are more concentrated in the northwest portion of the watershed — from Snohomish north to Lake Stevens and from Everett north to Marysville. The Tulalip Tribes’ Reservation is also located within this portion of the watershed.

- **WRIA 08 — Cedar/Sammamish** is located primarily in King County, but also includes a small portion of Snohomish County. WRIA 8 includes Lake Washington, Lake Sammamish, and Lake Union. Numerous sub-watersheds are located in WRIA 08. These sub-watersheds are primarily tributaries to Lake Sammamish, Lake Washington, or the Sammamish River. The largest surface water source in the watershed is the Cedar River, which drains into Lake Washington. Issaquah Creek flows into Lake Sammamish, which in turn flows into the north end of Lake Washington via the Sammamish River.

Forested areas are primarily limited to the extreme eastern edge and southeastern portion of the watershed. Some agricultural areas remain in the Sammamish River Valley. Otherwise, the watershed is largely developed for urban commercial and residential uses. The following cities are located in this watershed: Seattle (northern portion), Bellevue, Kirkland, Bothell, Redmond, Lynnwood, and Renton, Woodinville, Issaquah, Kenmore, Mercer Island, Sammamish, Mountlake Terrace, Shoreline, Edmonds, Mukilteo, and University Place.

- **WRIA 09 — Duwamish/Green** is located in King and Pierce counties. The primary water bodies in WRIA 09 are the Green River and Duwamish River. The Green River joins the historic Black River at approximately River Mile 13 to form the Duwamish River. The Duwamish River, a tidally influenced waterbody, discharges to Elliott Bay, creating the Duwamish Estuary. The Green-Duwamish River measures 65 miles from the Howard Hanson Dam to Elliott Bay. Other streams include Black River, Mill Creek, Newaukum Creek, and Soos Creek.

Southeast of Highway 18, the land is predominantly forested, interspersed with some transitional areas. The area around Enumclaw is largely agricultural. The areas northwest of Highway 18 that have been developed for urban commercial and residential use include the core suburban cities of Tukwila, Des Moines, Federal Way (portion), Burien, Auburn, and Kent, as well as south Seattle (a major metropolitan city).

- **WRIA 10 — Puyallup/White** is primarily located in Pierce County, but also includes a portion of south King County. The largest surface water source is the Puyallup River. Major tributaries to the Puyallup River are the Carbon and White rivers and South Prairie Creek. Puyallup River and Hylebos Creek both flow into Commencement Bay. On the White River, the U.S. Army Corps of Engineers controls the flow of water through the Mud Mountain Dam to prevent flooding and maintain minimum flows. Puget Sound Power and Light diverts water at two locations for electrical generation. One diversion is on the White River for the White River Canal, and the other is on the Puyallup River at Electron.

The southeastern two-thirds of WRIA 10 are predominantly forested, interspersed with some transitional areas. This mountainous area includes Mt. Rainier. Some agricultural areas are located around Buckley, east of Lake Tapps, and along the Puyallup River. The Muckleshoot Indian Reservation is located in this portion of the watershed. Urban commercial and urban residential areas are primarily located in the northwest portion of the watershed. The urban areas include the metropolitan city of Tacoma, the core suburban cities of Puyallup, Federal Way (portion), and Auburn (portion), and the smaller suburban cities of Sumner, Bonney Lake, South Prairie, and Buckley.

- **WRIA 11 — Nisqually** is located in portions of Pierce, Lewis, and Thurston counties. The majority of the upper watershed is forested. The central portion of the watershed is primarily rural residential, with large areas of forest and agriculture. Within Fort Lewis, much of the area is forested, but it includes some prairie. In the central watershed, urban areas are largely limited to Eatonville.
- **WRIA 12 — Chambers/Clover** is a relatively small watershed, nestled between WRIs 10 and 11. This WRIA includes a portion of Pierce County, including south Tacoma (major metropolitan city), the core suburban city of Lakewood, and the cities of Steilacoom, DuPont, Spanaway, and Parkland. Federal facilities (i.e., Fort Lewis Military Reservation and McChord Air Force Base) occupy at least 25 percent of the land within the watershed.

The watershed occurs entirely within the lowlands and is almost entirely within the urban growth area, with the exception of portions of the military bases and the far eastern portion of the watershed. The primary water bodies draining WRIA 12 are Chambers Creek and Clover Creek. Clover Creek originates from springs and ground water discharges to streams in the northeast corner of the watershed. Clover Creek enters Steilacoom Lake, which in turn is the source for Chambers Creek. Leech Creek and Flett Creek are two important tributaries to Chambers Creek, which flows north and west down a ravine into Chambers Bay and then the Puget Sound. The major surface water use in WRIA 12 is for single and multiple domestic supplies. The major groundwater uses are for public water supply and single domestic users.

- **WRIA 15 — Kitsap** is located in Kitsap County and portions of King, Pierce, and Mason counties. The watershed is bounded by Hood Canal to the west and the Puget Sound to the north and east. Much of the watershed is forested, interspersed with “transitional” areas (likely 10 percent or less existing impervious surface cover). Urban development is primarily concentrated around the major metropolitan city of Bremerton, the cities of Port Orchard, Gig Harbor, and Poulsbo, and portions of Bainbridge Island.





Public Services and Utilities

This chapter discusses potential impacts to public services and utilities under each of the growth distribution alternatives. Public services and utilities reviewed include: (1) solid waste collection and disposal, (2) sanitary sewer systems, (3) water supply, (4) fire protection and police services, (5) health and emergency medical services (including hospitals), and (6) schools.

Stormwater is discussed in *Chapter 5.6 – Water Quality and Hydrology*. Parks and recreation facilities are discussed in *Chapter 5.8 – Parks and Recreation*. Energy and electrical utilities are discussed in *Chapter 5.10 – Energy*.

5.7.1 Affected Environment

Under the Growth Management Act, cities and counties are required to develop and adopt comprehensive plans which include long range planning for future public service and utility needs. Among the required elements are a capital facilities plan element and a utilities element. The capital facility plan element is required to have an inventory of existing facilities showing locations and capacities, forecasts of future needs, proposed locations and capacities of new or expanded facilities, and a financing strategy (Revised Code of Washington 36.70A.070(3)). The utilities element is required to describe the existing and proposed locations of all utilities and their capacity (Revised Code of Washington 36.70A.070(4)).

5.7.1.1 SOLID WASTE

Revised Code of Washington Chapter 70.95.020, which relates to the protection of public health and the environment, requires that each county develop and implement a Comprehensive Solid Waste Management Plan. The purpose of the plan is to ensure that solid waste and disposal capacity is in place over a 20-year period. In order to achieve compliance, each county within the region has created a solid waste division.

There are four agencies that, together with the counties' solid waste divisions, oversee all aspects of solid waste management. First, the Washington State Department of Ecology approves waste management plans, establishes solid waste rules, and provides financial and technical assistance. Second, the Washington Utilities and Transportation Commission regulates the rates and services of the private collection providers. Third, county departments of public health enforce solid waste rules, issue operating permits for local solid waste facilities and collection vehicles, monitor historic landfills, and screen waste for any special handling needs. Lastly, the county departments of construction and land development issue land use and building permits for solid waste facilities. The counties within the region have varying solid waste management systems in place, which are discussed in greater detail below.



King County

Garbage collection in King County — outside the City of Seattle and with the exception of Enumclaw and Skykomish which provide their own garbage collection — is provided by two private service companies: Rabanco and Waste Management, Inc. A third provider, Waste Connections, Inc., provides garbage collection services to Vashon Island only. The Seattle/King County Department of Public Health is the primary enforcement and planning agency for solid waste management. Their responsibilities include issuing permits for new local and regional solid waste facilities, and monitoring landfills within the county that are at capacity.

The City of Seattle is not included in King County's service area and, because of this, its solid waste is managed independently from the rest of King County. Trash is picked up curbside by private providers and transported to county-owned transfer facilities. It is then transported to Waste Management Inc.'s landfill in Arlington, Oregon. For this reason, the Oregon State Department of Environmental Quality also monitors the manner in which Seattle's waste is disposed.

Kitsap County

In Kitsap County, Waste Management Inc., under the Washington Utilities and Transportation Commission, provides solid waste collection within unincorporated areas. Cities within Kitsap County may choose to provide their own collection service, contract with private collection service providers, or have the Commission oversee the hauler. Approximately 40 percent of Kitsap County residents choose to haul their own waste to drop-box facilities. Solid waste is collected and brought to the Olympic View Transfer Facility, where it is then loaded and transferred to the Columbia Ridge Landfill in Arlington, Oregon. Waste Management Inc. operates the transfer facility under a 20-year contract with Kitsap County and, in 2004, received 850 tons of waste daily.

Military bases are not under the Commission's purview and have the option of contracting out solid waste collection services or providing those services themselves. There are four military facilities in Kitsap County: Naval Station Bremerton, Puget Sound Naval Shipyard, Submarine Base Bangor, and Naval Undersea Warfare Center at Keyport. The Navy hauls its commercial and industrial solid waste to the Olympic View Transfer Facility for disposal. The operating support contractor at the base provides residential solid waste collection as an on-base benefit.

Pierce County

Three companies hold five solid waste permits within Pierce County: Murrey's Disposal, Harold LeMay Enterprises, and University Place Refuse. The Washington Utilities and Transportation Commission issues all permits. In Pierce County, cities and towns have three options available to them for solid waste collection, which are similar to the options available in Kitsap County.

- *Municipal option:* Cities have the option of operating their own solid waste utilities. Currently, Tacoma and Ruston use this option.
- *Contract option:* Cities may contract with private haulers to provide both residential and commercial solid waste collection. Presently, 14 cities in Pierce County use this option.
- *Washington Utilities and Transportation Commission option:* If a city does not choose one of the two options above, the Commission assumes regulation responsibilities by default. Presently, five cities and all of the unincorporated areas in Pierce County use this option.

Snohomish County

Snohomish County has been exporting its garbage since 1990. Each weekday, about 1,200 tons of trash is transported to the Roosevelt landfill located in Klickitat County. Garbage is collected curbside or citizens may choose to haul their own trash to transfer stations or rural drop boxes. From there, garbage is brought to one of three transfer stations, located in Arlington, Everett, and Mountlake Terrace. Garbage is then compacted and trucked to the Rabanco Rail Loading Facility in Everett. The cubes are then shipped to the Roosevelt landfill for disposal.

5.7.1.2 SANITARY SEWER

Sanitary sewer service is an urban service that provides treatment of sewage to levels that comply with state and federal water quality standards. With very few exceptions, sewer service is allowed only in urban areas. Exceptions are generally

provided only for schools or for specific health, safety, or environmental concerns. Service is provided by cities, counties, special purpose districts, and tribal nations. Each utility provider is required to prepare a comprehensive sewer plan, which documents current operations as well as predicted future demand. These plans are updated every six years and are required to forecast demand 20 years into the future; however, most plans analyze the needs of their system at ultimate capacity. All plans must be submitted to and approved by the Washington State Department of Ecology.

The purpose of a sanitary sewer system is to move wastewater from its source to a treatment facility. Gravity sewer systems are currently the preferred method of conveying wastewater. When topographic obstacles do not permit gravity sewer systems to function properly, a sewage pump station is needed. Treatment and discharge of wastewater is the final stage in the sewer system. Both secondary and tertiary treatment facilities are used with the region.

Portions of the designated urban growth area still rely on on-site septic systems. Soil properties, the age and type of the system, the size of the property and structure being served, and the cost of conversion from septic to sewer are factors influencing the decision to continue using a septic system. However, septic systems do not allow for urban levels of density or significant urban growth.

Sewer service areas are defined by the individual jurisdictions and provide the basis for the long-range facility plans (often 30-year plans). In the event of annexation, a city can coordinate with the existing local sewer provider. However, local sewer lines provided by a special district usually extend beyond the boundaries of potential annexation and therefore, historically, the provision of sewer service has not changed dramatically.

Sewer capacity, dimensions of sewer mains, and the schedule for capital improvements are based upon zoning data provided by the local planning jurisdiction, future growth forecasts, and historic sewer use patterns for existing service areas. Major issues taken into account when planning for sewer service include:

- Adjacent sewer service providers.
- Cost-effectiveness.
- Zoning.
- Existing soil conditions.
- Topographical limitations.
- Septic conversions.

Topography is often the most important factor in sewer design plans. If the urban growth area does not follow the natural drainage basin, it may be necessary for a facility to pass partially through a rural area, and more expensive conveyance systems will be needed. Facilities traversing rural areas are not allowed to provide direct service to rural property owners unless permits from local regulators have been granted.

Cost is also a major issue affecting the expansion of sewer services. A property owner within the urban growth area, but without sewer service, will likely be responsible for most or all costs associated with extending sewer service to his or her property. In addition, cities annexing new areas are also responsible for bringing an urban level of service to the area. As a result, increased costs may be shared by all system users to fund expansions. Conversion from septic to sewer service typically costs between \$15,000 and \$20,000 per connection.

The subsequent text describes the systems currently in place.

Sewer Districts and Major Facilities

King County. The King County service area for sewers is 420 square miles, including 250 acres on Vashon Island. The system serves about 1.4 million people, including most urban areas of King County and portions of Snohomish and Pierce counties. King County has three major treatment facilities, which are described below:

- *South Treatment Plant.* Located in Renton, the 94-acre South Treatment Plant includes facilities for biosolids handling, water reuse, and water treatment. The plant is a secondary treatment facility and, on average, treats 115 million gallons per day, but can treat up to 325 million gallons per day during peak storms.
- *West Point Treatment Plant.* Located near Discovery Park in Seattle, the 32-acre West Point Treatment Plant treats about 133 million gallons per day, but can treat up to 440 million gallons per day during peak storms. After multiple treatment stages, wastewater is discharged into Puget Sound through an outfall pipe and diffuser.



- *Vashon Treatment Plant.* The Vashon Treatment Plant serves the Vashon Sewer District and contracted with King County in 1999. The plant has recently undergone a number of operating changes and is now operating at capacity and without a backup system. The plant is currently slated for additional upgrades to its system.

Kitsap County. Kitsap County Public Works owns and operates four wastewater treatment plants, which serve central Kitsap, Manchester, Suquamish, and Kingston. The cities of Bainbridge Island, Bremerton, Poulsbo, and Port Orchard provide their own wastewater treatment. The four major wastewater treatment facilities are described below:

- *Kingston Wastewater Treatment Plant.* This 29-acre facility is located on the north end of the Kitsap Peninsula and treats an average of 292,000 gallons of wastewater per day. The treated wastewater is discharged into Puget Sound approximately 1 mile from the shoreline.
- *Suquamish Treatment Plant.* The Suquamish Treatment Plant is located near Port Madison Bay and treats an average of 0.40 million gallons per day. Residential and light commercial activities from the Suquamish area and the Clearwater Hotel and Casino are the primary sources of wastewater treated at this facility.
- *Central Kitsap Wastewater Treatment Plant.* This facility was completed in 1979 and provides wastewater treatment for the Silverdale area, Keyport area, Naval Submarine Base Bangor, and the Naval Undersea Warfare Engineering Station at Keyport. The facility treats an average of 6 million gallons per day and the treated wastewater is discharged into Port Orchard Bay in Puget Sound.
- *Manchester Wastewater Treatment Plant.* This facility is located near the south end of the Kitsap Peninsula and, on average, treats about 0.50 million gallons per day. The majority of wastewater arrives at this treatment facility from the town of Manchester, Manchester State Park, and includes wastewater from the Environmental Protection Agency (EPA) laboratory in Manchester.

Pierce County. The Pierce County Department of Utilities service area includes University Place, Lakewood, Parkland, Spanaway, Frederickson, South Hill, Puyallup, Brown's Point, Midland, and the lower Hylebos area of northern Pierce County. Steilacoom, Federal Way, Tacoma, and Bonney Lake are served by a series of different interlocal service agreements.

- *Chambers Creek Waste Water Treatment Plant.* The Chambers Creek Waster Water Treatment Plant is the only major wastewater treatment facility in Pierce County. It is located on 44 acres in University Place and is designed to treat an average of 2.1 million gallons per day during normal conditions and 28.7 million gallons per day during peak storms. Residual solids from this treatment plant process are converted into biosolids, which are used as an agricultural fertilizer and for soil amendments.

Snohomish County. Wastewater treatment is primarily the responsibility of the cities and towns within Snohomish County. Sewer service is provided by the following districts and municipalities: Alderwood Water and Wastewater District, City of Arlington, City of Bothell, City of Brier, Cross Valley Water District, City of Edmonds, City of Everett, City of Granite Falls, Jordan Village Sewer District, King County, Lake Stevens Sewer District, City of Lynnwood, City of Marysville, City of Monroe, City of Mountlake Terrace, City of Mukilteo, Olympic View Water and Sewer District, Olympus Terrace Sewer District, Silver Lake Water District, City of Snohomish, City of Stanwood, City of Sultan, and the Tulalip Tribes. Major treatment facilities are described below:

- *Everett Wastewater Treatment Plant.* The Everett Wastewater Treatment Plant is located on Smith Island in north Everett and is currently undergoing a four-phase expansion, which is slated for completion by the year 2040. Currently, the plant treats an average of 5 million gallons per day but after the expansion is complete, it will treat an average of 21 million gallons per day. The facility serves about 130,000 customers.
- *City of Snohomish Wastewater Treatment Plant.* This facility treats an average of 1 million gallons per day under normal conditions and 10 million gallons per day during peak storms.
- *City of Sultan Wastewater Treatment Plant.* This facility treats an average of 0.72 million gallons per day and treated water is discharged into the Skykomish River.

Regional Treatment Facilities. Wastewater systems are becoming increasingly regionalized due to more stringent environmental controls, population growth, and the need to separate combined sewer and stormwater facilities.

- *Brightwater Treatment Plant.* The plant is a large project that will expand regional capacity in King, Pierce, and Snohomish counties. The plant will be constructed in south Snohomish County with a marine outfall to discharge

treated wastewater off Point Wells into the Puget Sound. The facility will consist of two secondary treatment plants and will service north King County and south Snohomish County. The plant is expected to serve these areas until at least 2050.

Construction is slated to begin in 2006 and the plant is expected to be operational by 2010. The plant is expected to treat an average of 36 million gallons per day under normal conditions and 130 million gallons per day during peak storms in 2010. By 2040, it will increase to 54 million gallons per day under normal conditions and 170 million gallons per day during peak storms.

Regulatory Status

Water quality is regulated by the Department of Ecology, under authority delegated by the Environmental Protection Agency, pursuant to the Clean Water Act. In the past 10 years, 30 communities statewide have been required to ban sewer connections for a period of time due to improper treatment or contamination. Communities with on-site septic systems are currently experiencing the problems associated with higher levels of density and failures of these septic systems have contributed to contamination of local water bodies as well as the groundwater. The sewer industry has reacted to higher standards of water quality and in most cases, communities served by sewers have been able to comply with these new standards. However, major investments and upgrades have been needed and utility rates have increased for users.

Existing sewer plans will provide adequate service, but should be extended to plan for growth beyond current estimates. Updates to city and county comprehensive plans will need to take into account where growth is likely to occur and plan accordingly. Smaller communities, many of which rely on septic systems, will not have adequate means of treating wastewater in the future if the existing infrastructure is not expanded. Septic systems fail through homeowner misuse, poor design, or when the treatment system is exhausted.

5.7.1.3 WATER SUPPLY

Primary Water Sources and Water Supply

Section 246-290, Washington Administrative Code, defines a public water system as “[a]ny system of water supply intended or used for human consumption or other domestic uses, including source (surface water and/or groundwater), treatment, storage, transmission, and distribution facilities where water is being furnished to any community, collection, or number of individuals, but excluding a water system serving one single family residence.” Public water systems are further classified as either Group A or Group B systems. Group A systems typically serve 15 or more connections and Group B systems serve two to 14 connections. Citizens living within rural areas who wish to obtain water from a private source must have at least five acres of property located outside the urban growth area. A private water system is only allowed within the urban growth area if a public water system cannot deliver water in a timely and cost effective manner. Permits for private wells, in both cases, are issued by the county Department of Public Health.

Based on United States Geological Survey data for the year 2000 in King and Snohomish counties, most of the water supply was provided by surface water, with production constituting 76 percent and 90 percent of the total in each county, respectively. In contrast, most of the supply in Kitsap County in 2000 was provided by groundwater (75 percent), while in Pierce County, supply was provided fairly equally by both, with surface water providing slightly more at 55 percent. These data are summarized in Figure 5-7-1.

FIGURE 5-7-1: PUBLIC WATER SUPPLY IN 2000 FOR KITSAP, KING, PIERCE, AND SNOHOMISH COUNTIES BY SOURCE OF SUPPLY

County	Year	Total Population Served**	% Groundwater Production	% Surface Production
Kitsap	2000	190,560	75	25
King	2000	1,593,060	24	76
Pierce	2000	674,850	45	55
Snohomish	2000	503,370	10	90
Total	2000	2,961,840	38	62

* Data on population served in 2000 was compiled by the United States Geological Survey, and may not be the same as the population data for 2000 provided by the Puget Sound Regional Council.

Source: United States Geological Survey, Washington Water Science Center Data Collection Network.



Using United States Geological Survey data on water usage by county, it is noted that between 1995 and 2000, the population served in each of the counties increased (King – 6 percent, Kitsap – 15 percent, Pierce – 16 percent, and Snohomish – 17 percent).¹ Over the same time, the ratio of surface water production to groundwater production in King County changed slightly with surface water production increasing by 5 percent (from 71 to 76 percent of the total) and groundwater supply decreasing by 5 percent (from 29 to 24 percent of the total).

In Kitsap County, groundwater was the predominant source of supply in 1995 as well as in 2000 (77 and 75 percent, respectively). It is noted that in the 2005 updated Kitsap County Coordinated Water System Plan (CWSP), groundwater is believed to provide around 80 percent of the potable water for the county. The City of Bremerton's Union River is the only significant source of surface water. In Pierce County, by contrast, groundwater provided 66 percent of the supply in 1995 but only 45 percent of the supply in 2000. Snohomish County demonstrated a trend similar to King County, with the proportion of surface water production increasing from 84 to 90 percent and the proportion of groundwater production decreasing from 16 to 10 percent of the total.

In a 2001 "Outlook" report on water supply in the central Puget Sound region (Central Puget Sound Water Suppliers' Forum, 2001), a survey conducted by the Forum on 158 of the largest utilities in King, Pierce, and Snohomish counties showed that much of region's population is served by a few major sources (large rivers and reservoirs in the Cascades and a few large groundwater sources). The three largest purveyors of these in King, Pierce, and Snohomish counties include Everett, Seattle, and Tacoma as shown in Figure 5-7-2, on the subsequent page.

- **Everett:** The Spada Reservoir on the Sultan River constitutes the only source of water to Everett. Water supply and storage of the reservoir are jointly owned and operated by Everett and Snohomish County Public Utilities District.
- **Seattle:** Seattle has two surface water sources — the Cedar River System and the South Fork Tolt Reservoir, and a small groundwater source — the Highline Well Field. On average, the Cedar River system provides 70 percent of Seattle's supply, the South Fork Tolt 29 percent, and the Highline Well Field 1 percent (primarily used during peak summer periods). The Cedar River Habitat Conservation Plan (HCP), which was adopted in 2000, governs operation of the Cedar River System. According to the 2001 Outlook report (Central Puget Sound Water Suppliers' Forum, 2001), Seattle intends to develop a legal mechanism to reserve 100 million gallons per day of its annual water right claim to benefit fish.
- **Tacoma:** Tacoma has two main sources, one surface — the Green River — and one groundwater — the South Tacoma wells. With the Second Supply Pipeline now on-line, previous limitations on Tacoma's peak supply should be alleviated.

The reservoirs are used to store winter snowmelt runoff not only to prevent flooding, but to also provide dry season water supply, hydropower, and water for fish habitat. Figure 5-7-2 also shows the major, and some minor, water transmission lines from the sources to their respective service areas. In addition to the transmission lines shown, some utilities have interties with adjacent purveyors.

As a subset of the Forum, the Cascade Water Alliance (Cascade) was formed by a group eight water systems in King County to "jointly plan, develop, and operate a water supply system for its Members" (CWA, 2005). The eight members include the City of Bellevue, Covington Water District, the City of Issaquah, the City of Kirkland, the City of Redmond, Sammamish Plateau Water and Sewer District, the City of Tukwila, and the Skyway Water and Sewer District and are identified in Figure 5-7-2. Most of the Cascade water service area is contained within the contiguous urban growth area of King County covering approximately 376 square miles. Exceptions include the Sammamish Plateau's Cascade View Zone and portions of the Covington water service area, which are both designated as rural areas.

Members of Cascade Water Alliance have entered into an interlocal agreement to supply water to their respective service areas and the region by developing, owning, and operating regional water supply assets. Cascade is a non-profit organization and provides certain governmental functions on behalf of its members. A board of directors governs the organization with one representative from each of the members. Cascade currently has three standing committees — Finance, Membership, and Resource Planning, as well as a Conservation Work Group. If needed, Cascade also enters into contract arrangements with other entities, such as Seattle Public Utilities or Tacoma Public Utilities. Cascade has been providing water to its members since January 1, 2004. Figure 5-7-3 shows the different sources of supply for each of the Cascade members as of 2003.

¹ From Figure 5-7-1. Source: United States Geological Survey, Washington Water Science Center Data Collection Network. Web site at: <http://wa.water.usgs.gov/data/wuse/main.cnty>.

FIGURE 5-7-2: LARGER REGIONAL WATER SUPPLY SOURCES IN KING, PIERCE, AND SNOHOMISH COUNTIES



Source: Central Puget Sound Regional Water Supply Outlook, 2001. Updated Based on Cascade Water Alliance, 2005.



FIGURE 5-7-3: CASCADE MEMBER SOURCES OF SUPPLY IN 2003

Cascade Member	Seattle Public Utilities Supply (%)	Groundwater Supply (%)	Other Sources of Supply (%)	Reclaimed Water Supply (%)
City of Bellevue	100	0	0	0
Covington Water District	0	70	30	0
City of Issaquah	0	93	7	0
City of Kirkland	100	0	0	0
City of Redmond	66	34	0	0
Sammamish Plateau Water and Sewer District	0	100	0	0
Skyway Water and Sewer District	73	8	19	0
City of Tukwila	>99	0	0	<1

Source: Cascade Water Alliance, 2004 Transmission and Supply Plan

In addition to those listed above, there are about 10 smaller Group A and 100 smaller Group B water systems (wells and springs) located within the Cascade service area. However, Cascade is not obliged to supply water to any member whose planning is out of compliance with the Growth Management Act. It is also not obliged to provide water to service area expansions unless the board agrees to such expansions.

In Kitsap County, a survey conducted by the Water Utility Coordinating Committee for the 1992 Coordinated Water System Plan gathered information from each utility on its existing and future service area boundaries — the combination of the two is referred to as the utility’s service area. These are shown in Figure 5-7-2. The service areas are based on county land use policies and applicable ordinances, topography, readiness and ability to serve, local franchise areas, legal water systems, sewer service areas, and future population projections made at the time. Areas outside the retail service areas claimed by existing utilities are designated as Satellite Management Areas. Kitsap County Coordinated Water System Plan of 2005 says some water purveyors may provide wholesale water to other water systems in the future. Some may overlap to provide flexibility. Wholesale water sales will be conducted based on individual agreements among the parties.

5.7.1.4 FIRE PROTECTION AND POLICE SERVICES

Emergency services include fire, safety, and police services, which are provided by cities, counties and special purpose districts throughout the four-county region, and by the state highway patrol. Individual jurisdictions may have their own police and fire departments or may contract with other jurisdictions, such as adjacent cities or their county, to provide the services. Other public services, such as courts, justice, corrections, and other social services are also provided throughout the region.

Fire protection is provided either by departments within municipal government or by special districts set up independently of local governments. District or city taxes provide the basic support for fire protection services. Voter-approved levies and private donations also provide support. Many fire districts rely on volunteer firefighters to supplement the work of professional firefighters. Presently, there is no limit to the number of volunteer firefighters allowed per district, and there are no thresholds at which a volunteer force is required to convert to a professional force.

The following figure displays the number of fire departments within each county:

FIGURE 5-7-4: FIRE DEPARTMENTS IN THE REGION

	Number of Fire Departments
King County	35
Kitsap County	7
Pierce County	31
Snohomish County	20

Source: All information gathered from www.firedepartments.net.

Police Services. Jurisdictions in the region rely on both county sheriffs and municipal police departments for police services. County sheriff departments serve unincorporated areas, while local municipal police departments typically serve incorporated cities and towns. Sometimes cities contract with the county to provide this service locally. Many local fire and police agencies now have mutual response agreements, which allow public safety responsibilities to be shared across jurisdictional boundaries. This is especially helpful in emergency situations when sheriff departments are unable to respond in a timely manner, particularly in unincorporated “islands” where city departments may be closer.

5.7.1.5 HEALTH AND EMERGENCY MEDICAL SERVICES (INCLUDING HOSPITALS)

Major hospitals within the region are listed in Figure 5-7-5 and shown in Figure 5-7-6 (schools are also shown in this figure, but discussed in the next section). As stated in the Revised Code of Washington Chapter 70.168, the Washington State Department of Health contracts with eight Emergency Medical Services and trauma care councils. Districts are determined based on efficiency of delivered emergency medical services and trauma care, and each county within the region falls under a different district. King County is in the Central District, Kitsap County is in the Northwest District, Pierce County is in the West District, and Snohomish County is in the North District.²

FIGURE 5-7-5: HOSPITALS BY COUNTY

King County	Auburn General Hospital	Snoqualmie Valley Hospital
	Children’s Hospital and Medical Center	St. Francis Community Hospital
	Community Memorial Hospital	Swedish Medical Center – Ballard
	Evergreen Hospital	Swedish Medical Center – Providence
	Group Health Central	Swedish Medical Center – Seattle
	Group Health Eastside	THC Seattle Hospital
	Harborview Medical Center	University of Washington Medical Center
	Highline Community Hospital	Valley Medical Center
	Northwest Hospital	Veteran’s Affairs Medical Center
	Overlake Hospital and Medical Center	Virginia Mason Medical Center
Kitsap County	Harrison Memorial Hospital	Naval Hospital – Bremerton
	Harrison Memorial Hospital – Silverdale	
Pierce County	Allenmore Hospital	St. Clare Hospital
	Good Samaritan Hospital	St. Joseph’s Medical Center
	Madigan Army Medical Center	Tacoma General Hospital
	Mary Bridge Children’s Hospital	Veteran’s Affairs Medical Center
Snohomish County	Everett General Medical Center	Snohomish County Public Hospital
	Group Health Medical Center	Snohomish Family Medical Center
	Providence Hospital	Stevens Memorial Hospital
	Quilceda Medical Center	Valley General Hospital

Source: Parametrix, Inc.

Each county in the region also provides a variety of non-hospital social services and health care facilities.

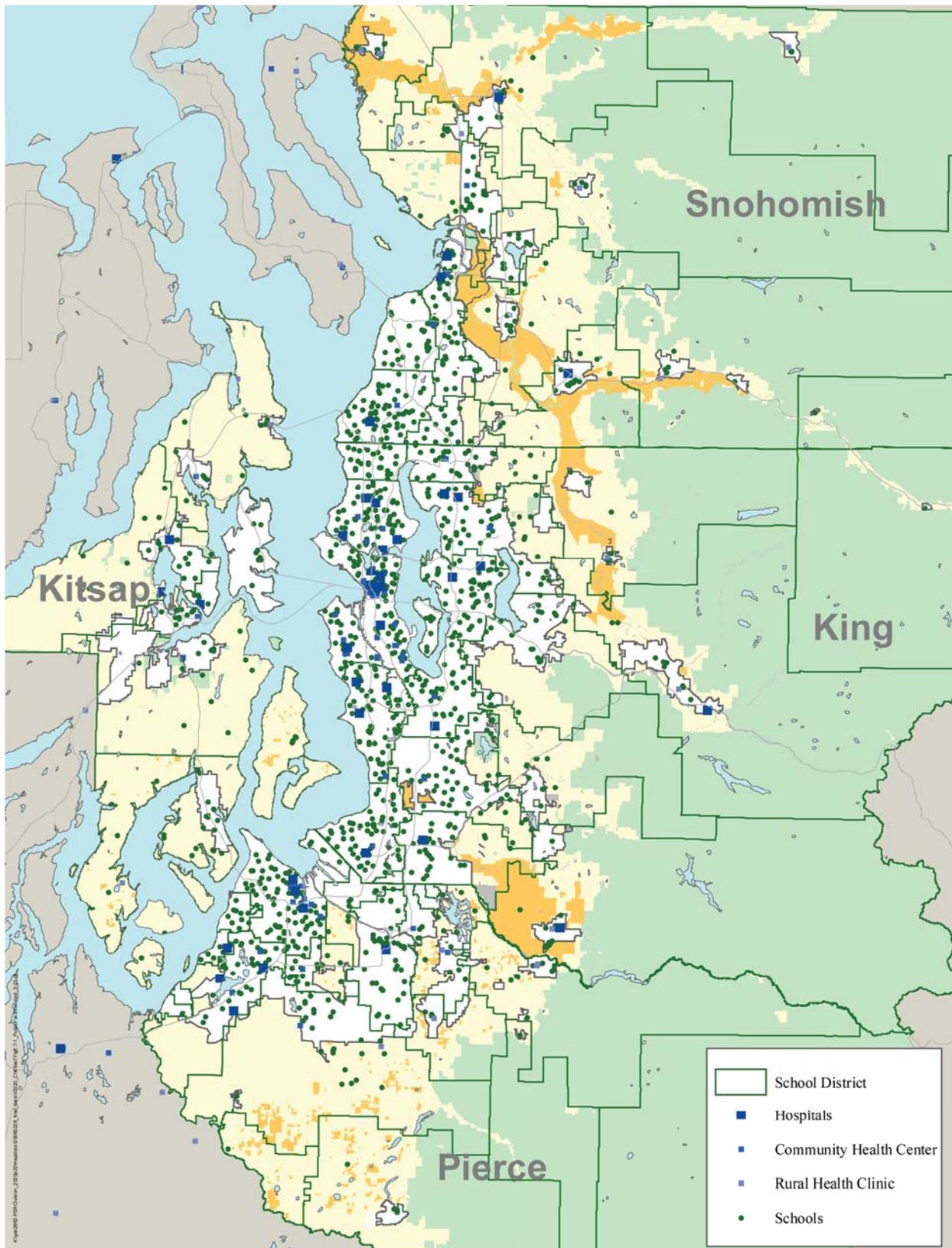
- **King County.** King County Department of Community and Human Services provides community services, mental health care and chemical abuse and dependency services, services related to developmental disabilities, and also houses the Office of the Public Defender.
- **Kitsap County.** Kitsap County Health Department’s office of Community Health provides clinical services, a parent and child health program, HIV/AIDS programs, health promotion, and jail and juvenile detention programs.
- **Pierce County.** The Pierce County Department of Community Services and the Department of Human Services provide aging care services, developmental disabilities services, chemical dependency treatment and prevention services, mental health services, housing services, and a variety of other services.
- **Snohomish County.** Snohomish County Department of Human Services provides mental health services, long-term care and aging services, homeless services, alcohol and chemical dependency services, and other important services.

² Major hospitals are developed in accordance with Washington Administrative Code, Chapter 246-310-210. The need for new or substantially expanded health care facilities is determined using the following criteria:

- All residents of the service area, including low-income persons, racial and ethnic minorities, handicapped persons, and other underserved groups and the elderly are likely to have adequate access to the proposed health service or services.
- The applicant has substantiated any special needs and circumstances.
- The project will not have an adverse effect on health professional schools.
- The project is needed to meet the special needs and circumstances of new and enrolled members of health maintenance organizations in a reasonable and cost-effective manner consistent with the basic methods of operation of the health maintenance organization.
- Nursing facilities must be approved according to Revised Code of Washington Chapter 70.41.



FIGURE 5-7-6: HEALTH CARE FACILITIES, SCHOOLS, AND SCHOOL DISTRICTS IN THE REGION



Source: Washington State Department of Health; King, Kitsap, Pierce, and Snohomish counties

5.7.1.6 SCHOOLS

The capital facilities plan required of each county, city, and town under the Growth Management Act requires an inventory of existing facilities owned by public entities, projected needs, including location of new facilities and the expansion of existing facilities, and a six-year financing plan to fund all construction. Educational facilities, including schools, are frequently included in the capital facilities plans. When analyzing potential sites for new facilities or expansions of existing facilities, the following criteria are considered by school districts:

- Inventory of similar and existing public facilities.
- Forecast of the future needs for the facility.
- Potential social and economic impacts and benefits to jurisdictions receiving or surrounding the facility.
- Facility consistency with existing legislation.
- Alternatives to the facility.
- Analysis of economic and environmental impacts, including mitigation.
- Public involvement.
- Consideration of any applicable prior review conducted by a public agency, local government, or citizens' group.

Schools and school districts within the region were displayed previously in Figure 5-7-6. As stated in the Washington Administrative Code (180-22-140), school districts are to be organized to accommodate the changing regional economic and educational goals of the state and to provide more equal and equitable educational opportunities. Topography and climate also play a part in the establishment of school district boundaries.

The superintendent of public instruction coordinates with the school district to conduct a review and evaluation of potential sites for new or existing school facilities. As found in the Washington Administrative Code (180-26-020), the following criteria are used when selecting a site:

- The property is generally clear of all encumbrances that would impede construction, operation, and useful life of the facility.
- The site is of a size to meet the needs of the facility. The minimum acreage of the site should be five usable acres and one additional usable acre for each 100 students plus an additional five usable acres if the school contains any grade above grade six. Health and safety of students, impacts to the surrounding neighborhood, and physical education requirements are all taken into account during the review process.
- A thorough code review with local agencies.
- A subsurface investigation by a geotechnical engineer has been conducted.

5.7.2 Analysis of Alternatives (Long-Term Impacts)

This section discusses the possible impacts to public services and utilities for the regional growth alternatives under consideration. Public services and utilities reviewed include: (1) solid waste collection and disposal, (2) sanitary sewer systems, (3) water supply, (4) fire protection and police services, (5) health and emergency medical services (including hospitals), and (6) schools. Stormwater is discussed in *Chapter 5.6 – Water Quality and Hydrology*. Parks and recreation facilities are discussed in *Chapter 5.8 – Parks and Recreation*. Energy and electrical utilities are discussed in *Chapter 5.10 – Energy*.

5.7.2.1 IMPACTS TO SOLID WASTE

Impacts Common to All Alternatives

Due to increased population, solid waste generation will increase over time, and related impacts are expected to be generally similar under all alternatives. Under all alternatives, the possibility and potential need for expansion of existing facilities is present. However, existing facilities can be difficult to expand, due to typical public concerns about noise, trucking, odors, and safety. Alternatively, transfer station use could be limited to haulers only, rather than open to the public, and collection services could be expanded from typical curbside collections, although costs for services have



the potential to increase. Finally, if current trends continue, the composition of waste that is generated could change slightly based on the distribution of population.

Higher density areas tend to generate less yard waste and have higher rates of recycling, while more suburban and rural areas generate more yard waste and debris, and have lower rates of recycling. Impacts to regional landfills may be minimal since most trash today is exported from all counties within the region and few other impacts to solid waste services beyond this would be expected. Increased quantities of recycled solid waste have the potential to decrease the percentage of overall solid waste deposited in landfills for all alternatives.

Analysis of Each Alternative

- **Growth Targets Extended Alternative.** Increased demand for new or expanded transfer stations is expected as a result of this alternative. Under Growth Targets Extended, rural, unincorporated portions of the urban growth area, and small cities would experience increased growth and could likely require new facilities to meet the demand from population and employment growth. Demand for solid waste infrastructure is expected to increase in all four counties, but Kitsap and Snohomish counties could experience the highest increase in demand under Growth Targets Extended.

Kitsap County could experience the greatest amount of impact to residential solid waste management under the Growth Targets Extended or the Smaller Cities Alternatives since currently 40 percent of residents haul their own trash to drop box facilities. With a substantial increase in population, the need for expanded systems of curbside collection could increase, as could the need for more drop box facilities.

- **Metropolitan Cities Alternative.** Since growth is concentrated in metropolitan cities under this alternative, the need to expand or construct new transfer facilities in urban areas is expected in cities such as Everett, Seattle, and Tacoma. Conversely, smaller cities will likely not experience a sharp rise in demand for solid waste services and infrastructure under this alternative.
- **Larger Cities Alternative.** The impacts to solid waste associated with the Larger Cities Alternative are similar to the impacts expected under the Metropolitan Cities Alternative. Growth is slightly more dispersed under the Larger Cities Alternative than in the Metropolitan Cities Alternative but the impacts are expected to be similar. The counties oversee solid waste management, and solid waste management plans are periodically updated to account for changes in demand for waste management services.
- **Smaller Cities Alternative.** The impacts to solid waste under the Smaller Cities Alternative are expected to be similar to the impacts expected under Growth Targets Extended. Smaller cities, rural, and unincorporated areas would experience the largest increase in population and employment and could therefore also experience an increase in demand for solid waste management. New or expanded transfer facilities in these areas could likely be necessary. Solid waste collection and management methods could also need to be updated to reflect the increased demand. Metropolitan cities could likely not experience a great increase in demand for solid waste management. Improvements to existing facilities would likely be needed, but this is the case under all alternatives.

Kitsap County could experience the greatest amount of impact to residential (and perhaps commercial) solid waste management under the Growth Targets Extended or the Smaller Cities Alternatives since currently 40 percent of residents haul their own trash to drop box facilities. With a substantial increase in population and employment, the need for expanded systems of curbside collection could increase, as could the need for more drop box facilities.

5.7.2.2 IMPACTS TO SANITARY SEWER

Impacts Common to All Alternatives

Typical impacts to wastewater treatment systems could include the need to expand or replace conveyance (pipeline), facilities, and treatment, which may lack the capacity to handle increased demands caused by growth. Some aging systems may also need repair or replacement. Pockets of unincorporated areas within the urban growth area lack sewer systems and rely on septic systems. For additional growth to occur in these areas, at typical urban densities, expanded collection, conveyance, and treatment facilities could be needed.

Currently, the region has its largest interconnected systems in King and Pierce counties, and in the cities of Tacoma, Bremerton and Everett. Smaller to mid-size cities in Pierce, south King, Snohomish and Kitsap counties have their own conveyance and treatment systems. Pockets of unincorporated areas, many with septic but also featuring residential and

commercial development, are near these cities. Increased growth within the cities on the edge of the urban area could place greater impacts on their systems, which may not have been designed or sited to accommodate high rates of expansion or larger service areas. Expanding such facilities may require a change in technology and more stringent discharge standards, possibly resulting in higher costs.

Smaller cities, which in some cases lack treatment facilities and where growth in some cases is already constrained, might need to develop conveyance and treatment systems to meet current standards and the increased growth forecasts under any of the alternatives. Alternatively, they could contract with regional or adjacent city systems to meet demand. In general, larger facilities have the advantage of efficiency over smaller systems, but engineering solutions might be available to meet the increased needs of growth; the primary differentiator would be user cost and affordability.

Current levels of sanitary sewer service capacity will not meet long-term demand and will require substantial expansion under all alternatives. If smaller jurisdictions choose to connect to larger urban systems in order to accommodate growth, overall costs per capita for increasing sanitary sewer capacity could be higher in small cities and unincorporated urban growth areas if longer pipelines were needed to connect more dispersed land development patterns to core urban systems. This could possibly result in higher per capita sanitary sewer costs for the Growth Targets Extended or the Smaller Cities Alternatives compared to the Metropolitan Cities and Larger Cities Alternatives.

Other regional solutions and systems such as new or expanded treatment plants could also serve increased growth that is more distant from existing facilities, but could be a challenge to implement.

Analysis of Each Alternative

- ***Growth Targets Extended Alternative.*** Growth Targets Extended, which includes relatively high amounts of growth in unincorporated urban growth areas, could possibly require expansion of sewer lines and treatment capacity into currently unserved areas, which could be costly. In terms of growth in incorporated urban areas, levels of growth in Growth Targets Extended are consistent with the typical costs of growth that many of the major systems have assumed: King County, City of Tacoma and others are implementing long-range system plans that could accommodate similar growth rates within their service areas. By law, sewer service cannot be extended into rural areas except in limited circumstances; therefore, the substantial amount of population growth in rural areas under this alternative would have to be served by septic systems.
- ***Metropolitan Cities Alternative.*** This alternative could require improvements to current sewer systems to increase their capacity and useful life in order to accommodate the growth expected within metropolitan and core suburban cities under this alternative. It is possible that the lower levels of smaller suburban city growth depicted in the Metropolitan Cities Alternative might not increase demand for new or expanded wastewater treatment facilities, especially cities bordering counties outside the region, in the same way that the Growth Targets Extended and the Smaller Cities Alternatives could. As such, smaller suburban cities could take a much less aggressive approach when deciding whether or not to expand sewer lines or continue the use septic systems. Since sewer systems are already in place in metropolitan and larger cities, expansion of existing sewer lines could be necessary to meet increased demand and maintenance of existing systems. The high levels of metropolitan and core suburban city growth in this alternative could place substantial strain on existing sewer capacity in metropolitan and core suburban cities, well beyond that currently anticipated in current long range system plans. New sites and facilities to serve these geographies may be needed under this alternative.
- ***Larger Cities Alternative.*** The Larger Cities Alternative, which increases growth in core and larger suburban cities at a higher level than identified in their current plans, could create more pressure than under the other alternatives to expand current suburban sewer systems. In some cases, expansion of current systems may not fully accommodate the amount of growth expected in suburban cities and the smaller cities that are nearby. New sites and facilities to serve these geographies could be needed under this alternative. Under the Larger Cities Alternative, unincorporated urban growth area population and employment growth and associated impacts could likely be less than described for these cities and areas under the Growth Targets Extended alternative.
- ***Smaller Cities Alternative.*** The Smaller Cities Alternative, which places the most development in smaller cities and unincorporated urban growth areas, could have significant impacts on existing small-scale sanitary sewer systems in these geographies. Rural and unincorporated areas rely heavily on septic systems and many have underdeveloped conveyance and treatment facilities. The Smaller Cities Alternative might require the extension of sewer lines out from more densely populated areas, which could be expensive.



Currently, sewer extensions are not allowed outside the urban growth area, except in limited circumstances. If an adjustment of the urban growth area were to occur, the new area would be eligible for sewer service extension. A substantial amount of growth in close proximity to urban growth area boundaries, as well as in the rural area, might put added pressure to adjust urban growth area boundaries, and extend sewer services into newly designated urban areas. Such a situation could be more likely under the Growth Targets Extended and the Smaller Cities alternatives, which have a substantial amount of growth in unincorporated urban growth areas and rural areas, than in the Metropolitan Cities and Larger Cities alternatives, where growth is more concentrated in core urban areas.

5.7.2.3 IMPACTS TO WATER SUPPLY

Regional Future Municipal Water Demand³

Current water supply plans address meeting future water demand in many of urban growth areas throughout the region through additional transmission lines, larger pipes, interlocal agreements, and conservation programs already underway. However, it is estimated that under Growth Targets Extended, there could still be shortfalls in a number of cities and towns if new supplies cannot be found and/or demand cannot be reduced by implementation of conservation and/or water re-use. Furthermore, shortfalls could be more severe in smaller cities and towns outside the contiguous urban growth areas since additional transmission lines are less feasible to these locations because of the need to traverse long distances through rural areas, and they are removed from larger treatment plants for which re-use might be an option.

Conservation

In addition to conventional supply options, conservation is an important option for reducing the demand for potable water. Past conservation programs and the 1993 plumbing code have succeeded in deferring a need for major new regional supplies so far (Central Puget Sound Water Suppliers' Forum, 2001). In May 2004, the Cascade Transition Water Conservation Program was adopted so that members could begin working together to develop regional conservation strategies. These would supplement conservation programs that are already in place or are planned.

The use of reclaimed water in the region is not yet highly developed. As with conservation, the use of reclaimed water would offset the demand for potable water. Potential uses include landscape irrigation and industrial cooling. To be used on a large scale, there is a need to overcome public health or environmental issues, as well the current lack of a distribution system from place of treatment to place of use.⁴ For all utilities, reuse options may become more feasible if suppliers and users are committed to promoting the environmental and sustainability aspects of reuse, as well as overcoming concerns associated with reusing water.

Future Water Demand in King, Pierce, and Snohomish Counties

Based on data from the individual utilities surveyed in King, Pierce, and Snohomish counties, the Central Puget Sound Water Suppliers' Forum (Forum) forecast future water demand for 2020 and 2050 using two scenarios:

- A baseline demand forecast that included water conservation achieved to date (but not existing or planned conservation programs).
- A forecast in demand using existing and planned conservation programs.

Using the baseline scenario, the regional average daily demand (ADD) is projected to increase by 14 percent between 2000 and 2020, and by 39 percent between 2000 and 2050. In comparison, using the forecast in demand with existing conservation programs, the average daily demand is projected to increase by only 4.4 percent from 2000 to 2020 (no projection was made beyond 2020 under this scenario). (Central Puget Sound Water Suppliers' Forum, 2001)

³ For King, Pierce, and Snohomish counties, information on the predicted demand for water in the future is summarized in a document called *2001 Central Puget Sound Regional Water Supply Outlook* (Central Puget Sound Water Suppliers' Forum, 2001), the *Cascade Water Alliance 2004 Transmission and Supply Plan* (Cascade Water Alliance, 2005), and Seattle Public Utilities' *2001 Water System Plan Update* (SPU, 2001). For Kitsap County, the 2005 revision to the *Kitsap County Coordinated Water System Plan* was used as the primary source of information on planning for future water demand in the county (Kitsap County, 2005). Given the manner in which this information is currently presented, it should be noted that the following discussion of impacts on future water supply for Growth Targets Extended and all other alternatives, is presented by county rather than by regional geographies and then by county.

⁴ To date, the primary source of reclaimed water is the King County Wastewater Treatment Division at its South Treatment Plant in Renton. Tukwila uses a portion of this supply and plans to use more in the future. Because of the difficulties associated with reusing water, in Kitsap County reuse options are included as Tier 6 in a seven-tiered water supply implementation strategy.

The Cascade Water Alliance (Cascade) has also projected future water demand through 2050 based on individual demand forecasts for each of its eight members. Using 10 years of data, and including annual water savings from conservation, the overall average daily demand for Cascade members is projected to increase by 48 percent from 2004 to 2023, and by 81 percent from 2004 to 2050. While the Forum and Cascade used different methods to calculate the average daily demand, the higher increases in demand forecast by Cascade reflect the overall higher rates of population change currently anticipated in King County when compared with Pierce and Snohomish counties. (Cascade Water Alliance, 2005)

For King, Pierce, and Snohomish counties, the Forum and Cascade predict that by about 2020 to 2023, *additional* supplies will be needed to meet the forecast average daily demand. The areas where demand is predicted to exceed supply by 2020 are shown in Figure 5-7-7.

Most of the shortfall occurs in the fringe of the urban growth areas of King County (e.g., Sammamish Plateau, Issaquah, Black Diamond, North Bend, Kent, and Covington) and throughout Pierce County (e.g., Tacoma, Sumner, Southwood, and Buckley). Other utilities may not run out of available supplies by 2020, but must plan for supplies needed after 2020. Existing conservation programs may provide adequate water supplies for other localities. When shortfalls occur, the extent to which demand can be mitigated by other sources of supply such as conservation will depend upon which of the alternatives is considered and the location of the predicted growth areas to future supply options already proposed in individual utility water supply plans.

Cascade plans to satisfy its members' (Bellevue, Covington, Issaquah, Kirkland, Redmond, Sammamish Plateau, Tukwila, and Skyway) demands through 2023 from a combination of its own self-supplied sources as well as regional sources. Proposed new regional water sources are shown in Figure 5-7-8.

Self-supplied sources include local groundwater and water purchased from nearby systems. They may also include reclaimed water purchased from King County Wastewater Treatment Division. Since Covington is a partner in the Tacoma Second Supply Project, it will have access to a portion of that supply in the future.

Beyond 2023, Cascade anticipates being able to use Lake Tapps as an additional long-term regional water supply source. Use of this source will depend on the Washington State Department of Ecology's approval of water rights to use Lake Tapps. While Puget Sound Energy did receive approval from Ecology in 2003 in a Report of Examination, it was appealed and has been remanded back to Ecology. It is anticipated that, as the Lake Tapps supply comes on-line, Cascade will be able to decrease its reliance on Seattle Public Utilities water. As discussed with Seattle Public Utilities, it is possible that demand will decrease because of changes in who will be providing the water. Since publication of its Water System Plan Update, Seattle Public Utilities is currently in the process of updating its future demand forecasts.⁵ The utility anticipates finalizing its forecasts around the middle of 2006.

For those locations outside the contiguous urban growth areas, there are fewer supply options available. For these areas, the feasibility of additional transmission lines and/or increased use of groundwater and conservation measures will have to be evaluated on a case-by-case basis (e.g., depending upon water rights and weighing the needs of water for municipal use versus water for farming or restoration purposes).

Future Water Demand in Kitsap County

In Kitsap County, future water demand is estimated to increase 43 percent by 2020 and 61 percent by 2030 on a per household basis. If it is assumed that conservation will result in a 1 percent reduction per year in water supply requirements for 2001 to 2010, then projected supply forecasts are lower, at 31 percent and 49 percent, respectively, for 2020 and 2030. For planning purposes, Kitsap County selected a third scenario that included conservation as well as additional industrial requirements resulting in projected increases of 42 percent and 61 percent, respectively, for the years 2020 and 2030.

In its Coordinated Water System Plan, Kitsap County concluded that for those water systems projected to serve the current urban growth area (Group A systems — see section 5.7.1.3), water rights appear to be adequate to meet demand beyond 2030. However, it is predicted that there will be some isolated areas where demand will exceed local area water rights prior to 2030 and the extension of transmission lines to connect to other areas with excess water supply could be cost-prohibitive. This could be of particular concern in Kitsap County under alternatives where growth is allocated to the rural areas.

⁵ Judi Gladstone, Water Planning Advisor, Seattle Public Utilities, personal communication, November 2005.



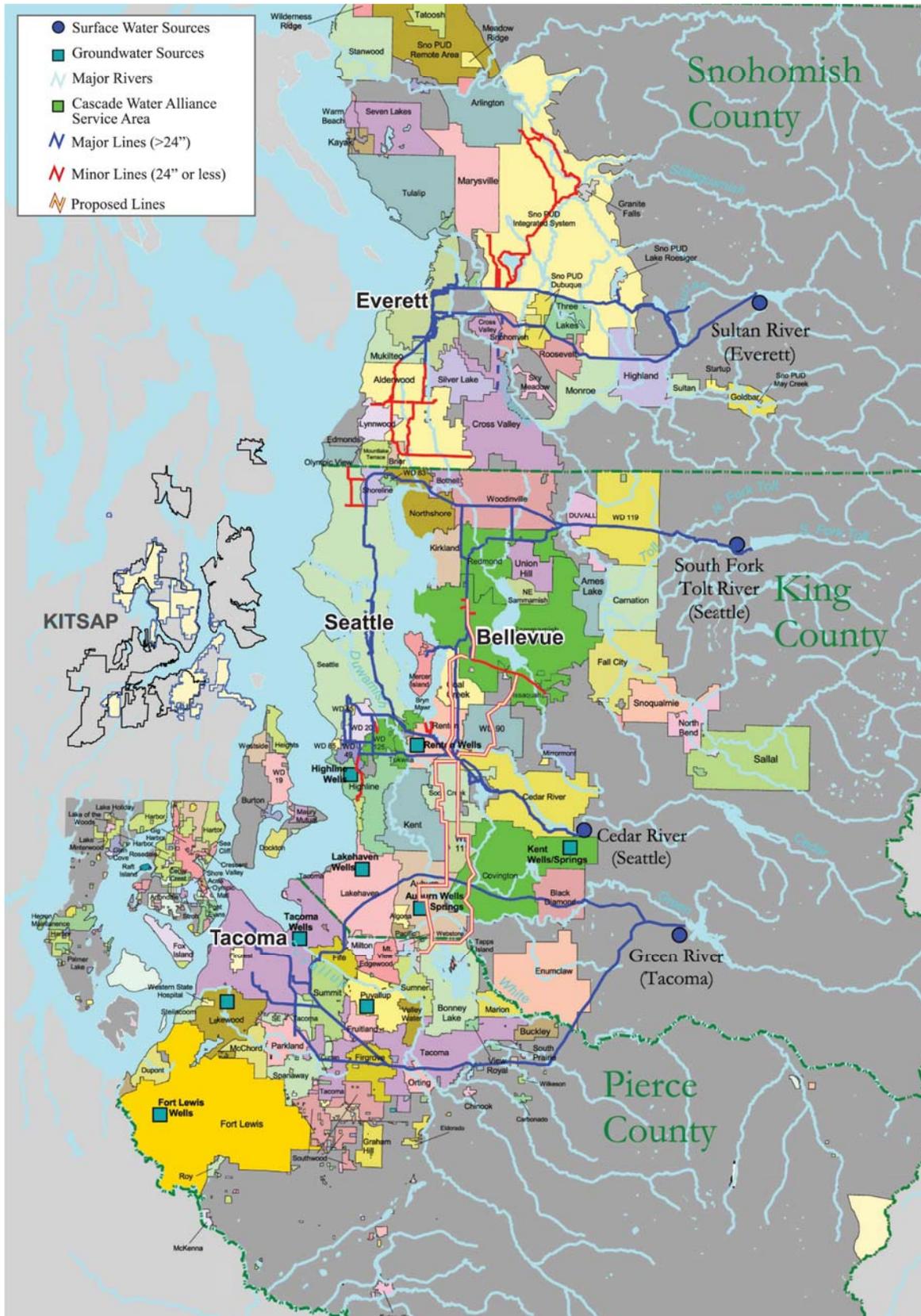
FIGURE 5-7-7: AREAS WHERE DEMAND IS EXPECTED TO EXCEED SUPPLY BY 2020



Source: Central Puget Sound Regional Water Supply Outlook, 2001



FIGURE 5-7-8: EXISTING AND PROPOSED WATER SOURCES IN KING, PIERCE, AND SNOHOMISH COUNTIES



Note: Projections not shown. Regional Water Supply Outlook Project did not include Kitsap County.
 Source: King, Pierce, and Snohomish counties from Central Puget Sound Regional Water Supply Outlook, 2001. Updated based on Cascade Water Alliance, 2005.

Since development of the Coordinated Water System Plan, an additional requirement is that water service areas support the intent of the Growth Management Act. Indeed, a stated philosophy of the Coordinated Water System Plan is that “water utility service should not dictate growth patterns.” To that end, each utility’s plan must address the water system facilities required to accommodate growth.

The Water Utility Coordinating Committee has proposed several procedures to improve coordination of new growth and restrict the proliferation of small public water systems. These include the development of future service area boundaries and the Satellite System Management Agency. Furthermore, Kitsap County has developed a Utility Service Review Procedure to identify purveyors who are willing and capable of providing water service to new development and expansions. If a purveyor is not able to provide “timely and reasonable” service, or if the area is a satellite management area, the closest adjacent utility (with an approved Water System Plan) becomes the preferred provider. If not available, a new utility may be formed according to specifications in the Coordinated Water System Plan once its financial viability can be demonstrated.

For Kitsap County, the preferred future supply option is continued reliance on groundwater at regional or local well fields. Initial Basin Assessments for Kitsap County and Water Resource Inventory Area #15 found that the availability of groundwater varies throughout the county. The Basin Assessments and a 1991 Ground Water Management Plan project that water is available for near-term growth — but recognize a need for more data and more analyses.⁶ Given this, the Kitsap County Coordinated Water System Plan recognizes the need to develop a focused and coordinated plan. To that end, Kitsap County has developed a tiered implementation strategy that relies on conventional supply options as well as alternative options such as conservation and possibly reuse.⁷ The Kitsap County Coordinated Water System Plan discusses the Water Purveyors Association of Kitsap County (WATERPAK), which has established a task force on conservation that will evaluate joint utility-based regional water conservation programs.⁸

Impacts Common to All Alternatives

Regardless of which growth alternative is considered, additional supply and/or reduced demand (e.g., conservation) will be needed to meet projected demand throughout the region by 2020 (if not before for some areas) and through 2040. In addition, the growth alternatives will need varying degrees of distribution and water movement across service areas to meet future demand in some locations.

Seattle Public Utilities is currently in the process of updating the future demand forecasts published in its 2001 Water System Plan Update.⁹ While overall demand projections are expected to be about the same, it is possible that Seattle Public Utilities’ demand will decrease because of changes in who will be providing the water. Seattle Public Utilities anticipates finalizing its forecasts around the middle of 2006.

Closer examination of the population growth allocated for the different alternatives reveals some differences between them that need to be considered from a water supply perspective. In general, growth occurring in existing large-population service areas has more options to meet future supply needs (due to the ability to transmit water from more sources using existing transmission corridors) and meet future demand (due to greater potential for conservation and economical reuse). However, increased population and employment in the service areas of existing urban systems could also require expensive retrofitting and expansion to accommodate additional demand. In contrast, a small population center in an isolated area with a single supply and no economical transmission corridor or source could have fewer

⁶ Continued drilling is taking place to evaluate long-term regional supplies, but to date, a few new wells in the southern part of the county have not identified significant new sources. This and the uncertainty of processing water right applications, surface/ground water continuity issues, as well as Endangered Species Act (ESA) issues, cause considerable concern about the feasibility of groundwater development plans even if significant resources are found.

⁷ It will be the responsibility of Kitsap County Public Utility District (KPUD) to work closely with the utilities and other government agencies to encourage resource development to obtain adequate water supplies and water rights throughout the county. The Coordinated Water System Plan tiered approach starts with: (Tier 1) lower cost options with greater ease of implementation such as local development of new groundwater sources, (Tier 2) continued application of effective water conservation and water system efficiency measures, (Tier 3) interties between adjacent utilities, (Tier 4) followed by more expensive and complex activities that may be required to address long-term needs such as interties between adjacent utilities requiring substantial adjustments, (Tier 5) regional source, storage, and transmission network, (Tier 6) reuse, and (Tier 7) desalination. Because of cost, desalination is an unlikely option at this time.

⁸ These programs are being included in the preparation or update of individual water system plans. Kitsap County Public Utility District is assigned lead responsibility for coordinating implementation of a regional program. In projecting future water supply, the Coordinated Water System Plan assumed a 1 percent reduction in water supply requirements due to conservation for 2001 through 2010. Reductions beyond 2010 were not included based on the assumption that the majority of the conservation gains, using current technology, will likely be realized by that time.

⁹ Judi Gladstone, Water Planning Advisor, Seattle Public Utilities, personal communication, November 2005.

options to meet increased demand, and could face considerable expense to accommodate growth due to longer pipeline lengths or the development of new supplies needed to connect more dispersed land development patterns.

Regardless of which growth alternative is considered, there will be impacts on meeting future demand in the region including:

- The challenges associated with identifying truly new sources and/or obtaining water rights to meet future demands at a regional level.
- The impact of climate change on future demand for water in the region. Research conducted at the University of Washington forecasts an increase in regional temperature by 2020 of 1.5° Centigrade (2.7° Fahrenheit) and by 2040 of 2.3° Centigrade (4.1° Fahrenheit) over the average annual temperatures in 2000 (Mote, 2003). These increases are significant since they are almost double those previously forecast for the region in the last 100 years. However, at this time, it is uncertain how these changes will affect the future demand for water in the region since the predictions do not agree on whether this will result in an increase or decrease in precipitation or change the seasonal timing and form (e.g., snow to rain) of precipitation.
- A need to develop and implement a sustainable water resource program that considers both the needs of people and fish. While the need to balance both of these is recognized, there is still a lack of complete data on the needs of fish for most of the region. It is uncertain when those data will be available and how they will impact the supply/demand forecasts.
- A need for a collaborative water resources management process at the regional level rather than individual utilities developing their own plans at just the local level.
- Challenges associated with meeting future water demand in the more isolated, rural, and unincorporated areas.
- More stringent water quality compliance standards may make it more difficult to use reclaimed water in the future.

Analysis of Each Alternative

- ***Growth Targets Extended Alternative.*** For the purposes of this Draft Environmental Impact Statement, it is assumed that overall future regional demand for municipal water under Growth Targets Extended could be equivalent to demand predicted under existing water system plans. However, the 2040 planning horizon goes beyond many of the service providers' planning horizons, which means that some have not yet begun to address needs in these later years; this will cause some to have to revisit their existing plans given the additional pressure from the new growth. (See previous discussion under the heading "Regional Future Municipal Water Demand" that begins this subsection.) For Kitsap County, under this alternative, there could be concern over proliferation of shallow wells associated with Group B systems (discussed in section 5.7.1.3 above) and the possible impact on stream flows as well as with the difficulty of managing such a dispersed group of small water systems.
- ***Metropolitan Cities Alternative.*** With growth focused in the metropolitan and core suburban cities under the Metropolitan Cities Alternative, it could be even more imperative that current plans for additional transmission lines and larger pipes feeding these locations be implemented to reduce the severity of impacts on water supply shortfalls. Without the ability to offset increasing demand through reuse and/or conservation, it is possible that planned system improvements could need to be updated to increase their capacity to meet future supply under this alternative.
 - *King County.* With population increases in urban King County, particularly in Seattle and Bellevue, it is possible that proposed supply improvements as currently planned might not meet future demands without modification. These modifications might include additional transmission lines or larger pipes to accommodate increased demand, as well as increased use of reclaimed water to decrease demand for potable water. For example, while King County's wastewater treatment plant currently supplies reclaimed water to Tukwila, it may be feasible to increase the treatment capacity of the plant and to add additional transmission lines so that this facility can supply reclaimed water to additional areas. Bellevue, Renton, Kent, and Covington are possible areas to consider since future growth could be focused in these areas in this alternative, and it is possible that transmission lines could be located cost effectively. However, it should be noted that even if these options were feasible, there could be an additional impact associated with the underground placement of the pipelines in such an urban environment.
 - *Kitsap County.* For Kitsap County, it is anticipated that the Metropolitan Cities Alternative could have less of an impact on future water demand than in King, Pierce, or Snohomish counties because overall population and employment growth is lower. Furthermore, with growth focused in Bremerton and Silverdale, it is possible that



this might alleviate concerns over the potential increase in the number of shallow wells outside the urban growth area in the county.

- *Pierce County*. Like Snohomish County, it is possible that the impacts of the Metropolitan Cities Alternative on the future demand for water could be less severe in Pierce County than in King County. This is especially true given completion of the Tacoma Second Supply Pipeline.
- *Snohomish County*. Overall, it is possible that the impacts of the Metropolitan Cities Alternative in Snohomish County could be less severe than in King County. Under the Metropolitan Cities Alternative, Everett, Bothell and Lynnwood would experience significant demand for new water supply in Snohomish County. Currently, the Spada Reservoir on the Sultan River meets Everett’s demand. However, without development of possible future supply options such as the Weyerhaeuser Water Right or the French Creek Aquifer Storage and Recovery project, future demand in these metropolitan areas of Snohomish County might not be met. Overall county growth, however, is the lowest in this alternative, offering a possibility of the reallocation of planned water supplies within the county. Accordingly, local impacts of this alternative could be fewer than the impacts under Growth Targets Extended — due to the possible expense of reallocation of planned water supplies.
- **Larger Cities Alternative**. Since the change in population for larger suburban cities under the Larger Cities Alternative is notably higher than under Growth Targets Extended, it is likely that future demand for water under this alternative might not be met in many locations throughout the region based on current water system plans. In comparison to the Metropolitan Cities Alternative, estimated growth in the unincorporated urban growth areas for King, Kitsap, Pierce, and Snohomish counties is almost double under the Larger Cities Alternative. As a result, the increased use of reclaimed water is probably less feasible in these areas because treatment plants are generally located farther away and the installation of reuse transmission becomes less economical. Under such circumstances, the installation of additional interties between adjacent service areas and a continuation of existing conservation plans may be the most cost effective approaches.
 - *King County*. With the estimated population increase in King County, it is possible that the proposed supply options as planned may not meet future demands without modification. As described for the Metropolitan Cities Alternative, these modifications might include additional transmission lines or larger pipes to accommodate the allocated future growth patterns. However, in contrast to the Metropolitan Cities Alternative, there could be fewer options available for the use of reclaimed water to offset demand. Thus, it is possible that in King County, this alternative could have a greater impact than either Growth Targets Extended or the Metropolitan Cities Alternative. Furthermore, without the development of additional system interties than are planned for under Growth Targets Extended, the impacts of this alternative on the larger cities in King County could be even greater.
 - *Kitsap County*. While overall growth in Kitsap County in this alternative is less than that under Growth Targets Extended, the lower growth allocated in rural areas may alleviate concerns over the installation of shallow wells and the impacts this might have on stream flow. Furthermore, since the difference in population increase between the Larger Cities Alternative and Growth Targets Extended is not as large as in King, Pierce, and Snohomish counties, the impacts of this alternative on future water supply in Kitsap County could be less than the impacts in King, Pierce, and Snohomish counties.
 - *Pierce County*. Under the Larger Cities Alternative, the greatest impact on future water demand could be experienced in core suburban cities and larger suburban cities. Pierce County has only three such cities (Lakewood, Puyallup and University Place). With lower growth in Tacoma, it is possible that increased demand in core and larger suburban cities might be addressed with the diversion of water supplies planned for Tacoma under Growth Targets Extended.
 - *Snohomish County*. Since growth in a number of the county’s larger cities is greater than that allocated under Growth Targets Extended, it is possible that these cities could experience shortfalls in water supply in 2040. Overall county growth, however, is the second lowest in this alternative, offering a possibility of the reallocation of planned water supplies within the county. Accordingly, local impacts of this alternative could be greater than the impacts under Growth Targets Extended — due to the possible expense of reallocation — and similar to the impacts under the Metropolitan Cities Alternative.
- **Smaller Cities Alternative**. As described in section 5.7.2.3 above, while current water supply plans address meeting future demand in many urban growth areas through additional transmission lines, larger pipes, interlocal

agreements, and conservation programs already underway, shortfalls in a number of cities and towns could occur if new supplies cannot be found and/or demand cannot be reduced by implementation of conservation and/or water reuse. Furthermore, shortfalls could be more severe in smaller cities and towns and outside contiguous urban growth areas since serving these areas with additional transmission lines might be less feasible due to the need to traverse long distances through rural areas, and distance from larger treatment plants through which the reuse of reclaimed water might be an option to serve increased local demand. The large amount of growth in smaller suburban cities and unincorporated urban growth areas could place additional strains on existing systems, for which water purveyors are not currently planning. Since most of the smaller cities would experience a percentage change in population that would be much greater than that allocated under Growth Targets Extended, current water system plans do not consider how future water demands in these areas are going to be met. It is possible that growth under the Smaller Cities Alternative could have the greatest widespread impact on current plans for future water supply in 2040.

- *King County.* While overall growth in King County is less under the Smaller Cities Alternative as it is under Growth Targets Extended, impacts could possibly be greater since this growth would occur in smaller cities. For localities within the urban growth area, it is possible that future supply could be met with fewer additional transmission lines and interties. For those urban islands outside the contiguous urban growth area, the cost of additional transmission lines could become prohibitive. For these locations, there might need to be greater emphasis on the use of groundwater, storage, or conservation measures such as the collection of roof runoff or increased use of “gray” water for irrigation. These approaches might be considered on a case-by-case basis depending upon feasibility and cost at the local level. Given the long lead-time required to plan for such facilities and secure water rights and permits, such constraints might prove to be a hindrance to allocated population growth in these areas. Furthermore, one consequence of an increased reliance on groundwater could be a need for increased protection of aquifer recharge areas through local land-use policies (e.g., open space acquisition, zoning, and proposed sensitive areas ordinances), which itself may conflict with plans for increased growth in these areas.
- *Kitsap County.* Future growth of smaller cities will be of particular concern for Kitsap County since, regardless of the alternative considered, future water supply will have to be met largely from groundwater sources given the absence of large rivers for surface water supply. Growth in smaller cities raises the potential for an increase in the number of shallow wells outside the urban growth area in the county. Furthermore, the Kitsap County Coordinated Water System Plan suggests that a few new wells located in the southern part of the county have not yet identified any significant new sources.
- *Pierce County.* In Pierce County, the impacts of the Smaller Cities Alternative on future water supply could also be greater than Growth Targets Extended, given the number and location of smaller suburban cities throughout the county. Furthermore, since overall growth in Pierce County under the Smaller Cities Alternative would be greater than that under Growth Targets Extended, the impacts could be even greater than those in King County. The large amount of growth might require the formation of an alliance in Pierce County such as the Cascade Water Alliance (in King County) to make planning for future water supply more organized and effective.
- *Snohomish County.* Similar to King County, overall growth under the Smaller Cities Alternative would be greater to that under Growth Targets Extended. However, since this growth may occur at a much greater rate in the county’s smaller cities than under Growth Targets Extended, it is possible that current planned supplies may not meet demand in these areas.

Comparison of Alternatives

Assuming that growth under Growth Targets Extended is similar to that used in water system plans currently developed in King, Pierce, Snohomish, and Kitsap counties, it is estimated that the impacts on water supply under the Growth Targets Extended Alternative will be lower than the other three alternatives. In contrast, since the change in population under the Smaller Cities Alternative for smaller cities is much greater than that under Growth Targets Extended, the Smaller Cities Alternative might have the greatest impact on future water supply in the region. The Metropolitan Cities Alternative could have a greater impact than Growth Targets Extended, but less of an impact than the Larger Cities and Smaller Cities alternatives because of the feasibility of increasing the capacity of supply systems currently planned, increased use of reclaimed water, and implementation of water conservation plans to decrease demand. The Larger Cities Alternative may have a greater impact than the Metropolitan Cities Alternative, but less of an impact than the Smaller Cities Alternative.



5.7.2.4 IMPACTS TO FIRE PROTECTION AND POLICE SERVICES

Impacts Common to All Alternatives

Additional fire and police services could be needed throughout the region, with existing facilities and staff levels potentially needing to be expanded and new stations or response centers built in some areas. Levies, passed by voters at the city level, provide funding to pay for new facilities, increased staffing, and expansion and renovation of existing facilities.

The need for justice facilities, including courts and jails, could be expected to increase under all alternatives. Few differences in impacts among alternatives could be expected, although with the most dispersed growth patterns (the Smaller Cities Alternative), the possible increased demand for courts and jails more widely distributed around the region may represent a shift from existing plans. Historically, most facilities of this type have been provided on a shared regional basis or in cooperation with other municipalities.

Analysis of Each Alternative

- ***Growth Targets Extended.*** Alternatives that encourage more dispersed growth patterns, such as the Growth Targets Extended and the Smaller Cities alternatives, could increase the need for new staff, stations, and facilities in the lower density and rural areas of the region. Response times could possibly increase due to the longer distances to travel within service areas. Kitsap and Snohomish counties could experience the greatest impact to fire and police services because these counties contain larger numbers of small, low-density towns and rural areas. Impacts in King County could be both in its major cities and along the fringe of the urban growth area. Impacts in Pierce County could be particularly significant in unincorporated urban growth areas.
- ***Metropolitan Cities Alternative.*** The Metropolitan Cities Alternative, which encourages growth in metropolitan and core suburban areas, could require new and renovated neighborhood fire and police stations to provide additional service capacity. Such efforts are already underway in cities such as Seattle, which passed the Fire and Facilities Emergency Response Levy in November 2003. The Metropolitan Cities Alternative has the lowest impact on smaller cities to expand their current levels of staffing and infrastructure. Small cities in rural areas could continue to utilize part time staff and could continue to coordinate with neighboring cities to provide fire and police services.
- ***Larger Cities Alternative.*** Impacts possible under the Larger Cities Alternative are somewhat similar to those described for the Metropolitan Cities Alternative. Greater numbers of the region's larger suburban cities could require new facilities under this alternative in order to accommodate an influx of new people and businesses.
- ***Smaller Cities Alternative.*** The impacts associated under the Smaller Cities Alternative may be similar to those described under the Growth Targets Extended Alternative. New facilities and staff levels may be required under this alternative in communities on the urban edge and beyond.

5.7.2.5 IMPACTS TO HEALTH AND EMERGENCY MEDICAL SERVICES

Impacts Common to All Alternatives

Population density and proximity to the larger cities are the primary factors when discussing impacts to and the need for more health care facilities. Because of this, demand for new facilities will vary by area, but overall regional needs for expanded health care facilities will be similar for all alternatives.

Recent trends of consolidation to minimize cost increases in the health care industry will likely continue in the future due to continued technology advances and increased specialization. As a result, it could become increasingly less cost effective to provide high levels of specialized health care services in less dense small cities and rural areas of the region. Recent research and studies have also linked lower density development with rising obesity levels and health care costs per capita due to development patterns that offer fewer opportunities for physical exercise.

Analysis of Each Alternative

- ***Growth Targets Extended Alternative.*** Growth Targets Extended (along with the Smaller Cities Alternative), which has higher levels of dispersed growth, could possibly require the construction of new health care facilities since many residents might not be within a reasonable distance of existing health care facilities. Emergency service response times and response needs could be affected by different distributions of population and employment in

the region. Impacts may be mostly experienced in smaller cities and rural areas, while metropolitan and larger cities could experience impacts to a lesser degree because hospitals and health care facilities are already in place.

- **Metropolitan Cities Alternative.** The Metropolitan Cities Alternative concentrates a large portion of new growth in already highly dense areas such as metropolitan cities. In order to meet increased demand under this alternative, existing facilities and staff levels may need to be expanded, and new stations or response centers could need to be constructed in some areas.
- **Larger Cities Alternative.** The impacts expected under the Larger Cities Alternative could be similar to those expected under the Metropolitan Cities Alternative. Growth is slightly more dispersed under this alternative, but demand may increase most dramatically in metropolitan, core and large suburban cities, and less in smaller cities and rural areas. New facilities and increased staff levels may be necessary to accommodate the growing demand in core and larger suburban cities.
- **Smaller Cities Alternative.** The impacts expected under the Smaller Cities Alternative could be similar to those expected under Growth Targets Extended. Construction of new facilities and increases in staff levels could be required under this alternative in smaller cities and rural areas. Current staffing levels may not meet the increased demand expected in rural areas and small towns under this alternative, as they may be able to under the Metropolitan Cities and Larger Cities alternatives.

5.7.2.6 IMPACTS TO SCHOOLS

Impacts Common to All Alternatives

The need for new expanded, or remodeled schools may increase for all counties under all alternatives. The location of new or expanded schools could vary by alternative, but the overall magnitude of the need could be similar. Transportation costs may be increased in areas where growth is more widely distributed.

Analysis of Each Alternative

- **Growth Targets Extended Alternative.** Under the Growth Targets Extended (as well the Smaller Cities Alternative), a greater number of people may not live within a reasonable distance of existing educational facilities, perhaps requiring the construction of new educational facilities. School transportation costs may also be higher due to a larger number of students regionwide that could require transportation services. Some studies have found that overall capital costs for infrastructure to serve new development, including schools, could be as much as two to three times higher for lower density development patterns than for higher ones.¹⁰
- **Metropolitan Cities Alternative.** The Metropolitan City Alternative would encourage most new growth to concentrate in metropolitan and core suburban cities. Enhancements and expansion of existing educational facilities and construction of new education facilities in metropolitan cities could be necessary under this alternative. School transportation costs for this alternative could be lower than with the Growth Targets Extended or the Smaller Cities alternatives. Overall costs per capita for public education could also be lower. Kitsap and Snohomish counties could experience the least overall amount of growth under this alternative compared to the other alternatives. Expansion of existing facilities and construction of new facilities could still be necessary under this alternative, but the demand to construct new facilities could be less under the Metropolitan Cities Alternative for those two counties.
- **Larger Cities Alternative.** The impacts expected under the Larger Cities Alternative may be similar to the impacts expected under the Metropolitan Cities Alternative. Core and large suburban cities would experience the majority of growth under the Larger Cities Alternative, and may therefore need to construct new education facilities or expand and renovate existing facilities more so than smaller cities and rural areas. Due to higher population and employment growth levels in King and Pierce counties, their school districts may be most impacted by the Larger Cities Alternative. Lower population and employment growth in Snohomish and Kitsap counties could result in fewer impacts to school districts than described under Growth Targets Extended. School transportation costs for this alternative could be lower than with the Growth Targets Extended or the Smaller Cities alternatives, due to the possibility that a larger number of students may be within convenient walking or public transit distance of school facilities.
- **Smaller Cities Alternative.** The impacts expected under the Smaller Cities Alternative might be similar to those described under the Growth Targets Extended Alternative. Smaller cities and rural areas could experience significant population and employment growth, and school districts in these areas could be most impacted.

¹⁰ James E. Frank. *The Costs of Alternative Development Patterns*. A Review of Literature. Urban Land Institute. (1989).



Construction of new facilities and expansion of existing facilities could be required in smaller cities in order to meet increased demand.

School transportation costs in the Smaller Cities Alternative could be higher due to the greater distances required to transport students to school facilities. Possible cost increases associated with the Growth Targets Extended or the Smaller Cities alternatives compared to the Metropolitan Cities and Larger Cities alternatives are dependent on many area specific factors; however, some studies have found that overall capital costs for infrastructure to serve new development, including schools, could be as much as two to three times higher for lower density development patterns. Similar to Growth Targets Extended, Kitsap and Snohomish counties could experience large increases in population and employment, which could require additional capital and operating expenditures for local schools. Conversely, King and Pierce counties could experience less growth, with fewer associated school expenditures.

5.7.3 Cumulative Effects

All alternatives address increased population and employment growth in the region, but vary geographically in density and distribution of growth. For all types of public services and utilities, increased growth would likely increase demand for public services. There could be relatively few other actions that would occur that result in additional demand for public services, as considered at the regional level. Overall, the regional consequences could be similar, with the primary impact being that public service and utility providers could need to expand their services and facilities to meet the needs of growth, which could increase public costs and impact environmental resources. The alternatives shift the changes geographically, but increased growth occurs with all alternatives and in all communities.

Solid Waste

Expansion of recycling programs to capture a larger percentage of solid waste generated may be more cost effective in dense urban areas due to economies of scale. Solid waste transportation costs per capita in less dense rural areas may be higher.

Sewer

The Growth Targets Extended and Smaller Suburban Cities alternatives could rely more on septic systems to serve new development occurring outside the urban growth area. Additional measures could be needed to address the related environmental concerns and possible impacts of adding to the number of septic systems already in the region.

Water Supply

Water supply could be affected in some watersheds by water withdrawals or diversions upstream, or by increased protections for endangered species, such as salmon. In addition, the impact of climate change-related temperature increases is significant since this amounts to almost double the previously forecast increases for the region in the last 100 years (see *Chapter 2 – Regional Environmental Baseline* for more information on climate change and regional temperature). However, at this time, it is uncertain how these changes will affect precipitation and seasonal snow-pack in the region.

Fire and Police

Most districts that currently rely on volunteer or part-time public safety services may need to consider expanding their service provision to include more full-time professionals.

Hospital and Emergency Medical Services

The impacts to these services could remain commensurate with the population increases under all alternatives.

Schools

School districts with service areas that are bisected by the urban growth area boundary may have increased pressure to expand new services. Attention is needed to ensure that services provided for urban populations in such situations are located inside the urban growth area.

5.7.4 Potential Mitigation Measures

Most of the public services and utilities impacts (increased demand for services and facilities) could be addressed through improvements and upgrades at levels sufficient to meet the needs of growth. Variables would include cost, efficiency, and the potential that, at the project level, environmental consequences may shape the choices made by individual service providers. Mitigation during subsequent planning actions will be required, although some conservation and demand reduction measures could reduce the demand for services and affect the level of necessary mitigation.

Solid Waste

For solid waste, impacts could be reduced through conservation measures to reduce waste and increase the rates of recycling, consistent with goal in all of the four counties' comprehensive plans. Increased emphasis on use of recycled products, recycling of construction waste, and reductions in non-recyclable packaging could all help to reduce the amount of solid waste generated.

Sewer

Continued implementation of planned and programmed improvements to sewer and wastewater facilities could be needed, and address most impacts. Federal, state, and local regulations also provide for the protection of public health by placing strict regulations regarding the handling of sewage/wastewater. Implementation of measures to conserve water could also benefit wastewater utility providers by reducing wastewater generation. Measures could include improving collection systems to reduce the amount of rainwater and groundwater that infiltrates the pipes, which then increases capacity at treatment plants, could reduce the need for expanded treatment facilities.

Water Supply

Most water utility providers could potentially meet increased demand by expanding systems and seeking services for supply through strategies such as:

- Conventional supply options
- Additional conservation
- Reuse options
- Stormwater options¹¹
- Extraction of water from new ground or surface water sources
- Extraction of additional water from existing ground or surface sources
- Storage and release when needed
- Interties and sharing supplies¹²

In some instances, adding new transmission lines is all that may be needed to meet the needs for some utilities.¹³

Fire, Police, Hospitals and Emergency Medical Services

The demand for public safety and other public services, including hospitals, educational facilities and courts correlates to growth. Interlocal agreements, which provide for mutual response, the sharing of facilities and/or joint service provision, could mitigate cost impacts for smaller jurisdictions.

¹¹ To become a viable source of water supply, stormwater management would need to include storage in impoundments or aquifers. Local governments may have to do this to meet Endangered Species Act requirements to minimize habitat alteration. For stormwater to be used on a large scale, these storage facilities would need to be built into water supply planning.

¹² For example, under a water supply agreement between Cascade and Seattle Public Utilities, the latter is obliged to provide potable water, and Cascade is obliged to buy it, through December 2053.

¹³ For example, in 2003, Cascade signed an "Agreement in Principle" with Tacoma Public Utilities for the potential purchase of water from the Tacoma Second Supply Pipeline, which just recently came online. As a result, Cascade is developing several long-term transmission pipeline alternatives to convey this supply to its members (See Figure 5-7-5). These include proposed pipelines from Tacoma Second Supply Pipeline to Seattle Public Utilities control works and from there, connecting to the existing Bellevue-Issaquah Pipeline. Cascade is also planning a regional storage reservoir with a storage capacity of 20 million gallons that is anticipated to be on line by 2021. Beyond 2023, Cascade anticipates transitioning to Lake Tapps in Pierce County, and other sources, as its supply commitments from Seattle Public Utilities and Tacoma Public Utilities decline.



Schools

Impacts to schools could be lessened through careful examination of resources and whether they are being allocated in the best possible manner. Additional measures could include reassessment of current school district boundaries.

5.7.5 Significant Unavoidable Adverse Impacts

All of the alternatives are likely to impact specific public services and facilities, in specific areas, in a manner that is not currently being planned for by providers. Other institutional issues may exist as well. The following is a list of institutional constraints to implementation of future water supply options that may apply to other services as well. Examples of these include:

- Lack of clear regional policies and decision-making structure.
- Lack of knowledge and documentation on existing resources (now or in the future).
- Impact of the Endangered Species Act.
- Balancing available information and risk in decision-making.
- Uncertainty of and disincentives to sharing supplies.
- Intertie limitations.
- Continuity of systems.
- Uncertainty of rights to existing services.
- Lack of distribution systems and plans for new conservation options. And, the need for reuse options to receive more complete evaluation and incorporation into existing plans.



Parks and Recreation

This chapter discusses parks and recreation resources with a focus on locally owned parks. The chapter includes a review of typical impacts due to growth. It also includes an analysis of park-to-resident ratios and population and employment proximity to parks and general qualitative analysis of park maintenance, use, and development issues. Some summary highlights are noted below regarding how these resources could serve and be impacted by the growth distribution alternatives.

Privately owned open space and environmentally critical areas are also discussed in several other chapters, including *Chapter 5.2 – Land Use* and *Chapter 5.5 – Ecosystems*.

5.8.1 Affected Environment

There are many parks, open spaces and recreational facilities throughout the four-county area, reflecting the diverse range of landforms, ecology, land use, and culture found in the region. These resources are in both private and public ownership, with public resources being operated by local, county, state, and federal agencies. Open space is a broad term used to define different types of privately and publicly owned lands that include environmentally critical areas such as steep slopes, wetlands, aquifer recharge areas, lakes and streams, designated parks and trails, and natural resource lands such as agriculture and forestlands.

A. PHYSICAL SETTING

Local Parks

Local parks consist of parks, trails and greenways, public school, college, and university campuses and facilities, and public rights-of-way alongside streets, roads, and highways.

Local parks are used primarily by people who live relatively close to them, but they can also serve as regional attractions. They are owned and managed by towns, cities, counties, metropolitan parks districts, and Native American tribes. Local parks are diverse in both size and uses, ranging from small urban parks, called “mini parks” or “pocket parks” (like Bergen Park in Seattle’s Ballard neighborhood), to mid-size neighborhood parks (such as Evergreen Park on Bremerton’s waterfront), to athletic field complexes (like Everett’s Kasch Memorial Park), to regionally significant community parks (such as Tacoma’s Point Defiance Park). They are used mostly during the daytime and generally accommodate both passive uses such as strolling and picnicking, as well as active uses such as sports fields, play areas, water access, jogging, biking, and skating. Local park resources also include arboretums, zoos, and aquariums, which often draw people from a much larger area. Some parks with sports facilities are used at night as well, particularly in communities where demand



is high. Local parks may also serve as natural area set-asides, protecting sensitive natural resources, and they may have meeting spaces and facilities for education and the arts.

Trails and greenways provide transportation and recreation uses for nonmotorized uses, including walking, jogging, bicycling, horseback riding, and skating. They are owned and managed by local, state, and federal agencies. Trails can be designed and designated for specific uses such as pedestrian-only trails with gravel surfacing, or serve as shared-use paths. The region contains many examples of highly popular trails, such as the Interurban Trail linking Pierce, King, and Snohomish counties, King County's Burke-Gilman/Sammamish River Trail system, and Kitsap County's Mosquito Fleet Trail. Greenways are open space corridors that link parks, natural areas, and recreation facilities to form a cohesive open space system. They typically include trails or shared-use paths that provide safe and efficient nonmotorized movement between outdoor recreation facilities. They often include and emphasize the natural environment.

Public school, college, and university campuses and facilities often provide open space and athletic fields that are available for use by the general public. These may be the only such facilities in some areas, and they play an important role in communities, especially where organized sports are a central part of social life. The often extensive campuses of institutions like community colleges and state universities are well-used by local residents looking for passive open space activities like strolling, jogging, or dog walking.

Streets, roads, and highways also provide for recreational opportunities like sightseeing, pleasure driving, bicycling, jogging, strolling, and skating. An increasing number of the region's streets and roads have been designed or rebuilt to provide safe and pleasant environments for non-motorized transportation and recreation. These are the most common recreational activities in the region.

Major Public Lands

Major public lands provide publicly-owned and operated facilities for parks and recreation uses, as described below:

National Parks are owned and managed by the United States Department of the Interior. They are created to protect natural, historic, and cultural features while allowing public access and interpretation. Mt. Rainier National Park, located primarily in Pierce County, is the most notable National Park Service facility in the area. National Parks are also found in urban areas, such as the Klondike Gold Rush unit in Seattle, an example of an interpretive facility that tells the story of a specific event with historical importance.

National Forest Lands are operated by the United States Department of Agriculture and managed to accommodate a broad range of uses that include not only recreation, but also grazing, logging, mining, watershed protection, and preservation of wilderness. Recreational uses include camping, hiking, fishing, horseback riding, off-road vehicle use, boating, swimming, and wildlife observation. Ski areas and snow parks are among the only National Forest recreational activities that include developed recreational facilities.

National Wildlife Refuges are managed by the United States Fish and Wildlife Service as areas for wildlife conservation. Recreation activities are allowed in refuges where compatible with conservation and include hunting, fishing, and lodging. Nisqually National Wildlife Refuge, partially in Pierce County, is a notable example of these facilities.

State Parks are operated by the Washington State Parks and Recreation Commission. They include a broad range of facilities, mostly consisting of lands with natural resources, along with lands with historic or cultural features. Facilities include campgrounds, picnic and day use areas, shoreline access and boat launches, trails, protected natural areas, commemorative sites, and sites with historic structures.

State Wildlife Recreation Lands are managed by the Washington State Department of Fish and Wildlife, primarily for hunting and fishing. They provide many opportunities for water access and are the largest provider of "put ins" for boats on trailers.

State Trust Lands are owned by Washington state and managed as natural resource lands by the Department of Natural Resources to generate income for education. While the primary use of these lands is the active production and harvest of timber and other natural resources, recreational activities are allowed as long as they do not detract from the lands' primary purpose and uses. Recreational activities include hiking, biking, and off-road vehicle use. These lands provide recreational opportunities that are similar to those in National Forest lands, but they are generally located closer to towns and cities and are more accessible as a result.

Private Facilities

Privately owned and managed recreational resources range broadly from small “mom and pop” businesses to not-for-profit access to the extensive lands of timber companies and farmers. These include community swimming pools, golf courses, water parks, gyms and sports clubs, marinas, cemeteries, firing ranges, zoos, and aquariums, among other facilities. They accommodate a diverse variety of resources and activities, including fishing, hunting, horseback riding, hiking, swimming, golf, skiing, team sports, and off-road vehicle use. There are also several reserves or estates such as the Bloedel Reserve on Bainbridge Island (150 acres) and Lakewold Gardens Estate (10 acres) in Lakewood that include historic properties and landscaped grounds that are open to the public.

B. REGULATORY SETTING

Under the Washington State Growth Management Act, comprehensive plans in Washington state must have a parks element. This requirement was added to the Growth Management Act in 2002, although the requirement depends on state funding and so has not fully taken effect. Nonetheless, many jurisdictions in the region already have a parks element within their adopted plans. Parks elements usually include estimates of demand for a 10-year period, an evaluation of facility and service needs, and an evaluation of opportunities to meet demand, including regional approaches.

Other regulations apply to parks as well, but generally are designed to protect parks from impacts from other actions, such as major transportation corridor improvements.

C. A PRELIMINARY REGIONAL INVENTORY

In order to better understand the extent and nature of the region’s existing publicly owned parks and open spaces, in 2001 PSRC developed a preliminary geographic information system (GIS) database of regional parks and open space (PSRC, 2005). The database was created by identifying Major Public Lands (DNR, 1997) within the region, and by compiling an inventory of parks and open space in local government ownership. The database includes Major Public Lands and Local Parks, as described above under Physical Setting.

Locally-Owned Facilities

Locally-owned facilities consist of a combination of community, neighborhood and some regional facilities, depending on ownership, function and size. For example, locally-owned facilities include both small neighborhood parks owned by individual cities, as well as larger county-owned parks intended for wider regional use. The PSRC Parks and Open Space database contains approximately 104,000 acres of locally-owned and managed neighborhood, community and regional parks and open spaces, which are widely distributed in King, Kitsap, Pierce and Snohomish counties. These are dispersed throughout the region. However, in general they tend to be either inside or close to the region’s urban growth area.

Major Public Lands

Major public lands represent approximately 40 percent of the land within the central Puget Sound region — or just under 2,500 of the region’s approximately 6,300 square miles. Major public lands are by definition regional in nature, and are generally accessible to regional residents within a drive of one to two hours. Many major public lands facilities provide significant opportunities for both passive and active recreation for the region’s residents.

The central Puget Sound region has a significant amount of major public lands that also provide recreational and other opportunities that are located in close proximity to the region’s residents — this is a highly unique recreational asset for which the region is internationally known. These major public lands are generally located outside of designated urban growth areas and are located in the eastern portion of the region and include U.S. national parks, forest service lands, wilderness areas, state parks, lands owned by the State Department of Natural Resources, and other publicly-owned resources.

Because major public lands lie almost exclusively outside of urban and rural areas, there is little difference in how any of the four alternatives would affect them. Therefore, the following analysis concentrates on impacts to parks and open spaces contained in the locally-owned and managed facilities portion of the database.

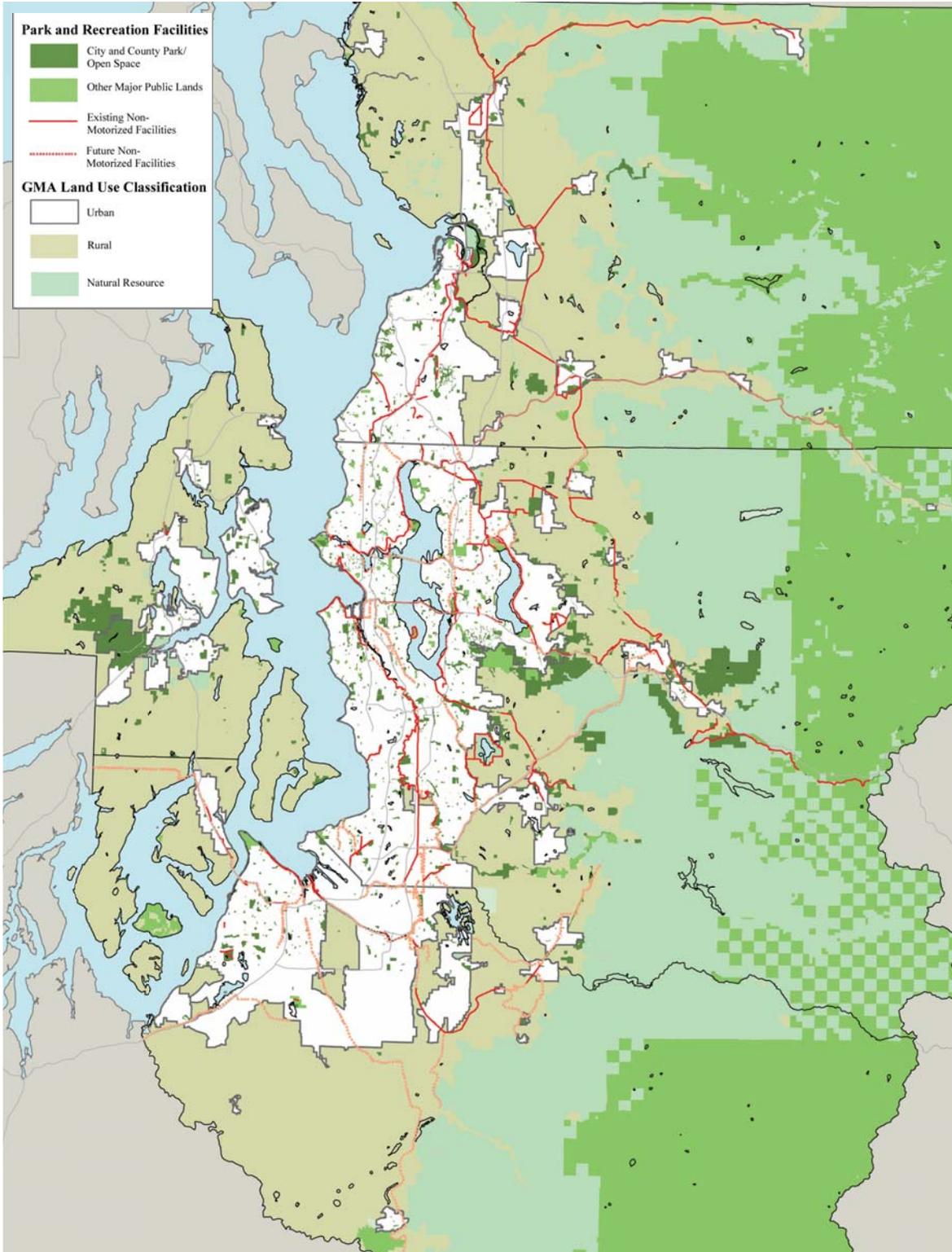
- ***Acres of local parks and residential population in base year 2000***

Available planning guidelines suggest that roughly 25 to 30 acres of local facilities should be available for every 1,000 residents, although other factors can be considered in determining parks needs. Using the region’s year 2000



base population of 3,275,000, at the regional level this amounts to approximately 32 acres of local parks for every 1,000 people. The following figure illustrates the amount of parks and recreation resources in the region as of the year 2000 and estimates the number of acres per 1,000 residents.

FIGURE 5-8-1: PARKS AND RECREATION RESOURCES IN THE CENTRAL PUGET SOUND REGION



Source: Puget Sound Regional Council

FIGURE 5-8-2: ACRES OF LOCAL PARKS PER RESIDENT IN 2000

	Acres of Local Parks / Open Space	2000 Population	Acres per 1,000 Residents
King	65,500	1,737,000	38
Kitsap	18,700	232,000	81
Pierce	5,800	701,000	8
Snohomish	14,100	606,000	23
Region	104,100	3,276,000	32

Source: Puget Sound Regional Council

However, at the local and subregional level, the amount of locally-owned parks and open space available to residents varies significantly in the region.

- *King County's* 1,737,000 residents in the year 2000 had access to approximately 65,500 acres of locally-owned neighborhood, community, and regional parks and open space, or just under 38 acres per 1,000 residents.
- *Kitsap County's* 232,000 residents had access to approximately 18,700 acres, or about 80 acres per 1,000 residents.
- *Pierce County's* 700,800 residents shared approximately 5,800 local park acres, or about 8 acres per 1,000 residents.
- *Snohomish County's* 606,000 residents had access to approximately 14,100 acres of local parks, or about 23 acres per 1,000 residents.

This rough assessment of the local neighborhood, community and regional park inventory would suggest that while King and Kitsap county residents currently have access to an adequate amount of parks and open space, Pierce and Snohomish county residents may not. Note: this analysis focuses on local parks. Were major public lands included, these determinations would change (in some cases, they would change significantly). Nonetheless, the analysis provides a useful assessment of parks near residents.

• **Access to local parks in base year 2000**

In order to assess access to parks and recreation facilities under the four alternatives, PSRC analyzed the amount of the region's existing population (using the 2000 Base Year data) that were within a quarter-mile distance of existing locally-owned parks. This method did not attempt to calculate access to the regional facilities contained in the major public lands portion of the database. As these major resources are largely outside the urban growth area, accessibility was assumed to be the same for each alternative. The following figure illustrates the current population and employment that is located within ¼ mile of these facilities.

FIGURE 5-8-3: POPULATION AND EMPLOYMENT WITHIN ¼ MILE BUFFER OF LOCALLY-OWNED NEIGHBORHOOD, COMMUNITY, AND REGIONAL PARKS, AND OPEN SPACES IN 2000

	Population and Employment
King	1,626,000
Kitsap	124,400
Pierce	383,800
Snohomish	457,900
Region	2,592,100

Source: Puget Sound Regional Council

5.8.2 Analysis of Alternatives (Long-Term Impacts)

A. IMPACTS COMMON TO ALL ALTERNATIVES

All of the alternatives will distribute growth in ways that would affect access and use of parks, open spaces, and recreational facilities. Affects on existing local recreational resources generated by population increases would primarily relate to demand. Parks would experience additional use, and in some locations users might experience crowding. There would be a higher demand for jurisdictions to develop, operate and maintain new facilities and recreational programs, which would increase capital expenses. There could also be increased conflicts between different types of recreational users, degradation of natural resources, displacement of undeveloped open space, and diminished convenience of access.



Acres of Parks Per Residential Population

The definition of the four alternatives did not include the identification of additional new locally-owned parks and open spaces facilities. Considering the current amount of parks and open space facilities in local ownership, and the addition of approximately 1.7 million additional people and 1.2 million jobs to the region between 2000 and 2040, it is expected that total acres of locally-owned neighborhood, community and regional parks and open spaces per 1,000 residents in the year 2040 will be reduced unless new parks are added.

With an increase in regional population of approximately 1.7 million residents by the year 2040 in all four alternatives,

FIGURE 5-8-4: CONCEPTUAL ESTIMATE OF ACRES OF LOCALLY-OWNED PARKS AND OPEN SPACES PER 1,000 RESIDENTS

	Acres Local Parks/Open Space	Base Year 2000		Growth Targets Extended Alternative		Metropolitan Cities Alternative		Larger Cities Alternative		Smaller Cities Alternative	
		2000 Population	Acres per 1000 Res.	2040 Population	Acres per 1000 Res.	2040 Population	Acres per 1000 Res.	2040 Population	Acres per 1000 Res.	2040 Population	Acres per 1000 Res.
King	65,500	1,737,000	38	2,440,000	27	2,733,000	24	2,705,000	24	2,406,000	27
Kitsap	18,700	232,000	81	386,000	48	326,000	57	336,000	56	370,000	51
Pierce	5,800	701,000	8	1,097,000	5	1,036,000	6	995,000	6	1,139,000	5
Snohomish	14,100	606,000	23	1,065,000	13	893,000	16	952,000	15	1,074,000	13
Region	104,100	3,276,000	32	4,988,000	21	4,988,000	21	4,988,000	21	4,989,000	21

Note: Totals may not sum consistently due to rounding.
Source: PSRC Parks and Open Space Database, 2001

the regional ratio of acres of locally-owned parks per 1,000 residents drops from 32 in the year 2000 to 21 in the year 2040. Under the different alternatives, the distribution of growth affects the amount of available parkland at the sub-regional level. Facilities in Pierce and Snohomish counties would appear to be put under particular strain from increased demand. In any alternative, additional park and open space facilities could be needed in these counties.

Access to Local Parks

To generally compare the four alternatives in terms of the ease of access to existing local parks and open space for future populations, PSRC considered the potential for each alternative to distribute population and employment within ¼ mile of local parks and open space facilities using the Parks and Open Space database. PSRC calculated the number of regional residents and jobs in each alternative that would be expected to have access to existing locally-owned resources. This method did not attempt to calculate access to the regional facilities contained in the major public lands portion of the database. As these major resources are largely outside the urban growth area, accessibility was assumed to be the same for each alternative:

FIGURE 5-8-5: CONCEPTUAL ESTIMATE OF POPULATION AND EMPLOYMENT WITHIN ¼ MILE BUFFER OF LOCALLY-OWNED NEIGHBORHOOD, COMMUNITY, AND REGIONAL PARKS, AND OPEN SPACES

	Base Year 2000	Growth Targets Extended Alternative	Metropolitan Cities Alternative	Larger Cities Alternative	Smaller Cities Alternative
King	1,626,000	2,958,700	3,126,700	3,115,900	2,509,500
Kitsap	124,400	207,800	169,700	189,700	193,400
Pierce	383,800	534,600	561,800	489,500	570,200
Snohomish	457,900	613,700	754,400	786,600	825,500
Region	2,592,100	4,314,700	4,612,600	4,581,800	4,098,500

Note: Totals may not sum consistently due to rounding.
Source: PSRC Parks and Open Space Database, 2001

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

Metropolitan cities are envisioned to accommodate 25 percent of regional population growth and 45 percent of regional employment growth in Growth Targets Extended, which would result in higher activity levels in existing parks and recreational facilities, as well as increased demand for new facilities and programs. A substantial amount of growth would also be directed to unincorporated urban growth and rural areas.

Acres of Parks Per Residential Population

Planning guidelines suggest that roughly 25 to 30 acres of local facilities should be available for every 1,000 residents. The following list details available park acreage by county in 2000 and 2040.

- **King County.** The ratio of parks to 1,000 residents falls from 38 acres in 2000 to 27 acres in 2040, at the midpoint of the standard recommended range.
- **Kitsap County.** The ratio of parks to 1,000 residents falls from 81 acres in 2000 to 48 acres in 2040, still above the suggested standard. This was the alternative with the lowest ratio for Kitsap County
- **Pierce County.** The ratio of parks to 1,000 residents falls from 8 acres in 2000 to 5 acres in 2040, well below the recommended range.
- **Snobomish County.** The ratio of parks to 1,000 residents falls from 23.3 acres in 2000 to 13.2 in 2040, below the recommended range.

Access to Local Parks

At the regional level in 2040, approximately 4,314,700 residents and jobs in Growth Targets Extended would be likely to be located within ¼ mile of an existing local park or other open space contained in the PSRC Regional Open Space Database. This compares to 2,592,100 residents and jobs in the year 2000.

- **King County.** Approximately 2,958,700 residents and jobs in Growth Targets Extended could be located within ¼ mile of a local park or other open space in 2040.
- **Kitsap County.** Approximately 207,800 residents and jobs in Growth Targets Extended could be located within ¼ mile of a local park or other open space in 2040.
- **Pierce County.** Approximately 534,600 residents and jobs in Growth Targets Extended could be located within ¼ mile of a local park or other open space in 2040.
- **Snobomish County.** Approximately 613,700 residents and jobs in Growth Targets Extended could be located within ¼ mile of a local park or other open space in 2040.

Impacts

Parks and recreation facilities of metropolitan cities in particular would likely experience a higher level of use that could affect the quality of the average visitor's experience, unless these areas expand programs or facilities. Increased use of more developed urban open spaces such as green streets, boulevards, plazas, and squares, created as part of infill and redevelopment projects, would also help serve additional demand. Greater numbers of users would also increase the scope and budget of parks and recreation facilities. Increased use of existing facilities might result in conflicts between user types, such as joggers and bicyclists or boaters and wildlife watchers, or between organized sports and other uses. Some of the likely increased demand for parks, recreation, and open space in Growth Targets Extended could be addressed by acquiring land and developing it into a variety of new local facilities, including neighborhood mini parks or larger community facilities.

In Growth Targets Extended, population growth in suburban geographies would be moderate. Parks and recreational facilities in suburban cities would likely experience increased use, but existing and planned facilities would probably absorb this growth to the extent that it would not significantly affect the quality of the average user's experience.

Unincorporated urban growth areas are predicted to receive 24 percent of the region's forecasted population growth under Growth Targets Extended. Typically, these geographies have few local parks, but rather rely on schools for sports fields and county, state, and private lands, as well as facilities in neighboring suburban cities, for other types of outdoor recreation. The predicted level of growth would increase demand for the development of new neighborhood parks and athletic complexes. While land for these facilities would be available, it would place additional pressure on counties to develop, operate, and maintain these facilities. This would represent a reversal of current trends, which show that a lack of county resources available for parks have led county governments to increasingly rely on local jurisdictions for the provision, operation, and maintenance of local parks and recreational facilities.

In addition, growth in unincorporated urban growth areas would likely increase the use of parks and facilities operated and maintained by neighboring incorporated jurisdictions. While these jurisdictions may be able to satisfy demand,



residents living in unincorporated areas will not contribute to the local taxes generated for operation and maintenance. Outdoor recreation that relies on access to relatively undeveloped or undisturbed natural areas might be affected by displacement of these resources, and increased population could cause a higher level of use that might impact the quality of some visitors' experiences. Conversely, others might enjoy the increased activity.

Growth Targets Extended represents the second largest amount of overall rural area growth (the highest for population), and the second highest amount of growth in unincorporated urban growth areas (with the majority being population). In some rural areas increased demand on existing facilities might exceed their capacity. Increased demand could be addressed by developing additional facilities, presumably to be administered by the counties. This would represent a reversal of current trends, which show that current resources have forced county governments to increasingly rely on local governments for the provision, operation and maintenance of local parks and recreational facilities.

METROPOLITAN CITIES ALTERNATIVE

In the Metropolitan Cities Alternative, the metropolitan cities of Seattle, Tacoma, Bellevue, Everett, and Bremerton are envisioned to receive 40 percent of forecast regional population growth, along with 45 percent of forecast regional employment growth. The region's core suburban cities are envisioned to receive 25 percent of forecast regional population growth and 30 percent of forecast regional employment growth.

Acres of Parks Per Residential Population

- **King County.** The ratio of parks per 1,000 residents would fall from 38 acres in 2000 to 24 acres in 2040, just under the standard recommended range. This was the alternative with the lowest ratio for King County
- **Kitsap County.** The ratio of parks per 1,000 residents falls from 81 acres in 2000 to 57 acres in 2040, still above the suggested standard. This was the alternative with the highest ratio for Kitsap County.
- **Pierce County.** The ratio of parks per 1,000 residents falls from 8 acres in 2000 to 6 acres in 2040. This was the alternative with the highest ratio for Pierce County.
- **Snohomish County.** The ratio of parks per 1,000 residents falls from 23 acres in 2000 to 16 acres in 2040. This was the alternative with the highest ratio for Snohomish County.

Access to Local Parks

At the regional level in 2040, approximately 4,612,600 residents in the Metropolitan Cities Alternative could be located within ¼ mile of a local park or other open space. This compares to 2,592,100 residents and jobs in the year 2000.

- **King County.** Approximately 3,126,700 residents and jobs in the Metropolitan Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.
- **Kitsap County.** Approximately 169,700 residents and jobs in the Metropolitan Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.
- **Pierce County.** Approximately 561,800 residents and jobs in the Metropolitan Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.
- **Snohomish County.** Approximately 754,400 residents and jobs in the Metropolitan Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.

Impacts

The effects of increased growth in the Metropolitan Cities Alternative would largely be of the same type described under Growth Targets Extended, however, the level of impact would be significantly greater in the region's metropolitan cities (and to some extent also in core suburban cities) and significantly reduced in unincorporated urban growth and rural areas.

Increased population would intensify competition for available open space land in metropolitan and core suburban cities, making it less available and affordable for development as new neighborhood and community parks, athletic fields, and trails. Crowding in existing facilities might reduce the quality of visitor experience for some users, whereas others might enjoy the increased activity. Increased numbers of visitors would necessitate significant increases in planning and funding for capital projects and maintenance for both existing and new parks facilities. Conflicts between different types of recreation could become a serious source of friction between facility users. Demand for parking could

be greater than the capacity of available land to accommodate it. Acquisition of land for public use, and provision of new parks and open spaces concurrent with large scale redevelopment and infill projects, would become increasingly important to maintain quality of life in densely developed urban areas. Linear urban parks, redeveloped boulevards and greenstreets, public plazas and squares would be important parts of the parks system, but larger scale parks and recreational facilities would also be in high demand.

Core suburban cities are envisioned to receive 25 percent of the region's population growth and 30 percent of the region's employment growth under the Metropolitan Cities Alternative. Increased use could negatively affect some visitors' experiences in parks, recreation facilities, and open spaces. However, land in these geographies could still be relatively available, and the inventory of existing parks, trails, sports fields, and open space in these cities could be expanded to accommodate the growing population. Significant levels of planning and funding would be required to design and construct these new facilities and to ensure that maintenance keeps pace with increasing use.

Larger and smaller suburban cities would experience moderate population increases under the Metropolitan Cities Alternative. Increased demand for parks and recreation facilities could likely be met by acquisition and development of relatively available and affordable land, financed by an expanded tax base from growing population and employment, or through developer contributions. As density of development increases in these geographies, privately owned open space would likely be displaced in some areas, altering the availability of outdoor recreation that requires undeveloped land or natural areas.

Unincorporated urban and suburban areas would see only modest population and employment increases under the Metropolitan Cities Alternative. Parks and recreation facilities would probably experience little or no effect from these changes.

LARGER CITIES ALTERNATIVE

Larger suburban and core suburban cities are each envisioned to accommodate 30 percent of the region's forecast 2040 population growth in the Larger Cities Alternative, along with 30 percent of the region's employment growth.

Acres of Parks Per Residential Population

- **King County.** The ratio of parks to 1,000 residents falls from 38 acres in 2000 to 24 acres in 2040, just below the standard recommended range.
- **Kitsap County.** The ratio of parks per 1,000 residents falls from a regional high of 81 acres in 2000 to 56 acres in 2040, still above the suggested standard.
- **Pierce County.** The ratio of parks per 1,000 residents falls well below the recommended range, from 8 acres in 2000 to 6 acres in 2040.
- **Snohomish County.** The ratio of parks per 1,000 residents falls below the recommended range, from 23 acres in 2000 to 15 acres in 2040.

Access to Local Parks

At the regional level in 2040, approximately 4,581,800 residents and jobs in the Larger Cities Alternative could be located within ¼ mile of a local park or other open space. This compares to 2,592,100 residents and jobs in the year 2000.

- **King County.** Approximately 3,115,900 residents and jobs in the Larger Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.
- **Kitsap County.** Approximately 189,700 residents and jobs in the Larger Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.
- **Pierce County.** Approximately 489,500 residents and jobs in the Larger Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.
- **Snohomish County.** Approximately 786,600 residents and jobs in the Larger Cities Alternative could be located within ¼ mile of a local park or other open space in 2040.

Impacts

Similar impacts to parks in core cities and higher impacts to larger suburban cities would be expected as are described in the Metropolitan Cities Alternative. Increased population and employment levels would be accompanied by a



corresponding demand for parks, sports fields, trails, natural areas, and water access where possible. Core and larger suburban cities would need to respond to this demand by acquiring properties and planning, funding, and providing primarily neighborhood parks, community parks (where available land permits), and sports fields concurrent with new development. Even with these additions to the outdoor recreation facility inventory, impacts from the predicted growth in population may detract from the overall experience of some users, whereas others might enjoy the increased activity. Additionally, increasingly dense development may displace existing open space, diminishing recreational opportunities that require or benefit from undeveloped land or natural areas.

Effects to parks and recreation facilities in metropolitan cities in the Larger Cities Alternative would be similar to those described under Growth Targets Extended, and effects to resources in smaller cities, unincorporated urban growth areas, and rural areas would be similar to those described under the Metropolitan Cities Alternative.

SMALLER CITIES ALTERNATIVE

Under this alternative, smaller cities and unincorporated urban growth areas are envisioned as accommodating 30 percent and 35 percent of the region's population growth respectively, along with 30 and 35 percent of the region's employment growth. Rural areas are allocated the most growth, and metropolitan, core, and larger suburban cities the least growth, under this alternative.

Acres of Parks Per Residential Population

- **King County.** The ratio of parks per 1,000 residents falls from 38 acres in 2000 to 27 acres in 2040 at the mid-point of the standard recommended range. This was the alternative with the highest ratio for King County.
- **Kitsap County.** The ratio of parks per 1,000 residents falls from a regional high of 81 acres in 2000 to 51 acres in 2040, still above the suggested standard.
- **Pierce County.** The ratio of parks per 1,000 residents falls well below the recommended range, from 8 acres in 2000 to 5 acres in 2040. This was the alternative with the lowest ratio for Pierce County.
- **Snohomish County.** The ratio of parks per 1,000 residents falls below the recommended range, from 23 acres in 2000 to 13 acres in 2040. This was the alternative with the lowest ratio for Snohomish County.

Access to Local Parks

At the regional level in 2040, approximately 4,098,500 residents and jobs in the Smaller Cities Alternative would be projected to be within ¼ mile of a local park or other open spaces. This compares to 2,592,100 residents and jobs in the year 2000.

- **King County.** Approximately 2,509,500 residents and jobs in the Smaller Cities Alternative are projected to be within ¼ mile of a local park or other open space in 2040.
- **Kitsap County.** Approximately 193,400 residents and jobs in the Smaller Cities Alternative are projected to be within ¼ mile of a local park or other open space in 2040.
- **Pierce County.** Approximately 570,200 residents and jobs in the Smaller Cities Alternative are projected to be within ¼ mile of a local park or other open space in 2040.
- **Snohomish County.** Approximately 825,500 residents and jobs in the Smaller Cities Alternative are projected to be within ¼ mile of a local park or other open space in 2040.

Impacts

Smaller suburban cities are envisioned to accommodate 30 percent of the region's population growth in the Smaller Cities Alternative. Today, these jurisdictions typically rely on schools for sports fields and on neighboring, larger suburban cities and county, state, and private lands for other types of outdoor recreation. To accommodate the envisioned levels of growth, these geographies will need to acquire available property and plan, fund, and provide new neighborhood and community parks, trails, waterfront access where appropriate, and athletic complexes. Increased population in smaller incorporated jurisdictions would intensify competition for available undeveloped land in smaller suburban cities, making it less available and affordable for development as new neighborhood and community parks, athletic fields, and trails. Increased demand for limited existing facilities might cause overuse and reduce the quality of visitor experience for some users, whereas others might enjoy the increased activity.

Increased numbers of visitors would require significantly increased local resources to plan and fund capital projects, and to operate and maintain both existing and new parks facilities. Provision of new parks and open spaces concurrent with large scale redevelopment and infill projects would become increasingly important to maintain quality of life in more densely developed urban areas. Linear urban parks, redeveloped boulevards and greenstreets, and public plazas and squares would become even more important parts of the public realm used for both passive and active recreation. Because smaller suburban cities currently have few developed recreational resources, these additions would be largely beneficial. However, outdoor recreation that relies on natural resources, such as undeveloped private land or undisturbed natural areas, may be affected by displacement of these resources by new land uses and higher levels of density.

Unincorporated urban growth areas are predicted to receive 35 percent of the region's forecast population and employment growth under the Smaller Cities Alternative. As stated above, these geographies often do not have local parks, but rather rely on schools for sports fields and county, state, and private lands, as well as facilities in neighboring incorporated cities for other types of outdoor recreation. The envisioned level of growth would increase demand for the development of new neighborhood parks and athletic complexes. While land for these facilities would be available, it could place additional pressure on counties to develop, operate, and maintain these facilities. This would represent a reversal of current trends, which show that current resources have forced county governments to increasingly rely on local governments for the provision, operation, and maintenance of local parks and recreational facilities. Growth in unincorporated urban growth areas would likely increase the use of parks and facilities operated and maintained by neighboring incorporated jurisdictions. While these jurisdictions may be able to satisfy demand, residents living in unincorporated areas typically do not contribute to the local taxes generated for operation and maintenance, and programs may need to be developed to address this interjurisdictional issue. Outdoor recreation that relies on access to relatively undeveloped or undisturbed natural areas may be affected by displacement of these resources. Because increased population brings a higher level of use, that might impact the quality of some visitors' experiences.

Impacts to parks and open space facilities in rural areas in the Smaller Cities Alternative would be similar to those described in Growth Targets Extended.

5.8.3 Cumulative Effects

As population and employment in the four-county area and beyond increases, the region would experience other changes to its overall physical and cultural environment. Some of these changes affecting parks and recreation would include related efforts for transportation, utilities, commercial development, planned communities, and changes in zoning. Other changes relate to trends in the way that people in the region live, work, and recreate. Demographics may change, and there will be other factors beyond just how many new residents join us over the next few decades, such as how close we live to our workplaces, and what we do with our spare time. Cumulative effects to parks could include the following:

- Population-generated increased levels of development may limit land available for development for recreation in some areas.
- Population growth may cause intense competition for available land, which could result in high land costs in some areas and make it difficult to develop sufficient park space to provide adequate levels of service.
- Infrastructure and facilities that serve growing populations (e.g., stormwater facilities, power and communication lines, sewer, water, gas lines) may intrude on existing or potential recreational lands.
- The increasing number of residents above the age of 65 with free time is expected to cause higher levels of park use or change the types of uses.
- Increased travel demand may increase travel time to regional recreational resources associated with major public lands and may require the development of alternate means for people to travel to these recreational facilities.
- Development of undeveloped open space and natural areas may impact wildlife habitat and plant communities at the heart of many recreational facilities.
- Development of rural areas may increase casual use in currently hard-to-reach state and federal lands or introduce recreational uses that conflict with current active natural resource uses.
- Increased development may conflict aesthetically with nearby existing open space and parks and recreational facilities.



5.8.4 Potential Mitigation Measures

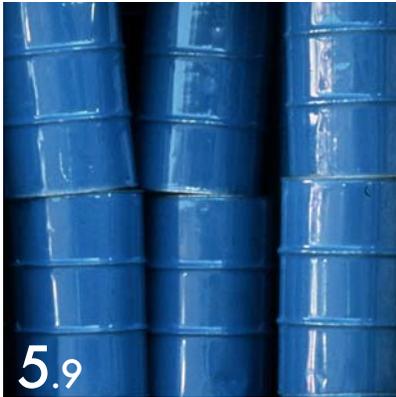
Mitigation of the effects of population growth on parks and recreation could take many forms, ranging from high-level regional planning to techniques for improving the physical properties of specific parks resources. Measures could include the following:

- Develop level-of-service guidelines for parks and recreation facilities that help the region and its communities evaluate facility needs, determine land needs for recreation facilities, and relate recreational needs on a more regional level.
- Commit to planning, funding, and constructing recreational facilities to achieve high levels of access and quality of service.
- Develop a comprehensive program for acquiring land for public use that will meet the projected needs of growing populations. Site facilities, when possible, where they will be most valuable to the public.
- Adopt local development impact fees for parks as authorized under the state Growth Management Act.
- Commit funding for maintenance and enhancements of existing facilities.
- Adopt local park development, enhancement, and maintenance levies.
- Preserve and enhance access to and interpretation of natural features.
- Redevelop brownfield sites, closed mining sites, landfills, and inactive industrial areas as public recreation facilities.
- When developing new infrastructure and facilities that serve growing populations (e.g., stormwater facilities, power and communication lines, sewer, water, gas lines), explore the possibility of joint recreational use. Examples include use of utility rights of way as trails (Chief Sealth Trail) and seasonal stormwater detention ponds as dog parks.
- Ensure that neighborhood parks are located near the greatest number of people possible (e.g., some local jurisdictions have planning guidelines for park development that suggest a goal for locating parks within 1/8 mile of dense communities for ease of access and convenience of use).
- Include bike lanes, broad sidewalks, and shared-use paths in the comprehensive planning for new transportation and recreation development and redevelopment.
- Plan for and provide public transportation, sidewalks, and trails systems that enhance convenient access to recreational facilities.
- Provide incentives and ordinances that encourage private developers to provide active recreation and passive open space concurrent with development projects, along with safe and efficient nonmotorized connections between recreational resources.
- Plan recreational resources on a regional or statewide scale to provide a comprehensive understanding and approach to regional parks and recreation resources.
- Expand the use of joint operating agreements between schools and local jurisdictions.

5.8.5 Significant Unavoidable Adverse Impacts

Effects on recreational resources generated by population increases are many and varied and could include crowding, need for increased maintenance, increased capital expense, conflicts between different types of recreational users, degradation of natural resources, displacement of undeveloped open space, and diminished convenience of access. The intensity and distribution of these impacts at the local level would tend to correspond with population growth. Small increases could likely cause minor to moderate impacts, whereas higher levels of growth would be anticipated to cause more significant impacts.

Increased use of natural area resources could conflict with goals to preserve sensitive areas and natural resources. It is possible that more active use of existing facilities could act as a disincentive for recreation for some users. Increased demand for adequate parks and recreational facilities will place increased pressure on local governments to acquire additional financial and human resources to fund, plan, develop, maintain, and operate new and existing facilities.



Environmental Health

This chapter focuses on how the growth distribution alternatives can impact the possibility for exposure to potentially hazardous materials. Other environmental health topics such as active living, noise, and air quality are also discussed. Some summary highlights are noted below regarding potential impacts.

5.9.1 Affected Environment

Although the State Environmental Policy Act requires discussion of Environmental Health related to a specific set of concerns (primarily hazardous materials), this section also responds to public scoping comments and discusses a wider range of environmental and human health issues. According to the University of Washington, environmental health is “the study of how environmental factors can harm human health and how to identify, prevent, and control these effects” (UW, 2000). Environmental health topics include quality of life as well as aspects of human health that are determined by biological, chemical, and social factors. The purpose of analyzing topics relating to environmental health is to determine the necessary measures to assess, correct, control, and prevent potentially adverse environmental factors that may have an adverse impact on public health.

Many topics relating to human health are discussed elsewhere in this Draft Environmental Impact Statement and include:

- Provision of adequate and affordable housing and maintenance of existing housing. They are key factors in promoting and maintaining the public health of a community.
- Safety, including personal safety, as well as mobility-related safety (automobile, transit use, biking and walking).
- Noise may be considered an emerging environmental health issue, due to potential noise increases from transportation, industry, and other sources in urban environment.
- The availability of sidewalks, bikeways and pedestrian-friendly development contributes to physical activity and general well-being of the population.
- Proximity and degree of risk of exposure to hazardous materials. A particular area of concern is the proximity of hazardous waste clean-up sites to residential communities.
- Air quality is a continuing concern, and while the Puget Sound Clean Air Agency addresses this issue, it is also a concern to environmental health — particularly the relationship to respiratory disease.
- Equitable community distribution of potential exposures to environmental hazards and the involvement of all citizens in the planning process.

Among these topics, noise is addressed in *Chapter 5.14*, while safety is discussed in the Health Issue Paper and Transportation Issue Paper in *Appendix E*. Water quality discussions, including surface water contamination and impaired waters, are addressed in *Chapter 5.6 – Water Quality and Hydrology*. Nonmotorized facilities are addressed in *Chapter 5.3*



– *Transportation*. Active living considerations are addressed in more detail in the Health Issue Paper and Transportation Issue Paper, which is included in *Appendix E*. Air quality, including a discussion of respiratory illnesses, is addressed in *Chapter 5-4*. Issues of equitable community distribution are part of discussion in *Chapter 6 – Environmental Justice*.

The additional analysis of environmental health considerations presented below focuses on information related to the location and nature of potentially hazardous material.

A. TOXIC AND HAZARDOUS MATERIALS

For a risk to human health and the environment to exist, two components must be present:

- Toxicity or hazard, which creates the potential for a substance to cause an adverse health impact (e.g., cancer).
- Exposure, which creates the potential for humans or environmental receptors to come into contact with the hazardous materials.

Examples of potentially hazardous sites include:¹

- Underground storage tanks
- Locations on the Toxic Release Inventory
- Industrial sites
- Hazardous waste generators
- Hazardous waste transfer facilities
- Federal (Superfund) cleanup sites
- Locations on the Emergency/Hazard Chemical Report
- Locations on the Remedial Action Program

Sites with identified chemical releases pose the greatest potential risk from toxic materials in or near the urban growth boundaries. The sites generally known as hazardous waste sites show exceedances of hazardous chemicals, as defined by the State of Washington (Model Toxics Control Act, as well as provisions for dangerous waste regulations, WAC Section 173-303) and the federal government (Comprehensive Environmental Response, Compensation, and Liability Act, commonly known as Superfund).

B. SOURCES AND TYPES OF HAZARDOUS MATERIALS

The following are typical examples of land uses that are potential sources of hazardous materials; the types of associated chemicals are shown in parentheses:

- Vehicle-related businesses, such as gasoline stations, oil-change facilities, and vehicle repair and maintenance facilities (gasoline, diesel fuel, paints, solvents, and oils).
- Other land uses such as dry cleaners (solvents), chemical and photographic labs (solvents, other chemicals), lumber mills (wood preservatives, heavy metals), railroad yards (fuels, oils, solvents), and landfills (methane gas, leachate).
- Light industry, such as machine shops (solvents), storage yards, electrical parts manufacturers (solvents, polychlorinated biphenyls [PCBs]), boat builders and repairers (fuels, oils, solvents, resins), and metal finishers and plasters (heavy metals, solvents).
- Heavy industry and manufacturing, such as fuel and chemical distribution and storage, railroad facilities, and steel mills (fuels, oils, solvents, metals).
- Stormwater and wastewater outfalls and non-paint source pollutants. Contaminants in water may be discharged into rivers, lakes and Puget Sound and eventually settle in sediments and along shorelines.

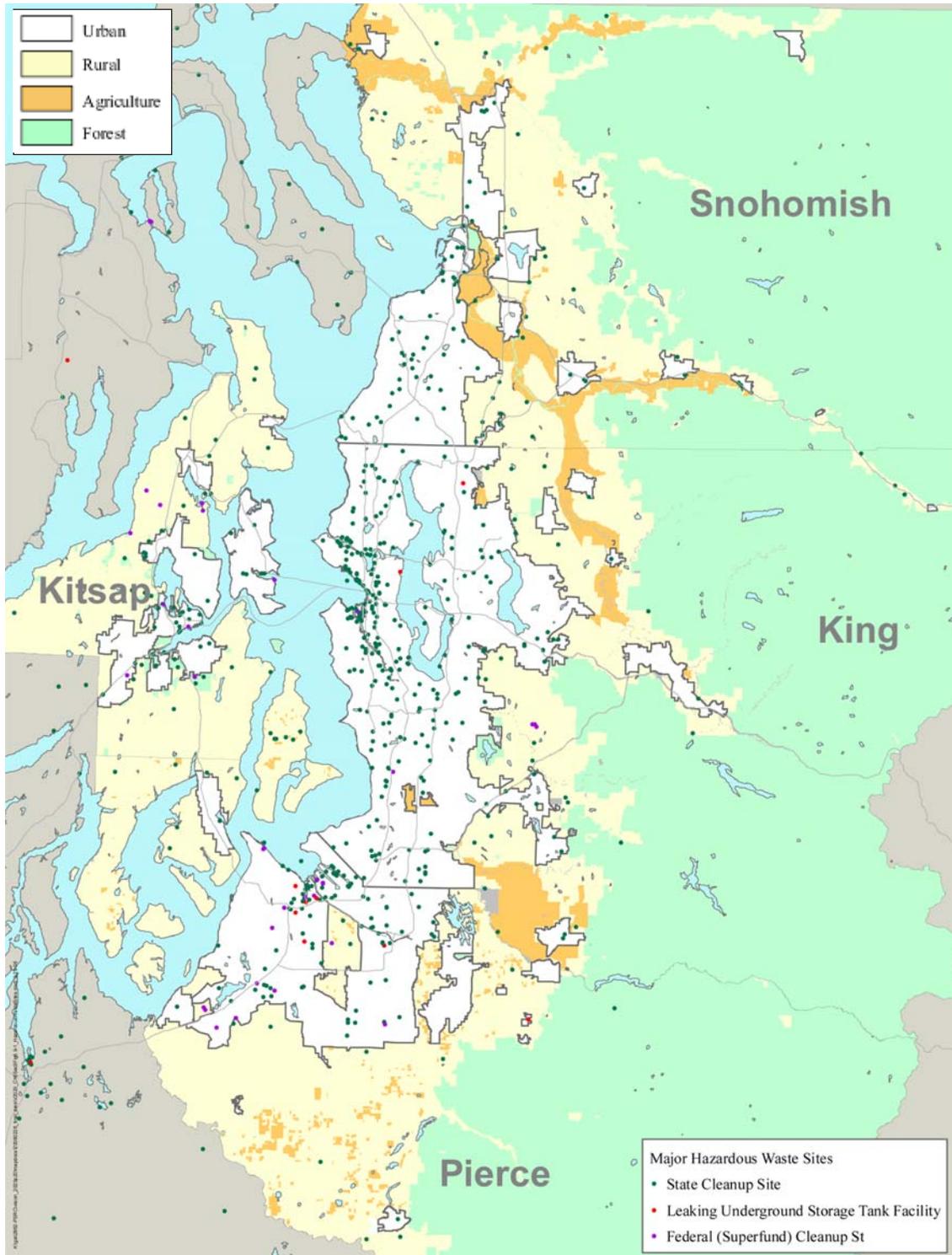
C. LAND USES OF POTENTIAL ENVIRONMENTAL CONCERN

Contaminated-site maps were reviewed for the urbanized areas of King, Kitsap, Pierce and Snohomish counties. Contaminated sites of particular concern are located in all four counties — commonly near shorelines, major

¹ Sources: Washington Department of Ecology base data

transportation corridors, and in industrial and manufacturing areas. Figure 5-9-1 illustrates the location of potentially significant hazardous waste sites in the region, using 2005 data from the Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology).²

FIGURE 5-9-1: POTENTIALLY SIGNIFICANT HAZARDOUS WASTE SITES IN THE CENTRAL PUGET SOUND REGION



Source: Washington State Department of Ecology

² CERCLIS Database. U.S. Environmental Protection Agency. October 27th, 2005. <http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm>.



D. APPLICABLE FEDERAL AND STATE LAWS

A high degree of regulation applies to the release and management of hazardous materials. Future development projects and the actions of local governments to accommodate growth would likely be subject to the following regulations:

- ***Occupational Safety and Health Act of 1970 (29 U.S.C. Sec. 651 et seq.)***
Purposes: To encourage employers and employees in their efforts to reduce the occupational safety and health hazards at their places of employment, and to stimulate employers and employees to perfect existing programs and institute new ones for providing safe and healthful working conditions.
- ***Washington Industrial Safety and Health Act (Chapter 49.17 RCW)***
Purposes: To create, maintain, continue, and enhance the industrial safety and health program of the state, which shall equal or exceed the standards prescribed by the Occupational Safety and Health Act of 1970 (Public Law 91-596, 84 Stat. 1590).
- ***Model Toxics Control Act (Chapter 173-340 WAC)***
Purposes: To establish administrative processes and standards to identify, investigate, and clean up facilities with hazardous substances. It defines the role of the Department of Ecology and encourages public involvement in decision making at these facilities.
- ***Dangerous Waste Regulations (Chapter 173-303 WAC)***
Purpose: To designate solid wastes which are dangerous or extremely hazardous to public health and the environment. Provide surveillance and monitoring of dangerous and extremely hazardous wastes until they are detoxified, reclaimed, neutralized, or disposed of safely. Provide the form and rules necessary to establish a system for manifesting, tracking, reporting, monitoring, recordkeeping, sampling, and labeling wastes. Establish the siting, design, operation, closure, post-closure, financial, and monitoring requirements for waste transfer, treatment, storage, and disposal facilities. Establish design, operation, and monitoring requirements for managing the state's extremely hazardous waste disposal facility. Establish and administer a program for permitting dangerous and extremely hazardous waste management facilities. Encourage recycling, reuse, reclamation, and recovery to the maximum extent possible.
- ***Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)***
Purposes: Establish prohibitions and requirements concerning closed and abandoned hazardous waste sites. Provide for liability of persons responsible for releases of hazardous waste at these sites. Establish a trust fund to provide for cleanup when no responsible party can be identified.

For more discussion of other environmental regulations related to air quality, see *Chapter 5.4 – Air Quality*.

E. INTERDISCIPLINARY CONSIDERATIONS

In order to effectively maintain the environmental health of a region and determine which growth model could best serve the population, there are many interrelated factors to consider. In order to understand regional environmental health, policy makers must take into account different disciplines such as toxicology, sociology, public policy, and epidemiology, among others. The following text gives a brief overview of the interrelationships between human health and the built environment.

Much research has been conducted to explore the link between human health and the built environment. One of the primary concerns for human health is air pollution and its adverse health impacts such as cardiovascular diseases, asthma, and other respiratory illnesses.

In the paper *“At the Microscale: Compact Growth and Adverse Health Impacts,”* researcher Gail Sandlin notes that in Washington state “...the primary source of air pollutants is motor vehicles” (Sandlin, 2005). The paper later discusses the concept of the “urban canyon,” which is an area of urban streets surrounded by buildings on both sides, which trap high concentrations of traffic pollutants. High-density urban designs often foster increased opportunities for physical activity due to decreased reliance on personal automobiles. While pedestrians are experiencing the health benefits of walking, these benefits may be negated by the fact that they are being exposed to high levels of particulate matter in these urban canyons. Mitigation measures, such as improving vehicle emissions to reduce levels of carbon dioxide and other particulate matter, should be explored to avoid potential health impacts due to air quality.

The built environment also has an impact on the mental health of individuals in the community. In 2003, G.W. Evans concluded that the physical environment may have indirect influence on mental health by “...altering psychosocial

processes” (Evans, 2003). Evans further argues, “Personal control, socially supportive relationships, and restoration from stress and fatigue are all affected by properties of the built environment” (Evans, 2003). Walkable and mixed-use communities have been proven to foster a sense of community and provide positive mental and physical health benefits for community members.

High-density urban design has the potential to decrease reliance on personal automobiles, which can encourage physical activity and reduce diabetes, obesity, cardiovascular disease and other health problems. However, as more people live and work in urban areas, more people may be exposed to impacts such as noise and air pollution.

Dispersed growth models have risks and trade-offs, as well. Greater travel distances typically occur with a more dispersed, lower density development pattern, leading people to drive more and farther to access jobs, schools, shopping, and entertainment. This increase in driving often leads to an increase in vehicular-related accidents and fatalities (Deary, 2006).

Obesity has been called an epidemic and Deary states that obesity is “...the most recently publicized link between the built environment and public health...” (Deary, 2004). Studies have shown that low-density development is associated with more vehicle travel and low levels of physically active modes of transportation such as walking or bicycling. The converse is associated with high-density development (Deary, 2004).

Tony McMichael argues in his book *Human Frontiers, Environments, and Disease* that over-eating is not the sole cause of rising obesity levels but instead is a result of “... a systematic imbalance between the average amounts of energy ingested and expended” (McMichael, 2001). Walkable cities, increased food options for people of all races and socioeconomic levels, and mixed-use development are all mitigation measures that may help curb the obesity epidemic.

5.9.2 Analysis of Alternatives (Long-Term Impacts)

A. IMPACTS COMMON TO ALL ALTERNATIVES

The four alternatives would indirectly result in redevelopment or development activities that could potentially occur in the presence of hazardous materials. All of the alternatives would involve urban activities that would involve the use of hazardous materials. This could include the need to develop or transport increased amounts of hazardous materials to support economic growth and human activities (i.e., transportation, aviation, heating, power, etc.).

Workers excavating contaminated soils and being exposed to contaminated groundwater and people living near construction areas are most likely to be affected, but releases can also affect nearby people and the environment.

As Figure 5-9-1 shows, the highest number of contaminated or potentially contaminated sites is within the more established cities and along waterfronts and transportation corridors. The occurrence of contamination diminishes away from the established, city centers, transportation corridors and waterfronts, although pockets of large-scale contaminated sites (landfills, industrial, or manufacturing sites) still occur. Rural land uses, such as farms, can have areas with localized contamination, as can residential areas, usually related to fuel releases; however, the overall potential for contamination is lower in these areas. The incidence of both point and non-point source pollutants released to water from sewer and stormwater systems may carry fertilizers, automobile runoff, and runoff from industrial, commercial, and other developments.

When growth is focused in areas with previous releases, cleanup and management requirements would result in an environmental benefit, although the costs of development could be higher to clean a contaminated property before construction could occur. When growth occurs in areas with few or no past releases, there could be an increased potential for new contamination to occur. However, with increasingly stringent regulations, the potential for harm is lower than in the past.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

Growth Targets Extended would keep the adopted planned proportions of regional growth in place and would extend the plans out until the year 2040. Population and employment growth would continue to be dispersed throughout major metropolitan cities and core suburban cities. Redevelopment of contaminated sites, as well as the risk of contaminating



new ones, is likely under Growth Targets Extended. However, rural areas and the less developed unincorporated urban growth area would also be developed, which increases the potential for future releases.

The Growth Targets Extended and Smaller Cities alternatives, with their dispersed growth patterns are estimated to have the highest amount of vehicle miles traveled. Decreases in the amount of daily physical activity are also likely given that supermarkets, entertainment, schools, and major centers of employment would not be within walking distances in many instances. This could have impacts on community-building, various physical and mental health concerns, habitat loss, and would likely degrade air and water quality.

Unincorporated urban and rural areas would experience the second highest levels of growth under Growth Targets Extended as would large and metropolitan cities. Improvements and expansion of existing roads and highway systems would be necessary, as could the construction of new roads. Transportation forecasts show that Growth Targets Extended increases travel demand compared to other more focused growth alternatives (Metropolitan Cities and Larger Cities alternatives). The impacts associated with this are discussed in great detail in *Chapter 5.3 – Transportation*.

METROPOLITAN CITIES ALTERNATIVE

The intent of the Metropolitan Cities Alternative is to focus growth in the region's major centers, primarily Seattle, Tacoma, Bremerton, Everett, and Bellevue, and to limit growth in less developed parts of the region. Under the Metropolitan Cities Alternative, environmental and hazardous waste risks would be largely confined to metropolitan cities and would be reduced in outlying rural areas. As these cities are more established and have a higher level of occurrence of past uses that are likely to have caused releases to the environment, there could be a greater likelihood that development and redevelopment would encounter contaminated sites. Cleanup would be a benefit, but costs for development would increase. In economic terms, higher intensity development could create an "economy of scale," or provide sufficient market value for available redevelopable land to attract investments.

The Metropolitan Cities Alternative would have higher density development in cities such as Seattle, Tacoma, Everett, and Bellevue, with the potential for exposing people to typical impacts found in denser areas (air quality, noise), but also providing the potential for walking, biking, and transit to compete with the private automobile, and encourage greater levels of physical activity.

LARGER CITIES ALTERNATIVE

Under the Larger Cities Alternative, growth would be concentrated in core suburban and larger suburban cities. This likely means that the benefits of cleanup from redevelopment would be spread throughout a larger area. Areas presently classified as open space or low density would still be relatively protected from risks of environmental degradation and hazardous materials under the Larger Cities Alternative. However, with a more dispersed growth pattern, the pressure to redevelop previously contaminated sites may be less than for more focused growth alternatives such as the Metropolitan Cities Alternative.

The impacts to human health by regional geography and county expected under the Larger Cities Alternative are similar to those expected under the Metropolitan Cities Alternative, but with a higher potential to increase density in currently suburban cities. These areas would have an increased potential for changes in transportation choices, particularly transit, walking, and biking. They also tend to have lower levels of localized air quality pollutants than the densest urban cities, and exposure of people to adverse health effects of urbanization would be somewhat less.

SMALLER CITIES ALTERNATIVE

Under this alternative, growth would be widely dispersed in outlying portions of the urban growth area and beyond into the rural area. As growth disperses, the risk of contaminating new sites with hazardous waste increases (although this is limited given current regulations). The Smaller Cities Alternative could expose areas presently defined as rural and open space to the risks associated with development far more than the development proposed in other alternatives because growth is spread over a wider area.

The impacts to human health by regional geography and county expected under the Smaller Cities Alternative are similar to those expected under Growth Targets Extended.

5.9.3 Cumulative Effects

The impacts discussed are inherently cumulative in that they consider the past and future activities of others and involve actions that would not directly occur with PSRC's adoption of an updated vision.

- The demand for fuel, power, and materials could increase pressures to develop or expand manufacturing or processing activities that involve hazardous materials.
- Increased development activities would result in a higher potential for the release of hazardous materials.
- The military bases in the region are also potential sources of contamination.

5.9.4 Potential Mitigation Measures

For hazardous waste management, as individual projects are developed, they would be subject to approval and would need to be in compliance with the regulatory requirements as discussed above. This would minimize the potential for further release of hazardous materials and the exposure or further transport of past releases. However, the potential for exposure would still exist under all alternatives. Actions to help minimize the level of exposure to resources and people, and to encourage cleanup of contaminated properties include:

- Incentives or actions to encourage "brownfields" redevelopment either by individual jurisdictions or collectively in the region.
- Seeking alternatives to the use of chemical-intensive activities.
- Seeking alternatives to petroleum-based fuels for heating, transportation and manufacturing.
- Further refinement of land use plans to discourage chemical-intensive industries or practices from occurring in areas that have been identified as high priority conservation areas (or that are in areas where large amounts of people live and work).

Many adverse health impacts could be mitigated through planning and design measures that emphasize alternatives to driving. Walkable cities could increase physical activity levels with all of its associated benefits. Parks, greenbelts, bicycle paths, and mixed-use development are all ways to encourage community building, alternative means of transportation, and higher levels of physical activity. Stringent vehicle emissions policies would help curb air pollution.

The Sandlin paper also identifies the following as possible mitigation strategies:

- **Improved Education could also help minimize human health impacts.** Understanding the interdisciplinary relationship between many issues relating to environmental and public health is key to developing appropriate growth models and mitigation measures. According to Sandlin, "...only 7 percent of accredited planning programs in North America offer specialized coursework in air quality planning," (Sandlin, 2005) which shows a potential disconnect in the academic world. Collaboration between different disciplines could greatly improve big picture understanding and would lead to better policy decisions.
- **Technological Advances.** Underutilized technological advances could mitigate impacts to environmental health. For instance, more fuel-efficient buses are already being used in the Puget Sound region as a result of the implementation of the Diesel Solutions program developed by the Puget Sound Clean Air Agency. Additional discussion of air quality mitigation is found in *Chapter 5.4 – Air Quality*.

5.9.5 Significant Unavoidable Adverse Impacts

Development and redevelopment will occur under all alternatives, and the risk of encountering old hazardous sites (and creating new ones) is present under all alternatives as well. With increased development comes an increased risk to human health in the form of exposure to toxic or hazardous materials. The benefit of promoting growth within already developed metropolitan and larger cities is the decreased risk of contaminating less spoiled rural and open areas. However, when the risks to human health as a result of site contamination from hazardous materials are analyzed together, the differences between the alternatives are minimal. Cleanup of contaminated sites in order to redevelop sites presently deemed unfit for use is possible under all alternatives.

Some of the other human health concerns associated with increased development, as discussed above, could be reduced by mitigation, but not wholly avoided.







Energy

This chapter discusses energy issues, focusing on the main types of energy in the region, which are electrical power, natural gas, and petroleum. For each of these types, this chapter discusses consumption, sources and availability, and conservation and renewable sources, and the potential for impacts to energy under each of the growth distribution alternatives.

5.10.1 Affected Environment

A. ENERGY CONSUMPTION

Total energy use in Washington increased 67 percent from 1970 to 1997 (Washington State Department of Community, Trade, and Economic Development, 2006). Transportation energy use is the fastest growing part of energy use, largely related to population growth and increases in per capita travel. This section discusses the consumption of electrical power, natural gas, and petroleum. The difference between primary and end-use energy consumption is the treatment of electricity (fuels such as natural gas, petroleum, and coal are primary energy sources). Electricity must be generated using energy sources such as coal, natural gas, or falling water. These inputs to the power plant are counted as primary energy; the output of the power plant that is consumed by homes and businesses is end-use electricity. The suppliers of these energy sources are discussed in section B – Source and Availability.

Electrical Power

Electricity consumption in Washington has grown steadily over the last several decades and by 1999 was almost four times greater than in 1960. But this growth in overall electricity use reversed in 2001 due to a significant decline in industrial electricity use, largely due to the shutdown of aluminum smelters in Washington. In 2004 the residential sector used the most electricity, accounting for 39 percent of the total, with the commercial sector using 35 percent, and the industrial sector 27 percent. Historically, the demand for electric power peaks in winter months. However, some of the dense urban centers (e.g., Seattle and Bellevue) now reach their peak demands in the summer due to increased use of cooling systems.¹

Natural Gas

Natural gas consumption in Washington state has grown significantly since the early 1980s and is now more than three times greater than the value in 1982 and 1983 (Washington Department of Community, Trade, and Economic Development, 2003). Currently, industrial consumption accounts for about a third of total use and residential and commercial use accounts for a little more than 20 percent of total use each. Electricity generation accounts for almost a quarter

¹ Puget Sound Regional Council (2005). VISION 2020 Energy Issue Paper. See *Appendix E*.



of use. Residential and commercial consumption has been relatively stable with growth in the 1990s due to population and economic growth as well as an increasing preference for natural gas for space and water heating. Industrial natural gas consumption tends to be more volatile and price sensitive than the residential and commercial sectors.

Natural gas prices have been driven higher by numerous domestic and international events, ranging from hurricanes in the Gulf Coast region to more rapid decline in natural gas well production than originally predicted. Overall, the demand for natural gas has remained high, which is reflected in higher market prices.

Petroleum

In 2001, residents of Washington consumed a total of 17.5 million gallons per day of refined petroleum products. Washington residents consume gasoline at a rate of 7.5 million gallons per day, diesel at 2.8 million gallons per day, jet fuel at 2.5 million gallons per day, liquefied petroleum gas at 0.8 million gallons per day and residual fuel at 0.7 million gallons per day. In Washington state over the last 25 years, demand for refined petroleum products has been increasing at about 1.7 percent (average rate) per year, or just a bit more than the state's long-term population growth rate. In the early 1980s demand actually fell for several years, but began to increase again as fuel prices declined in the mid-1980s. Most of the increase in demand has been for transportation fuels, with gasoline demand up by more than 50 percent, diesel (distillate) demand up by more than 40 percent, and jet fuel demand up by more than 100 percent since 1980.

As mentioned previously, most of the recent growth in energy consumption was due to transportation energy use, largely related to population growth and increases in per capita travel. From 1985 to 1997, transportation use grew at 3.7 percent per year (Washington State Energy Office, 2001). Consumption of fuels for travel is influenced by several factors. These include the number of trips made by automobiles, the amount of congestion on the roadway system, and the mix of vehicles using the system. The amount of vehicular travel is influenced by the urban environment, mainly the spatial relationships among residences, work, and other travel objectives. The non-vehicular travel or higher-occupancy modes available may also affect the amount of vehicle traffic in the region. Transportation costs are the second highest expenditure in the typical American household budget, trailing only mortgage costs (Surface Transportation Policy Project, 2003). Greater dependency on automobiles for most daily travel will increase household costs. Oil consumption will be especially problematic if increased need for automobiles results in increased automobile ownership levels. The estimated cost of an additional auto ranges from \$4,000 to \$8,000 a year.

Petroleum gasoline and diesel are projected to continue to be critical components for nearly all forms of regional vehicular mobility — cars, trucks, buses, trains and ferries. Given continued U.S. dependence on foreign oil imports, international oil supply and demand will be relevant to the central Puget Sound region for public and private transportation.

Like natural gas, petroleum has been driven higher by numerous domestic and international events, ranging from hurricanes in the Gulf Coast region to rapidly increasing petroleum demand in China. For example, in fall 2005, oil shortfalls resulting from Hurricane Katrina's impact on U.S. oil supplies demonstrated the high degree of retail price sensitivity to available supply. Overall, the demand for petroleum has remained high, which is reflected in higher market prices.

B. SOURCE AND AVAILABILITY

This section describes the providers of electrical power, natural gas, and petroleum, and discusses the availability of those energy sources. Energy resources and supplies in the Pacific Northwest and the central Puget Sound region differ significantly from those in other sections of the country. Hydroelectric power has historically provided 80 percent of the electricity in the region, while the rest of the nation depends on hydroelectric power for 15 percent of its energy. The Pacific Northwest does not have oil, gas, or coal resources like many other areas, although the area refines gasoline in excess of its own requirements.

The characteristics of the electrical power, natural gas, and petroleum suppliers in the region vary considerably in regional scope, corporate structure, capitalization, and function. The area is served by large, small, for-profit, and not-for-profit utilities. The federal government, through the Bonneville Power Administration, Army Corps of Engineers, and the Bureau of Reclamation, owns a large amount of the power generation and transmission resources that the region depends upon. Electric power, natural gas, and petroleum infrastructures are multistate and international, creating considerable cross-border interdependencies for both reliability and economy. The systems are highly interconnected networks covering vast regions of the western United States, Canada, and portions of Mexico.

Electrical Power

Hydroelectricity is the Washington state's main electricity source, accounting for 66 percent of electricity consumed in the state in 2004. Electricity generated from coal accounted for 18 percent of electricity used. There is one coal-fired power plant in the state. Some coal-fired power is purchased from plants located in other states, including Wyoming and Montana. Natural gas (9 percent) and nuclear power plants (6 percent) are the primary sources for the remainder of the electricity used. Other renewable sources accounted for less than 1½ percent of the electricity purchased. Biomass² (0.7 percent) is the largest renewable generation source, followed by wind generation (0.4 percent). Over 70 percent of the new generation added since 1998 in the Northwest is produced from natural gas power plants. Most of the remaining new capacity is wind-powered generation. While this diversifies our existing mix of generation, we are dependent on one fuel source for our new generation — wind power. Transmission line construction has been minimal since 1987.

Washington is part of an interconnected, regional bulk power system. Utilities purchase electricity generated from a variety of sources throughout the region to serve consumers in Washington. A unique aspect of the electric utility industry in Washington relative to most states is that publicly owned utilities account for more than half of Washington state's customers and electricity sales to end-users. This has energy policy implications because these public utilities are accountable to locally elected boards rather than the state utility commission.

Federal hydroelectric facilities are used to meet the demand of customers in the Puget Sound region. In general, power is generated in eastern Washington, Idaho, and Montana and is transmitted over high-voltage transmission lines to the region. It is important to recognize that total generation from hydroelectric dams varies depending on water flow in rivers. Environmental requirements, drought conditions, low snow pack, or poorly timed run-off can lower hydro production. Generation in 2001 was 32 percent lower than the average over the last 30 years. This compares to the peak year in 1997 when generation was 29 percent greater than the average.

Other factors that will affect the supply of electric power are the expiration of Bonneville Power Administration power supply contracts and the transmission grid (PSRC, 2005). The Bonneville Power Administration is beginning to renegotiate power supply contracts that expire in 2011. The new long-term contracts and rates will affect customers of all utilities in the central Puget Sound region. Transmission bottlenecks severely constrain the amount of capacity that can be delivered to the region. Grid West and the Transmission Group are in the process of developing proposals to address a raft of regional problems and opportunities.

Washington state generators produce more electricity than is needed in the state. In 2004 power plants in Washington generated 24 percent more electricity than was consumed in the state. While West Coast supply was an issue earlier in this decade, the addition of electricity capacity in California and the Northwest in the last several years, along with reductions in electricity demand, has resulted in a much improved supply situation. The Northwest Power and Conservation Council projects adequate generation capacity through 2010, but significant changes in economic activity and electricity load growth could change this situation. Most providers expect a need for additional electrical power resources by 2040 or sooner. See the next section on Conservation and Renewable Energy, for some strategies being implemented to meet power demands.

Six electric utilities provide electric power in the Puget Sound region: Puget Sound Energy, Seattle City Light, Snohomish County Public Utility District, Tacoma Power, Peninsula Light Company, and Bonneville Power Administration. These utilities are described in more detail below.

Bonneville Power Administration. The Bonneville Power Administration (BPA) is an extension of the federal government, and along with the Army Corps of Engineers and the Bureau of Reclamation, it owns major power generation and transmission resources on which the Puget Sound region depends.

BPA is currently divided into two main business lines — power and transmission. Both are operated under a single administrator. The power business line operates the power plants in the Federal Columbia River Power System. The system has 23,000 megawatts of installed generating capacity at 29 federal dams and 7 nonfederal power plants, including a major nuclear project. Similarly, the transmission business line operates the transmission system that is a major part of the Western Interconnection³ in the Northwest Region.

² In the energy context, the term Biomass refers to the use of plant materials and/or animal waste used as a source of fuel (Source: Merriam-Webster Online dictionary).

³ The Western Interconnection includes all major electrical transmission facilities from British Columbia to portions of Mexico. The Western Interconnection includes all of the Pacific Coast states, as well as the intermountain provinces and states of Alberta, Montana, South Dakota, Nebraska, Colorado, and New Mexico.



BPA along with the Army Corps of Engineers and the Bureau of Reclamation owns a large share of power generation and transmission resources that serve the region. They currently operate 29 federal dams and 7 nonfederal power plants through their Power and Transmission Business Lines.

A large number of regional contracts with the BPA are set to expire in the year 2011. Beginning in 2006, new contracts will be offered by the BPA. At that time, customers must choose to continue receiving power from BPA at tiered rates, seek competitive power supply contracts, or agree to a combination of the two. The results of these contract negotiations will affect customers of all utilities in the Puget Sound region. Along with BPA, two other key organizations — the Northwest Power and Conservation Council and Grid West — have tremendous influence and impact on energy infrastructure in the Puget Sound region.

The Northwest Power and Conservation Council was created by Congress to give citizens of Idaho, Washington, Montana, and Oregon a stronger voice in deciding the future of electrical resources common to all states involved. The council produces a power plan, which addresses key policy issues including: the future role of the BPA in power supply, issues associated with fish and wildlife, planning, and funding.

Grid West is an independent, non-profit corporation comprised of regional grid owners. According to the energy issue paper produced by PSRC, Grid West is “a product of work by a comprehensive cross-section of the region’s transmission stakeholders, including transmission providers, power producers, end users, public power, environmental and other public interest organizations, and state, provincial, and tribal officials from across Idaho, Oregon, Washington, Montana, Utah, Wyoming, Nevada, British Columbia, and Alberta.” The purposes of this corporation include providing regional market monitoring and dispute resolution, transmission planning and capacity extension services, improved efficiency and reliability of power flows, and a more streamlined approach to transmission systems so as to align physical power flows with commercial commitments and forecasts.

Puget Sound Energy. Puget Sound Energy provides electricity and natural gas to portions of all four counties within the region. A variety of sources are used to generate energy, including hydroelectricity, coal, natural gas cogeneration, natural gas, nuclear, waste, biomass, landfill gas, and petroleum. Hydroelectric, coal, and natural gas account for approximately 94 percent of all energy production. The hydroelectric power produced by Puget Sound Energy is generated by non-federal projects on the Columbia River whose contracts begin to expire in 2011. It is expected that Puget Sound Energy will have insufficient resources to meet peak load in both the near and long term without acquiring additional production resources. As a result, Puget Sound Energy is currently acquiring wind and other power-generating resources to further diversify its production portfolio.

Puget Sound Energy’s retail gas distribution system is served by a single interstate, wholesale pipeline corridor, which is owned and operated by Williams’ Northwest Pipeline. While interstate and retail pipeline rates are regulated, wholesale prices for gas products are only partially regulated. Scarce supply in the face of increasing demand has driven wholesale gas prices to triple over the last 10 years. Because of this, inland production of gas will need to be augmented by more efficient and economical delivery of liquefied natural gas to ensure a reasonable price for natural gas.

Seattle City Light. Seattle City Light supplies electricity to approximately 365,000 customers. Source generators include hydroelectric, natural gas, nuclear, wind, coal, waste incineration, and biomass. Hydroelectric, natural gas, and nuclear account for approximately 97 percent of all of its energy production. Seattle City Light’s resource portfolio is not as diversified as Puget Sound Energy’s portfolio.

During normal and high water years, Seattle City Light produces surplus energy that can be sold in wholesale markets to offset the cost of power delivered to consumers. However, during drought years, the Seattle City Light portfolio exposes the utility and its customers to power supply risks. In the long term, Seattle City Light will need to apply for a new license for its Boundary hydroelectric facility in eastern Washington in 2009. The conditions that may apply to the new license are not known at this time.

Snohomish County Public Utility District. According to their Integrated Resource Plan, the Snohomish County Public Utilities District (PUD) receives 80 percent of its power from the Bonneville Power Administration. The remaining 20 percent of the total power is supplied by the Jackson Hydroelectric Project and Kimberly Clark. The Jackson Hydroelectric Project outputs power generated by the Culmbach Dam located on the Sultan River. The PUD receives 100 percent of the power output and has also secured the rights to raw water, which is delivered to Lake Chaplain for its water supply. The permit for this project expires in 2011. The Kimberly Clark Cogeneration Project went online in

1996; the PUD receives 100 percent of the power generated from steam in the Kimberly Clark mill process. The permit for this project expires in 2016 but could be extended up to 50 years.

Tacoma Power. Tacoma Power serves approximately 150,000 customers in the city of Tacoma and portions of Pierce County. Over half of Tacoma's retail load is served by power purchased from the Bonneville Power Administration, with additional power purchased from the Grant County PUD Priest Rapids hydroelectric system, Columbia Basin irrigation districts, and wholesale contracts. Tacoma owns four hydroelectric projects with a capacity of 713 megawatts. According to their 2004 Integrated Resource Plan, Tacoma Power's output will exceed the forecasted loads. Surplus conditions during the spring and summer months can be used to cover deficits in other months or sold in wholesale energy markets to optimize Tacoma's power supply portfolio.

Peninsula Light Company. Peninsula Light Company serves over 26,000 member homes and businesses, covering 112 square miles in western Pierce County. The service area includes Key Peninsula, Gig Harbor Peninsula, Fox Island, Tanglewood Island, Raft Island, and Herron Island. Peninsula Light Company is a locally owned non-profit cooperative directed by elected representatives from the community.

Natural Gas

More than two-thirds of our natural gas comes from western Canada (Alberta and British Columbia) with the rest from the Rockies (Wyoming, Utah and Colorado), but this mix can vary depending on the price of Canadian and domestic natural gas.

Higher natural gas prices are due to growing demand for natural gas. After peaking in the early 1980s, inflation adjusted retail natural gas prices declined significantly by 1990, nearing the price levels of the mid-1970s. Prices were relatively stable during most of the 1990s. Residential prices were highest and were almost twice as much as industrial rates for much of this period, largely due to the higher cost of delivering gas to smaller customers. Natural gas prices for utilities tended to be more volatile because consumption was primarily for natural gas-fired power plants used for meeting peak power demand. Beginning in 1999/2000 prices began to rise due to increased demand and constrained natural gas supply. Market prices for natural gas in Washington state grew 71, 82, and 178 percent for residential, commercial, and industrial users respectively from 1998 to 2004. Recent price forecasts indicate a continued tight supply-demand balance for natural gas and high prices. Most providers expect the need to increase natural gas imports and system capacity by 2040 or sooner. See the section on Conservation and Renewable Energy for some strategies being implemented to meet natural gas demands.

Three entities provide most of the region's requirements: Puget Sound Energy, Cascade Natural Gas, and Williams' Northwest Pipeline. Puget Sound Energy was discussed in the previous section and Cascade Natural Gas and Williams' Northwest Pipeline are discussed below. A single main bidirectional pipeline serves the Puget Sound region with lateral feeders.

Williams' Northwest Pipeline. Williams' Northwest Pipeline currently transports 85 percent of all natural gas consumed in Washington State. It delivers wholesale gas distributed by Puget Sound Energy and Cascade Natural Gas. Due to an amended corrective action order issued by the Office of Pipeline Safety, Williams' Northwest Pipeline has permanently abandoned its 26-inch pipeline in the Suma-Washougal corridor and has begun construction on a new pipeline at a cost of approximately \$331.1 million. Work is expected to be completed by the end of 2006.

Cascade Natural Gas. Cascade Natural Gas distributes natural gas to consumers in Bremerton, Port Orchard, and Poulsbo, as well as unincorporated communities in Bangor, Belfair, Chico, Gorst, Keyport, Manchester, Silverdale, and Sunnyslope.

Petroleum

The central Puget Sound region does not produce any petroleum. Washington state relies on imports from Alaska (74 percent), Canada (9.6 percent), Argentina (5.3 percent), Saudi Arabia (4 percent), plus other foreign imports (7 percent) to supply our needs (2003 import data). The North Slope region of Alaska has provided the majority of Washington's petroleum imports for the past 25 years. North Slope production has been in decline for about 15 years, so other petroleum producing regions have begun supplying Washington refineries. Over the next 20 years petroleum imports are expected to increase, particularly from Canada. There are five oil refineries in Washington state that produce a full range of refined petroleum products. The refineries are located in Ferndale, Anacortes, and Tacoma.



Petroleum products produced at these refineries are distributed throughout Washington and other parts of the Northwest by the Olympic Pipeline, barge and truck.

There are several factors energy analysts cite as responsible for the current high prices for petroleum and refined petroleum product. These are:

- Rapid growth in global demand over the past few years that has created a tight balance between available petroleum supply and demand.
- A shortage of low viscosity and sulfur petroleum.
- Forecasts of continued petroleum demand growth despite high prices.
- War and terror price premiums.
- A shortage of world refining capacity, particularly in the United States.

Demand for gasoline usually peaks during the period from late June through August due to higher demand. Gasoline demand starts to fall in early September and reaches its lowest levels in January. If petroleum prices are stable, retail prices for gasoline tend to follow demand pattern: higher in the summer, lower in the winter. The price for diesel fuel follows a different pattern, since diesel and home heating oil is nearly the same product. Demand for home heating oil starts to increase in September and is strong through January. If petroleum prices are stable, retail prices for diesel often rise in the fall and decline in the spring.

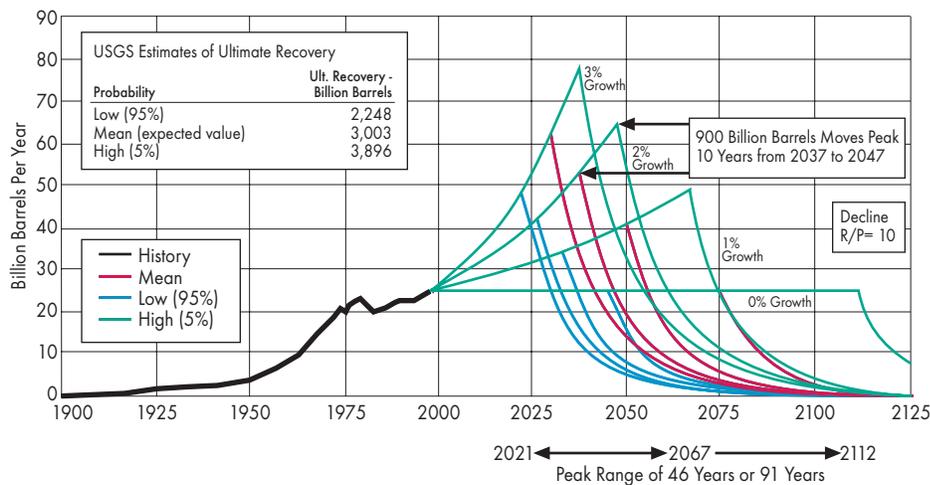
There is a vigorous debate in the petroleum industry as to whether there are adequate petroleum supplies to sustain the anticipated increasing global consumption levels over the next 20 to 30 years. The pessimists in this debate, known as peak oil advocates, note that global petroleum discoveries have been trailing global petroleum consumption for about 10 years. Many of the most productive fields in the Middle East are over 50 years old and production is being sustained by more advanced and expensive extraction techniques. The advocates generally don't ascribe much production potential to less conventional petroleum sources such as heavy oil, oil sands, deepwater, oil shale, or alternative sources of liquid fuels such as (natural) gas-to-liquids, or coal-to-liquid techniques. Some of them believe that, because of huge development costs, these unconventional resources will only be pursued in a large-scale manner after conventional production peaks and petroleum prices are sustained at very high levels.

The optimists in this debate believe large quantities of conventional oil are yet to be discovered. They think the reason discoveries have lagged consumption since around 1990 is because low prices have limited the incentive for discovery. The optimists tend to believe in new technology, particularly enhanced oil recovery technologies. They also tend to believe unconventional resources will add significantly to global production over the next 20 to 30 years.

The summary graph that follows shows 12 long-term production scenarios developed by the U.S. Department of Energy's Energy Information Administration. These scenarios are based on four annual production growth rates (0, 1, 2, and 3 percent) and three U.S. Geological Survey technically recoverable oil resource volumes (2,248, 3,003, and 3,896 billion barrels) equivalent to the 95 percent probable, the mean (expected value) and a 5 percent probable volume. The estimated peak year of production ranges from 2021 to 2067 (a span of 46 years) for the 1, 2, and 3 percent per year growth rates and the three resources volumes. Including the 0 percent growth rate extends the estimated production peak range to 2112 (a span of 91 years). For the mean resource and 2 percent production growth rate scenario, which reflect the expected resource volume and the recently experienced production growth rate, the peak occurs in 2037.

Market feedback mechanisms might smooth and flatten the sharp production peaks as the actual production paths play out, moving the peaks earlier in time. The peak year would be delayed by discovery of a larger recoverable conventional resource base than is currently estimated, or it could occur earlier with accelerated production rates. It may also vary as global oil demand varies. For example, if demand for oil weakens for economic reasons or because substitutes for conventional oil gain market share, the conventional oil production growth rate may decline and result in a later peak. In summary, projections vary for estimates of when the United States will return to levels of oil production it had in the 1950s. Based on year 2000 oil consumption levels, these lower levels would be significantly inadequate. See the section on Conservation and Renewable Energy for some strategies being implemented to meet oil demands and reduce greenhouse gas emissions.

FIGURE 5-10-1: ESTIMATES OF PEAK OIL PRODUCTION



Note: U.S. volumes were added to the USGS foreign volumes to obtain world totals.
 Source: U.S. Geologic Survey

The production of greenhouse gases from energy use has grown significantly over the last 40 years. Consumption of petroleum products (primarily for transportation) is the major contributor to greenhouse gases and has a direct impact on global warming. Electricity generation from fossil fuel sources (coal and natural gas) also contribute to greenhouse gas production. The majority of emissions from coal used locally are due to electricity production at a generating station in Centralia. The burning of fossil fuels also results in the release of particulate matter, sulfur, and nitrogen oxides. These emissions have been linked to a number of human health problems such as asthma, heart disease, and pulmonary disorders.⁴ For more information, see *Chapter 5.4 – Air Quality*.

C. CONSERVATION, RENEWABLE ENERGY, AND ALTERNATIVE ENERGY SOURCES

All energy providers have a strong conservation emphasis, and public conservation campaigns are in place in all counties within the region. In order to avoid an energy crisis such as the one experienced in 2000-2001, which sent energy prices soaring, energy planning needs to incorporate the elements of uncertainty and risk. Major conservation efforts will likely come in the form of increased efficiency of the infrastructure needed to transmit electricity between destinations. As the region grows, more aggressive public conservation campaigns will need to be implemented. The market may also cause the region to conserve as the price for energy increases. The federal government provides income tax incentives for energy efficient products and technologies. The program was passed by Congress as part of the Energy Policy Act of 2005.

Electrical Power

Conservation is believed to be the most cost-effective approach to future power plans. Savings from energy efficiency programs have gone up and down over the last 20 years. After reaching a high in 1993, savings declined over 70 percent by 1999, before approaching the historical high in 2001. Providers are currently implementing public education campaigns to encourage energy conservation. Many energy conservation education resources are available, and include topics such as heating, lighting, windows, and appliances for residents. Information is also available for contractors and builders, building managers, realtors, and agencies. “Green” building practices incorporate energy efficiency measures into the building and renovating of structures.

Between now and 2040, there will likely be improvements in alternative energy technologies including solar, wind, tidal, and geothermal. Only a very small fraction (less than 2 percent) of the electricity provided to Washington consumers by electric utilities was generated from renewable energy sources (biomass, geothermal, wind, or solar) in 2001. The Northwest Power and Conservation Council published their Fifth Power Plan on May 13, 2005. The plan includes the goal of producing 1,100 megawatts of energy from wind generation between 2005 and 2014. Puget Sound Energy

⁴ American Medical Association. 2002. John. F. Staropoli. Journal of the American Medical Association. May 1, 2002 Volume 287, Number 17. Available at: <http://jama.ama-assn.org/cgi/reprint/287/17/2283.pdf>.



concluded in its least cost plan that it will accelerate energy efficiency and early fuel conservation and build the infrastructure to generate 10 percent of its energy through renewable resources.

Natural Gas

Energy efficiency and conservation measures can reduce natural gas consumption while maintaining comfort and productivity. Like electrical power providers, natural gas providers are implementing similar public education campaigns to encourage energy conservation. Most energy conservation messages are applicable to natural gas, electrical power, and oil consumers.

Petroleum

Non-transportation oil uses can benefit from the same energy conservation measures listed above. For example, residents who heat their homes with oil are being encouraged to maximize the energy efficiency of their homes.

In order to encourage transportation-related oil conservation, many agencies are currently implementing public education campaigns to reduce petroleum consumption, lower automobile emissions, and alleviate traffic congestion. The following are typical recommendations for consumers:

- Use carpooling, public transit, and nonmotorized options.
- Take advantage of telecommuting and telecommunications technology.
- Eliminate extra wind resistance and weight.
- Minimize vehicle idling.
- Maintain vehicle efficiency through regular maintenance.
- Drive or purchase a fuel-efficient vehicle.
- Use the right grade of gasoline and don't top off one's tank.

Incentives such as Location Efficient Mortgages encourage people to live in neighborhoods with transit and nonmotorized facilities. Location Efficient Mortgage programs are available in Seattle and are a part of national urban trend in major cities.

There are a series of alternatives to traditional petroleum and products. These range from synthetic petroleum and product resources to complete substitutes for gasoline and diesel. A partial list is below:

- At today's oil prices, synthetic petroleum can be derived economically from oil sands and perhaps from oil shale, though probably not from coal. Synthetic petroleum can be directly processed in traditional refineries, but overall is much more expensive to produce and requires significant energy inputs.
- Ethanol and biodiesel are direct substitutes for gasoline and diesel and can also be blended with these traditional transportation fuels. These alternative fuels result in lower greenhouse gas emissions and displace more energy than they consume during production (ethanol less so than biodiesel). Currently, ethanol and biodiesel rely on field crops (sugar cane, corn, soy beans, rapeseed) and so limits on agricultural land and competition with other crop end users will restrict these substitutes to perhaps 5 to 10 percent of current gasoline and diesel volumes.
- Many consider the best replacement for the internal combustion engine to be the hydrogen-powered fuel cell. Currently, fuel cell and hydrogen storage costs are too high to compete with internal combustion engines. Reliability and fueling infrastructure problems also prevent rapid adoption of fuel-cell powered vehicles. Electric-powered vehicles are another potential replacement, though limited range, long recharge times, and battery weight and cost issues have prevented their adoption. A cross type of vehicle, the Plug-in Hybrid Electric Vehicle (PHEV), can achieve very high (gasoline or diesel) fuel economy and is another possible substitute. The PHEV is similar to a current Hybrid Electric Vehicle (HEV), but has a smaller gasoline or diesel engine than a HEV and a larger battery pack that can be plugged in and recharged.

5.10.2 Analysis of Alternatives (Long-Term Impacts)

The core question addressed by all the alternatives is where new population and employment growth should be distributed. Under all alternatives, energy consumption is anticipated to increase as the population increases. More energy sources will likely be needed, and conservation strategies will likely need to be implemented regardless of which growth alternative is selected. Impacts of the alternatives are discussed below by energy type, electrical power, natural gas, and petroleum.

ELECTRICAL POWER

Population and proximity are the major factors influencing the expected impacts on and demand for electrical utilities. As the population of the Puget Sound region increases, demand for power supply and transmission by electrical utilities is anticipated to also increase. As discussed in the section on the Affected Environment, most providers expect a need for additional electrical power resources by 2040 or sooner. Demand for electrical power is anticipated to be nearly the same for all alternatives because the alternatives differ by growth pattern, not growth level. There is no indication that electrical power demand per person rises or lowers with compact or dispersed growth. For these reasons, the impact of hydroelectric facilities on rivers is anticipated to be similar for all alternatives.

Expansions of generation and transmission facilities are expected under all alternatives, which will likely increase the cost of electric utilities. Puget Sound Energy determined in their 2005 Least Cost Plan that the inevitable need for additional capacity, combined with increases in credit and price risks, will result in higher electricity rates. The alternatives that most disperse population and employment (the Growth Targets Extended and Smaller Cities alternatives) are more likely to require the expansion of utilities into areas that are currently not served or have limited service. For this reason, the Metropolitan Cities and Larger Cities alternatives may offer some efficiency by concentrating growth where utility infrastructure is already well established. However, some upgrades to these existing utilities could be needed to serve the increased population and employment. Additional information on energy infrastructure is provided in *Chapter 5.7 – Public Services and Utilities*.

NATURAL GAS

Like electrical power, population and proximity are the major factors influencing the expected impacts on and demand for natural gas. Natural gas prices are expected to rise steadily under all alternatives. As discussed in the section on the Affected Environment, providers expect the need to increase natural gas imports and system capacity by 2040 or sooner. The alternatives are anticipated to have similar effects on natural gas infrastructure and demand as on electrical power infrastructure and demand. Natural gas prices are expected to rise steadily under all alternatives.

PETROLEUM

Like electrical power and natural gas, population and proximity are the major factors influencing the expected impacts on and demand for petroleum. As discussed in section on the Affected Environment, although there are different theories on the future supply of petroleum, it will likely be less available in 2040 than it is today. In terms of non-transportation uses, the alternatives are anticipated to have similar effects on petroleum infrastructure and demand as on electrical power infrastructure and demand. Prices are expected to rise steadily under all alternatives. However, differences between the alternatives can be expected for transportation related uses.

Greater vehicle use (and therefore higher oil consumption impacts) is found in alternatives that feature more dispersed development patterns with less opportunity for transit, bicycling or walking. This also holds true for air quality/global warming impacts — worse with dispersed development requiring higher levels of auto use. The Growth Targets Extended Alternative forecasts the greatest vehicle miles traveled of all of the alternatives and is anticipated to therefore create the greatest demand for petroleum. The fewest vehicle miles traveled are forecast for the Metropolitan Cities and Larger Cities alternatives, and therefore they are anticipated to have the least demand for petroleum. The Smaller Cities Alternative has the second highest vehicle miles traveled. Lower vehicle miles traveled also corresponds with lower greenhouse gas emissions.



5.10.3 Cumulative Effects

The previous discussion of energy includes the cumulative effects of various influences such as projects and plans of energy providers, jurisdictions, and agencies. Drought, global warming, energy resource depletion, and energy resource expansion can influence the availability of electrical energy, natural gas, and petroleum. Drought and global warming can reduce river flows, thereby decreasing energy production at hydroelectric facilities. Many influences, such as increased energy consumption in developing countries, can place additional demand on energy sources. Natural gas and petroleum are particularly susceptible to international actions because the Puget Sound region relies on imports of natural gas and petroleum to meet energy needs. New energy sources and new and improved technologies can increase energy supplies.

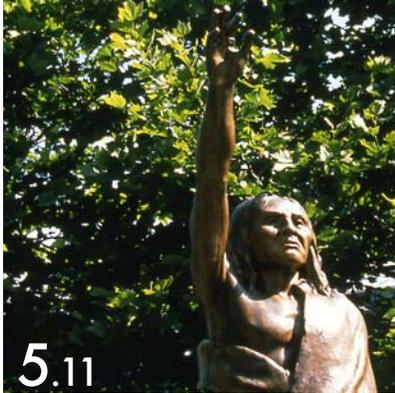
5.10.4 Potential Mitigation Measures

The programs and measures listed in the section on Conservation, Renewable Energy, and Alternative Energy sources are potential mitigation measures for energy impacts under all of the alternatives. The goal of many of the conservation policies is to reduce energy consumption, especially during times of peak demand, while still maintaining comfort and productivity. Over the long term, these programs and policies will likely need to be reviewed and updated as the need arises.

5.10.5 Significant Unavoidable Adverse Impacts

Significant unavoidable adverse impacts for all of the alternatives are anticipated. They include, but are not limited to, the following:

- Higher prices for energy as demand increases.
- Habitat reduction resulting from construction of new energy generation infrastructure such as dams, natural gas refineries, and wind farms.
- Air pollution and greenhouse gas emissions from the burning of fossil fuels.
- The potential for reduced availability of energy resources such as fossil fuels.



Historic, Cultural, and Archaeological Resources

The central Puget Sound region has a long cultural history, beginning with indigenous peoples, who lived here in a rich ecosystem. The tools, structures, record of their existence, and of the settlers who came after them, are the Puget Sound region’s historic and cultural resources. Some summary highlights are noted below regarding the potential for them to be impacted under the growth distribution alternatives.

5.11.1 Affected Environment

The Washington State Department of Archaeology and Historic Preservation (DAHP) uses the phrase “cultural and historic resources” for property types representing human culture and heritage, including sites, buildings, structures, objects, districts, traditional cultural places and cultural/historic landscapes that have been identified and documented as being significant in local or state history, architecture, archaeology, engineering or culture (DAHP, 2004; DAHP, 2005). DAHP broadly defines cultural resources as any resource, regardless of age, that has the potential to be listed on the National Register of Historical Properties (NRHP). DAHP includes modern resources (i.e., less than 50 years old) in their inventory of cultural resources. Resources that post-date Euro-American contact (1790) are referred to as “historic resources.” This terminology differs from the National Park Service. The National Park Service defines “cultural resources” as those actually listed on, or eligible for listing on the National Historical Register (DAHP, 2004).

For this analysis, historic and cultural resources include properties and resources that have been identified or evaluated for inclusion on the Washington Historic Register, the NRHP or local registers or landmark registries. Inclusion on the National Register automatically places a property on the Washington Historic Register. The Washington Historic Register includes properties that do not meet the higher standards of the National Register, as well as properties that are listed on the National Register. Common features of the two registers are that a resource (a building, site, structure or object) must be at least 50 years old. If newer, the resource should have documented exceptional significance. The resource should have a high to medium level of integrity, meaning it should retain important character defining features from its historic period of construction, and the resource should have documented historical significance at the local, state or federal level (DAHP, 2005).¹

¹ Documented significance, or exceptional significance, is normally defined as those properties (of the resource) that “...demonstrate that the nominated property is an especially good or unusual example of its kind, or that it has remained intact while most other related properties have been changed, or that events or individuals connected with the property had a long lasting impact on the town, community or region.” (DAHP, 2005). See Washington State Heritage Register Guidebook, accessed from DAHP web site <http://www.oahp.wa.gov/pages/Documents/Sites.htm>.



A. REGULATORY SETTING

Federal, state, and local laws and ordinances regulate the identification and treatment of historic properties. There are several laws and regulations that apply to the protection of historic resources, although the applicability of the regulations depends upon the actions involved. For the VISION 2020 update, the action is a planning-level decision, and does not directly involve project-level permits or approvals, and is not site-specific. However, the most applicable regulations for developing actions are:

- Archeology and Historic Preservation — Legislative Declaration: Revised Code of Washington 27.34.200 and 200 and Chapter 25-12 Washington Administrative Code.
- State Environmental Protection Act.
- Shoreline Management Act.
- National Environmental Policy Act.
- Section 106 of the National Historic Preservation Act of 1966.
- Section 4(f) regulations of the Federal Department of Transportation (FHWA, 2005).²
- Archaeological Resources Protection Act of 1979.

The Revised Code of Washington 27.34.200 and 25.12 Washington Administrative Code provide the legal framework for the designation, preservation, protection, enhancement, and perpetuation of structures of historic, archaeological, and cultural significance. Chapter 25.12 Washington Administrative Code specifically addresses compliance by the advisory council on historic preservation with the provisions dealing with public records.

The State Environmental Protection Act requires any impacts to historic and cultural resources, known or unknown, be considered during the public environmental review process. The Shoreline Management Act deals with development permits issued by local governments, including areas with archaeological sites.

The National Historic Preservation Act (Section 106) and its implementing regulations (36 Code of the Federal Register 800) include requirements for projects having federal funding, federal permits, or that involve federal lands, to consider the effect of the project on historic or cultural resources within the region. A Section 106 review involves consultation with the President's Advisory Council on Historic Preservation, the State Historic Preservation Officer, Native American tribes, and the public.

County and city governments frequently maintain local historic registers for historic and cultural resources in their municipality and many have ordinances protecting resources. Criteria for inclusion vary, but most require a minimum age (usually greater than 50 years) and/or historic significance relating to the area's history. These local sites and landmarks may be included in the Washington State Register. As with state historical sites, protection for the sites may be limited. The local historic preservation department normally considers requests for changes to designated historic sites or resources.

Section 4(f) is part of the Department of Transportation Act of 1966. It states that it is a national policy to preserve, where possible, "the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites."

The Archaeological Resources Protection act of 1979 applies to archeological sites on both tribal and non-tribal lands, which are managed under the federal government such as the National Park Service and the Bureau of Land Management.

B. RESOURCES

Archaeological Sites

Archaeological sites in the central Puget Sound region include shell middens, burials, lithic sites, wet sites and rock shelters. These resource types reflect a number of cultural uses including villages, camps, food gathering and other seasonal activity sites used by hunter-fisher-gatherer groups beginning around 11,000 years ago. Most sites are associated with shoreline areas and watercourses. In the central Puget Sound region, many of the major cities and activity areas

² DAHP Web site: <http://www.oahp.wa.gov/pages/EnvironmentalReview/EnvironmentalReviewOverview.htm>.

have been developed along shorelines, which has altered them either through fill or movement. Surface evidence of pre-historic sites is scarce as they get damaged or lost due to development and watercourse modifications.

However, evidence of prehistoric development may be found below ground in areas near historic watercourses and shorelines. Archaeological sites from the historic period may be visible at the surface as they are more recent. Relatively little information is available to the public for archaeological sites due to the sensitive nature of the site and state laws that exempt public disclosure to help prevent looting and vandalism.³ However, during project-level reviews, site-specific investigations are used to identify the likelihood or probability of encountering archaeological resources, and areas with known resources are identified.

Traditional Cultural Properties

Traditional cultural properties refer to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. The traditional cultural significance of a historic property, then, is significance derived from the role the property plays in a community's historically rooted beliefs, customs, and practices (Parker & King, 1983). Traditional cultural properties in the central Puget Sound region are primarily associated with Native American tribes. Both federally and non-federally recognized tribes are allowed to identify traditional cultural properties. Consultation with the appropriate tribe is done at the project level by the lead agency with the assistance of the DAHP and the Washington State Governor's Office of Indian Affairs to avoid or minimize impacts to traditional cultural properties.

Historic Properties

Euro-American settlement in the central Puget Sound region began in the 1850s. Early settlers farmed, logged, ranched and mined in the area. Railroad construction connected communities in the 1870s and the transcontinental railroad arrived in Seattle in 1893. The Klondike gold discovery in 1896 sparked a population and development boom throughout the Puget Sound region. Evidence of early Euro-American settlements is widespread in the region. Many historic buildings, bridges, and sites are listed in the NRHP, the Washington Historic Register and local historic registers (HistoryLink.org, 2005). The majority of the historic properties currently listed are concentrated in major urban areas of Seattle, Tacoma, Bremerton, and Everett.

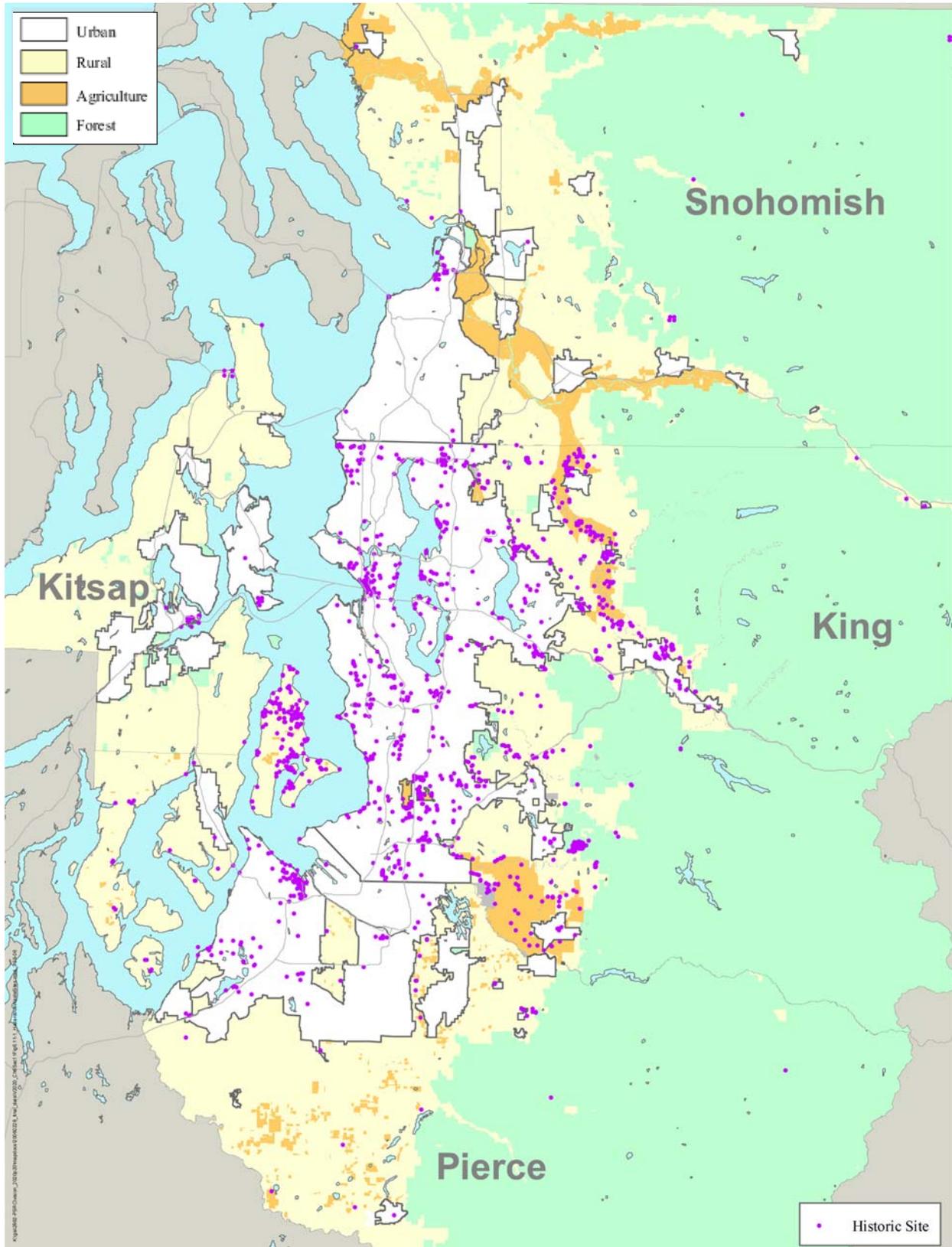
Figure 5-11-1 on the next page, shows the historic and cultural resources listed in the Washington Historic Register as of 2005. The concentration of historical and cultural resources in the core urban areas may also be reflected in local community and county registers.

The majority of resources listed on the state and national registers are from pre-World War II eras. Resources and properties dating from the World War II era and the modern era are now becoming eligible for investigation and inclusion in the historic registers (HistoryLink.org, 2005; DAHP, 2005), and are increasingly being noted as properties most in need of protection because their qualities and significance may be overlooked and they are often in areas with high rates of redevelopment activities. There are a large number of properties that may be eligible, or that could become eligible in coming years. Some of these properties have not yet been identified or evaluated for eligibility on the national, state or local historic registers, while others have been determined eligible but have not been formally nominated. The region has seen roughly four boom and bust cycles through the years, including the lumber industry/gold rush booms (circa 1850 – 1900), the shipbuilding boom (circa 1900 – World War I), the Boeing boom (circa World War II – 1970), and the emergence of the high technology sector (circa 1979 – 2000). With each boom cycle the region's population expanded, and suburbs sprang up surrounding the early urban centers. Many recently identified historic resources may be located and identified in these suburbs.

³ HistoryLink.org Online Encyclopedia of Washington State History, Overview of King County History, Historical Paper No. 3 (by King County Landmarks and Heritage Program, King County Office of Cultural Resources, 2002), <http://www.historylink.org/> (accessed 10/27/05).



FIGURE 5-11-1: HISTORIC SITES IN THE CENTRAL PUGET SOUND REGION



Source: King, Kitsap, Pierce, and Snohomish Counties, National Register of Historic Places

5.11.2 Analysis of Alternatives (Long-Term Impacts)

Development actions are a reasonably foreseeable result of the projected population and employment growth expected in the region. The analysis of effects considers the potential for construction and changes in setting in areas where historic, cultural, and archaeological resources may exist.

As areas are developed or redeveloped, there is potential for new projects to encounter previously unknown or newly eligible historic and cultural resources, with ages ranging from archaeological to Euro-American settlement to recent (post-World War II) eras. Suburbs dating from the 1930s and 1940s have potential for historic preservation resources as sites in these communities become eligible for listing. Such properties more and more include those associated with America's roadside culture including motels, drive-in restaurants, gas stations and automobile dealerships from the post-World War II era. However, properties from any era may be viewed as viable for development, and even NRHP-listed properties may be demolished, particularly when ownership and the proposed redevelopment are privately owned (DAHP, 2005).

A. IMPACTS COMMON TO ALL ALTERNATIVES

All of the alternatives predict high levels of population and employment growth in the region. Development has the potential to alter landscapes and properties that may yield archaeological, cultural, or historic artifacts and settings. Impacts to historic, archaeological, and cultural resources could include damage or destruction, loss of association, visual impact, change of setting, and noise, vibration or traffic impacts that make current uses difficult or uneconomic.

At the same time, increased population in proximity to already protected resources may provide increased access and opportunities for residents to experience these resources, strengthening their own connections with the region's history and culture.

Airborne transportation pollutants, including particulate matter, can impact, degrade and erode historic structures and sites, because the materials of older buildings and resources are often more susceptible to damage from them. The primary difference among the alternatives relates to the distribution of growth in specific areas relative to the distribution of historic and cultural/archaeological resources, as shown earlier in Figure 5-11-1.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

The majority of listed historic sites are located within urban King County. Growth Targets Extended includes substantial growth in unincorporated rural areas, metropolitan cities, and core suburban cities. The alternative has the second least amount of growth in King County overall. Growth Targets Extended could have substantial impact on archaeological, cultural and historic sites located in rural areas as a result of the pressure to disperse growth to these areas. Growth Targets Extended may also result in the uncovering of new sites. If recognized at the time of construction, these sites could be recorded and studied.

METROPOLITAN CITIES ALTERNATIVE

This alternative would place the most pressure on redevelopment of properties in major metropolitan cities, which have the highest stocks of historic, archaeological, and culturally significant properties 50 years or older. The Metropolitan Cities Alternative encourages concentrated growth and would create pressure on urban historic buildings. In some instances, this pressure could result in removal of significant structures, and alter or destroy historic settings. In other instances, however, it could create a market for renovation and reuse. The Metropolitan Cities Alternative would have the least impact on rural, unincorporated areas, and small suburban city archaeological sites, although typical impacts discussed above could still occur.

King and Pierce counties contain the highest number of historic structures as well as the two most highly populated cities within the region, Seattle and Tacoma. The Metropolitan Cities Alternative allocates the most amount of growth in King County. Since the Metropolitan Cities Alternative encourages growth within major metropolitan cities, the impacts of this alternative on historic structures would likely be the greatest in King and Pierce counties. Kitsap and Snohomish counties contain fewer registered historic and cultural sites, and more of the developed areas are more recently built. Therefore, growth outside of older neighborhoods and downtowns would be less likely to impact historic resources.



LARGER CITIES ALTERNATIVE

With population and employment growth dispersed slightly more under this alternative than in the Metropolitan Cities Alternative but less than in the Growth Targets Extended and the Smaller Cities alternatives, the Larger Cities Alternative would have a greater impact on suburban and rural historic, archaeological, and cultural sites than the Metropolitan Cities Alternative. Impacts could include removal or alteration of significant structures and sites. Conversely, as with all other alternatives, the opportunity for renovation and reuse exists.

Impacts would be greatest in King and Pierce counties since those counties contain the highest number of significant sites and structures. However, since the Larger Cities Alternative encourages growth outside major metropolitan areas, suburban and rural structures and archaeological sites are more likely to be impacted, especially in Snohomish and Kitsap counties.

SMALLER CITIES ALTERNATIVE

The impacts expected under this alternative are similar to those expected under Growth Targets Extended. As with Growth Targets Extended, the majority of impacts would occur in rural archaeological, cultural, and historic sites. The possibility of encountering new sites, especially archaeological and cultural, is greater under the Smaller Cities Alternative than under the Metropolitan Cities and Larger Cities alternatives.

Urban historic sites, mainly located in King and Pierce counties, would experience a lesser degree of impact under this alternative when compared to the Metropolitan Cities and Larger Cities alternatives.

5.11.3 Cumulative Effects

Cumulative impacts include both past and reasonably foreseeable future impacts to historic and cultural resources. Most of the future impacts are already within the range of impacts discussed as part of the long-term impacts of the alternatives, which assume that future population and employment growth would result in increased development and redevelopment throughout the region. There would be relatively few other factors or forces that would impose change on the resources within this region. However, from the perspective of past impacts plus the potential for future impacts (with continued population and employment growth likely to continue past the planning horizon of this VISION update), there would be a high potential for continued loss of many of the properties and artifacts that provide examples of an important information about the region and its peoples' past. At the same time, development and growth can provide opportunities for redevelopment and reuse of historic or culturally significant structures.

5.11.4 Potential Mitigation Measures

While federal and state governments provide guidelines and incentives for historic preservation, in general, the local governments make the final decisions. Local governments could evaluate the following strategies for preserving archaeological and historic sites:

- Use local planning and zoning techniques to identify and protect historic properties, including:
 - Additional property surveys and inventories. This additional information could be used to identify resources and conservation areas.
 - Encourage increased protection through historic preservation ordinances and historic resource review processes, in coordination with DAHP. For example, transfer of development rights programs for historic districts.
 - While maintaining the original character, allowing for the adaptive reuse of properties.
- Provide tax incentives to encourage preservation and rehabilitation of historic properties. Make maximum use of the 20 percent federal tax credit on the cost of certified rehabilitation of income-producing property that is on the National Register.
- Use fee simple acquisition or the purchase of protective easements to control historic properties.
- Purchase of easements, which is a portion of the property rights, can provide historic preservation at less cost.
- Design guidelines to preserve historic facades.

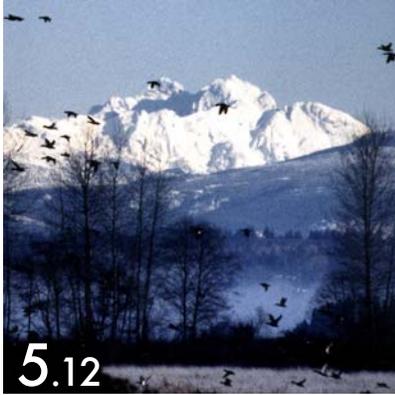
5.11.5 Significant Unavoidable Adverse Impacts

Pieces of the past are often lost as a result of growth. The destruction of historic, cultural, and archeological sites is likely under all alternatives, particularly when ownership of properties and proposed development actions are in the private sector. Historic structures of all significance levels may be demolished to pave the way for new growth. Even if a structure is designated as historic by the state, if the structure is privately owned, the landowner may choose to demolish the structure. Even if structures are not demolished, the general context and scene surrounding historic structures is likely to change as development occurs around them.

Archaeological sites are likely to be discovered under all alternatives. In some cases, sites are not recognized as significant and remain undocumented. If structures are built on land containing unrecognized artifacts, these artifacts are essentially locked up and will remain undocumented. If the land is privately-owned, development is not prohibited even though archaeologically and culturally important resources could be lost. If the land is federally- or state-owned, development must cease until the site is recorded, studied, and the artifacts catalogued. If the site is of particular importance, especially sites significant to native peoples, the site could be designated as significant and further development would not occur. Development may still occur on these federally-owned lands and there are many high profile examples of this, both regional and national.







Visual Quality and Aesthetic Resources

To many people, the region is defined by its mountains, water, and abundant greenery as well as the inherent aesthetic qualities characterized by visually diverse, stimulating views of rural landscapes, towns, cities, and prominent structures. This chapter discusses potential impacts to the visual setting of the region under each of the growth distribution alternatives.

5.12.1 Affected Environment

The natural beauty of the central Puget Sound region is considered one of its most valuable resources. The Draft Environmental Impact Statement considers existing visual resources and elements that define visual and aesthetic character in the region, including:

- Viewpoints and views to visual resources — natural resources, farm landscapes, historic structures, dramatic downtown skylines.
- Landforms — types, gradients, and scale.
- Vegetation — types, size and maturity, and continuity.
- Land uses and structures — size, scale (apparent size in relation to actual size), and character of associated buildings and ancillary site uses.
- Urban design.
- Historic structures and neighborhoods.
- Public spaces — including civic facilities, plazas, gathering places, and public art.
- Other open space types (including parks, reserves, greenbelts, and undeveloped land), extent, and continuity.
- Transportation facilities — types, sizes, scale, and directional orientation.
- Streetscapes — including pavement types (for the roadway itself, as well as bike lanes, crosswalks, and sidewalks), median design, street trees, street furniture, and light fixtures.
- Overhead structures, utilities, and lighting — types, sizes, and scale.
- Apparent upkeep and maintenance.

A. PHYSICAL SETTING

The central Puget Sound region has rolling plateaus that trend north-south, bordered by parallel valleys occupied by the waters of Puget Sound, Hood Canal, and the harbors and bays next to which many of the cities in the four-county area are sited. River valleys lead to Puget Sound in Tacoma, Seattle, and Everett. Throughout the area, plateaus generally rise 100 to 300 feet above the valley floors. Most of the valley walls are moderately steep and many remain unde-



veloped. The Cascade and Olympic Mountains and their foothills are visible throughout the area. These views are especially valued, as are views of Mt. Rainier, Mt. Baker, Puget Sound, and the many lakes and rivers in the region.

FIGURE 5-12-1: VISUAL RESOURCES IN THE CENTRAL PUGET SOUND REGION



Source: Parametrix, Inc.



Generally, land use patterns and associated structures relate to the underlying terrain. The plateaus and gentler valley walls are largely occupied by residential, institutional, and commercial uses that are small to moderate in scale. Buildings associated with these uses typically range from one to four stories high. Major valley bottoms support commercial, industrial, and transportation uses that are moderate to large in scale. Aside from high-rise structures in urban areas, building heights in the valley bottoms typically range from one to six stories, but many buildings have large horizontal dimensions. Many of the steeper valley walls support dense greenbelts of primarily native trees. These linear greenbelts are visually distinctive features in otherwise densely developed urban areas.

Valley walls have also channeled major existing transportation facilities and high-voltage transmission lines to be oriented north-south. Where east-west corridors occur, the corridors can also be visually prominent (i.e., the Tacoma Narrows Bridge, or Interstate 90). The visible features of this infrastructure include support structures such as bridges, viaducts, retaining walls, noise barriers, overhead structures such as towers and conductors. It also includes right of way developments such as park-and-ride lots, parks, trails, public art installations, and mature landscape plantings.

Natural Features

The rolling topography in the region allows for numerous scenic views. Plateaus and hillsides, river valleys, water bodies and islands, wooded areas, and wetlands are notable parts of the area's visual and aesthetic character. The forests and peaks of the Cascade and Olympic Mountains and foothills are visible from many points in the region. These mountain views are picturesque and valuable and appear from many locations in the core urban area to be in a natural state, although clear-cuts and other forestry activity become visible as one approaches the mountains.

Scenic water views of Puget Sound and Hood Canal are available in the western part of the region. Lake Washington and Lake Sammamish, as well as many smaller lakes, are valuable visual resources in the eastern part of the planning area. Waterfront land uses and water or marine activities such as pleasure boating, commercial fishing, ferry and cruise ships, and shipping provide further visual interest. Other bodies of water that are locally and/or regionally important due to their size, visibility, or scenic land uses include Green Lake, Lake Union, Lake Stevens, the Lake Washington Ship Canal, and the Puyallup, Duwamish, Green, White, Cedar, Sammamish, and Snohomish rivers.

In suburban areas throughout the region, undeveloped wooded areas, wetlands, creek and river corridors, and floodplains (located between areas of development and at the suburban fringe) are valuable visual resources that give portions of these areas the natural character that is an important part of the region's identity.

Urban and Rural Environment

The built-environment in urban portions of the region is extremely diverse in scale, bulk, height, and overall character. Structures such as the Space Needle, sports stadiums, and bridges are significant pieces of public architecture, as well as prominent visual features. High-rise buildings such as occur in downtown Seattle, Tacoma, Bellevue and Everett create scenic skyline views for viewers within these cities as well as in outlying areas. Additionally, these structures may serve as landmarks that orient viewers. At the street level the layout and orientation of buildings define places and pathways for people. Public plazas, civic facilities, and public areas further define the urban environment.

The region is defined by bluffs, steep slopes, water bodies, or other natural features that provide breaks in urban development. This helps provide visual distinction to different communities. Plantings in most dense urban areas are limited to street trees and perimeter landscaping in some locations, but there are also urban parks, and the grounds of office complexes and educational institutions that contribute to the "green" appearance of the region.

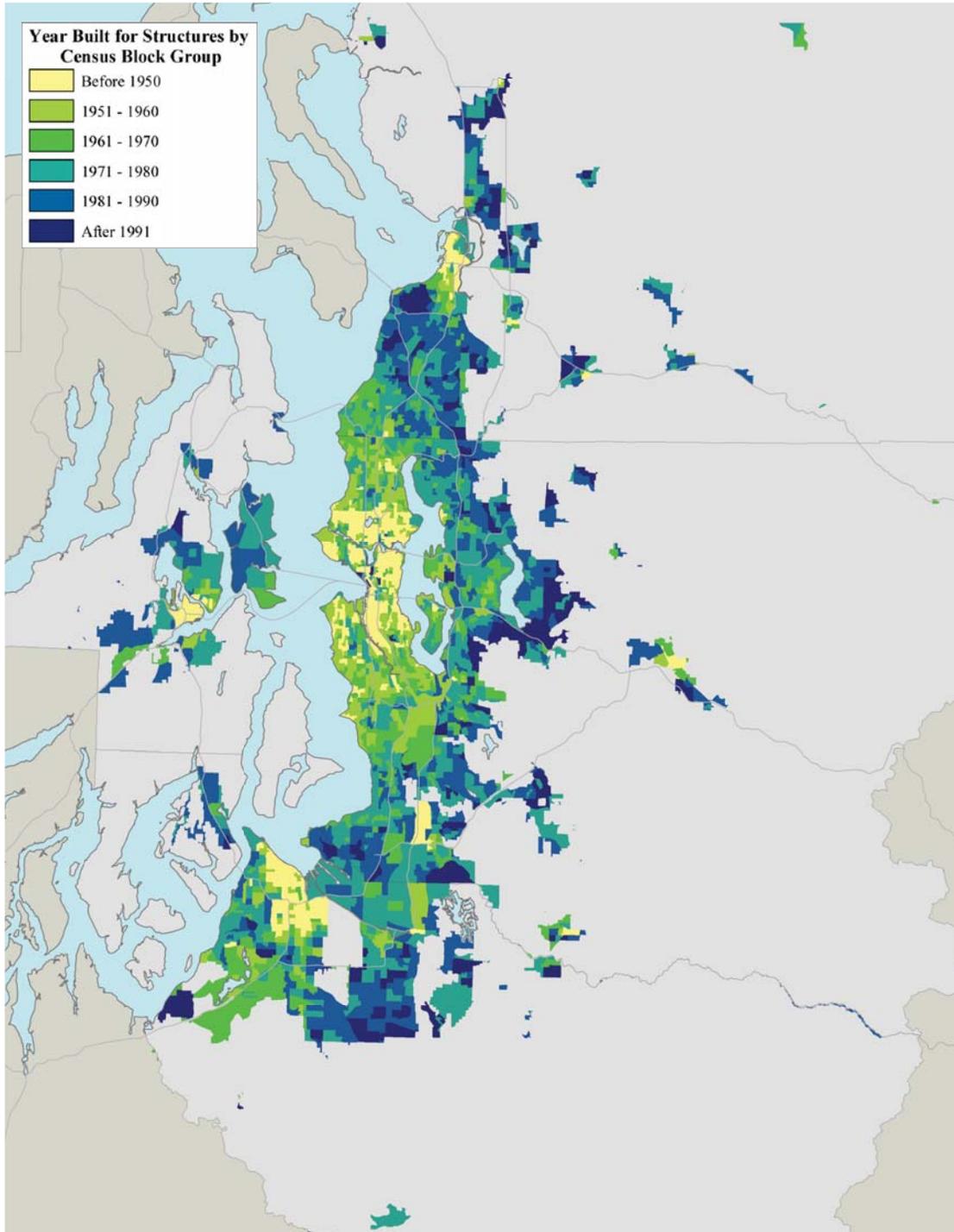
Industrial land uses such as shipping, manufacturing, and warehouses are located along parts of the waterfronts of Bremerton, Everett, Seattle, and Tacoma. These areas are typified by filled shorelines, low-rise industrial buildings, mid-rise commercial buildings, and large shipping equipment. Large expanses of pavement are often required in these areas to accommodate parking, handling and storage of equipment and material, and container cargo processing and storage.

Byways and thoroughfares are also prominent parts of the built environment. The view-from-the-road is an everyday urban experience, but roadways also affect urban form and the experiences of people once they have left their cars, bikes, or the bus. Some boulevards and highways are well landscaped, with wide promenades for walking and accessing businesses. Many more roadways lack landscaping, facilities for pedestrians and bicyclists, and have auto-dominated uses, including parking, which do not contribute to a uniform and aesthetically pleasing experience.



Urban and suburban neighborhoods are located throughout much of the urban area. The highest intensity development is generally along the Interstate 5 corridor through King, Pierce, and Snohomish counties, and it decreases as one moves away from Puget Sound. Older urban areas developed in the 19th and early to mid-20th centuries exist in and around the historic large cities of Bremerton, Everett, Seattle, and Tacoma, as well as numerous smaller towns and historic cores of suburban cities.

FIGURE 5-12-2: AGE OF STRUCTURES IN THE CENTRAL PUGET SOUND REGION



Census Note: The figure only presents data within the urban growth area because the data only exists at the census block group level. Given the large size of the census blockgroups outside the urban growth area, they are not shown to increase the legibility of the figure.
 Source: Puget Sound Regional Council

These areas are generally denser, more uniformly developed, and organized around the straight lines of the street grid. Suburban-style development became more widespread with neighborhoods and cities developed from the mid-20th century until the present. These areas are generally characterized by lower density, more open space, greenery, and curvilinear street systems that more closely follow topography.

Aesthetic features of the urban and suburban areas of the region include the diversity and visual interest provided by concentrations of human activity, instances of prominent structures featuring historic or distinctive architecture, and urban art. The oldest architecture is found in downtowns and surrounding neighborhoods. Smaller to mid-range cities such as Edmonds, Kirkland, Des Moines, Poulsbo and Auburn are located throughout the area. They were typically founded around a historic city center with a relatively small street grid, small to moderate-scale buildings, and a pedestrian-friendly environment. Other cities such as Bellevue, Federal Way, or Redmond, cover larger areas, with core downtowns as well as areas with commercial and industrial uses, and large areas of mostly single-family residential neighborhoods. Recent development and land use in and around these cities varies; however, reliance on the automobile for transportation has led to an extensive system of arterial roads and highways, and automobile-oriented retail/commercial development such as medium- to large-scale retail malls, small- to medium-scale commercial and retail strip development, and office parks. The height of these structures can be equivalent to that of a typical three- or four-story building, and their horizontal scale tends to be moderately large to very large. However, some newer cities, particularly Bellevue, have increasingly prominent skylines. Throughout the suburban areas, development is buffered in most neighborhoods of the region by native vegetation, especially evergreen trees which maintain a visual barrier year-round. Some neighborhoods have trees interspersed through them, which can even mask entire residential areas and give the impression that the area is undeveloped and in a near-natural state.

Parks, public places, and open spaces are found throughout urban areas. In business cores, parks tend to be small-scale, with some large linear parks located along shorelines. Larger urban parks tend to be located outside the business core, near urban neighborhoods or at the outskirts of urban areas. Campuses of several colleges and universities, as well as high schools and grade schools, also serve as civic facilities with open space for sports and recreation.

Utilities and transportation infrastructure are visible throughout most urban areas. Light standards and overhead utilities and transmission lines are common visual elements. Transportation signage can be seen near freeways and state highways, and commercial signage can be viewed in commercial cores and industrial areas. Roads, on-ramps, retaining walls, parking lots, and parking garages are all very prominent aspects of views and visual character of urban centers.

Light standards, electric utilities, and communications lines are located mostly along transportation corridors, with the exception of high-voltage transmission lines and towers, which utilize rights of way that were established before much of the suburban areas were developed. Signage for transportation facilities and commercial establishments is a major visual element in areas with strip development.

Rural areas (e.g., eastern portions of King, Pierce, and Snohomish counties, and outlying parts of Kitsap County) are typified by their dominance of natural features, openness, low density of development, rural architecture, and occasional historic structures. Farming and grazing activities, as well as low-intensity commercial uses are also typically associated with rural areas. The pastoral character of these areas within close proximity to the more intense core urban area is considered an invaluable resource worth protecting from encroaching urban and suburban development.

In rural and other less-developed parts of the region, single-family neighborhoods are typically located on or near ridge tops and desirable natural features, while multifamily development tends to be located closer to arterials, highways, and commercial centers. Vegetation is diverse, including residential landscapes, broad and mostly open landscapes typical of business parks, landscaped public parks, nature reserves, and street trees. Native conifers — oftentimes remnants of native woodlands — are found at or near the boundaries of many properties, creating a naturalistic visual quality that is typical of the Pacific Northwest. These trees act as informal visual screens, sometimes giving the impression that native vegetation extends into a site's interior.

B. CURRENT TRENDS

Changing development patterns are continuing to alter the visual environment of the four-county area. New private and public developments are emerging in the centers of metropolitan and core suburban cities, redeveloping underutilized parts of urban areas. The region is seeing expanded road systems, new public open space and recreational facilities, and higher levels of density. In many places, thoughtful zoning, planning, and design have led to numerous



beneficial additions to the visual landscape. These additions include ambitious civic projects like Seattle's Public Library and Bremerton's City Hall, Redmond's and Bellevue's city hall complexes, commercial development like Bellevue's Lincoln Center, and development in South Lake Union in Seattle, which have become new urban landmarks. Many of these areas incorporate public and semi-public streetscape spaces, such as those that characterize Tacoma's revitalized downtown. In some cases, roadways such as Bremerton's SR 304 Gateway and SeaTac's International Boulevard have been re-envisioned as boulevards and parkways, with street trees and ornamental plantings. Similarly, Washington's Department of Transportation has begun to commit to context sensitive planning and design that will allow its road projects to fit more appropriately into the visual characters of the landscapes through which they pass.

Recent trends in the region's development have also affected the region's visual character. Throughout the region, much of the growing population has been accommodated by residential development based on traditional suburban models, with low-density single-family houses, located away from employment centers, shopping, recreation, and entertainment. Areas that were originally rural, farm or agricultural uses are being converted to residential, commercial, warehouse, industrial and other urban uses which, while making an economic contribution to the region and housing the region's growing population, also can affect urban form and the visual character in these areas. As development has occurred in what was formerly open space, both in rural areas and at the fringes of suburban cities, some natural resources, vegetation, and scenic views have been altered.

The increased transportation needs of the region's growing population have affected the visual character of the region, too. New and expanded roadway facilities are increasingly dominant elements of the visual landscape, as are new high-capacity transit facilities, such as infrastructure associated with new commuter and light rail systems. Other adverse trends related to recent development are displacement of historic structures, obstruction of scenic views, and reliance on architectural models that are ubiquitous throughout the country, rather than regional style. These changes to the visual landscape of the region will be more thoroughly covered in the following sections.

C. REGULATORY SETTING

Within the four-county area, cities and counties have developed and adopted plans, policies, and regulations that impact design, aesthetic, and visual character in different ways. Some local jurisdictions have adopted view regulations that specifically address light, glare, or protected views. For example, some cities have adopted specific requirements for environmental review on projects or plans within the city that protect views of specific natural and human-made features; discourage light, glare, and light blockage; and list parks, shorelines, schoolyards, and street ends that are to receive special protection.

Local jurisdiction comprehensive plan policies also address the visual character of their communities, either explicitly through formal policies or in more general terms within the entire planning document. Urban design concepts are more and more part of the comprehensive planning process and combine with the public involvement process to present and discuss the desired look and feel of the community as it develops. These comprehensive plan policies and provisions, whether general or specific, are then translated into land use regulations that control the type, height and bulk of individual projects throughout the region. Many communities also adopt design guidelines to specify certain architectural standards in specific districts.

5.12.2 Analysis of Alternatives (Long-Term Impacts)

A. IMPACTS COMMON TO ALL ALTERNATIVES

All four alternatives being studied have the potential to affect existing visual resources at several levels. Each of them could add, alter, or remove some of the visible features that compose the basic visual resources of the landscape. These features include landforms, water bodies, vegetation, structures, and transportation facilities. Growth also could result in new and renovated residential, commercial, and industrial buildings as well as new and expanded infrastructure (e.g., transportation and utility structures). At the neighborhood scale, these new, expanded, or renovated structures could affect the views and viewsheds,¹ especially in areas experiencing high rates of growth or change. New structures and buildings would be introduced. Issues involving design and community character would come into play. At larger scales, such as that of the region, the conversion of land uses from agricultural or open space to urban would be apparent, as

¹ The term viewshed refers to the entire area that is visible from a particular vantage point. From a vantage point at significant elevation in the Cascade foothills, for instance, much of the region would lie within the viewshed.

would the addition of prominent individual structures or buildings, or the general intensification of uses within individual neighborhoods.

Long-term impacts would vary depending on localized factors, including the nature of existing land use, the proximity of future development, and the incorporation of potential measures to avoid or mitigate potential negative effects that impact visual resources, design or aesthetics. The impacts would vary for each alternative. For example, neighborhoods with single-family homes, parks, cemeteries, schools and hospitals with open space campuses would tend to be more sensitive to bulk, height, increase of scale, and visual change of potential development than mixed-use areas that are already characterized by larger multistory residential buildings and commercial or industrial land uses. Similarly, future development could markedly alter the setting and features in areas that are currently rural, unincorporated, or natural, which might be disruptive to the character of those areas. Light and glare impacts could increase, and taller buildings could increase shading. Conversely, redevelopment could improve the visual and aesthetic environment in areas with aging infrastructure, poor maintenance, or that visually contrast with or are otherwise incompatible with adjacent land uses. Areas devoted to parking may be developed to incorporate parking within other more aesthetically pleasing structures.

In many cases, new development could be an attractive addition to the views and visual character of communities, helping to create new community identity or enhancing the existing sense of place. However, as areas redevelop and become denser, parcels and subareas would likely redevelop in different time frames. Some neighborhoods could have a discontinuous visual appearance, and visual contrasts could increase. This is particularly true where properties are privately-owned, and development proposals (or decisions not to develop) will largely remain with many individual parties.

In terms of public developments and projects, needed street and transit improvements would provide opportunities to balance the requirements of motorized transportation with other community goals such as pedestrian-friendly streetscapes, the addition of street trees and attractive ornamental plantings, and reducing the visual dominance of existing roadways in communities. Similarly, public facilities such as schools, city halls, parks, and other civic buildings can also provide opportunities for improved visual conditions, incorporating high quality design and the use of art or aesthetic treatments as part of public projects.

All alternatives anticipate the significant growth and change in the region that will result from approximately 1.7 million new residents and 1.2 million new jobs. Regardless of how this growth is distributed, it will result in visible change in many parts of the region. As an illustration, a 2004 report by the Brookings Institution determined that 44 percent of the residential buildings that will be needed in the Seattle metropolitan area in 2030 have not yet been built. Commercial and industrial buildings generally have a shorter lifespan, which makes the figures even more dramatic for these uses. According to this study, as much as 63 percent of the commercial square feet, and 60 percent of the industrial square feet that will exist in the metropolitan area in 2030 has yet to be built (Nelson, 2004).

New development will frequently be placed in areas with existing neighborhood character and design features. The specific manner in which development occurs and the extent to which the opinions of the community are considered will largely determine whether changes are considered positive, negative, or neutral. An emphasis on sound planning and public involvement at all levels of the land development process would likely help promote well-designed, context-sensitive projects that will maintain and improve the aesthetic qualities of the region's built and natural environments.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

Metropolitan Cities

In Growth Targets Extended, populations of metropolitan cities are predicted to grow by 450,000 by 2040. This growth will be accommodated by construction on undeveloped private property and redevelopment of currently built property with land uses that are denser, larger, and taller than existing development. In some places, surface streets could be widened from residential to arterial, and large-scale transportation projects like freeway expansion or the addition of both light and heavy rail could be required to provide transportation for a growing population. This development could affect visual and aesthetic character in several important ways. Undeveloped and relatively low-density areas that have been zoned for new types of development would experience the most notable changes. In some areas, multi-use development with offices, retail, and multifamily residences might replace stand-alone houses that are currently common in parts of neighborhood centers (like Seattle's Ballard Neighborhood) or in adjacent districts of other activity centers.



The highly developed city centers such as those found in Bellevue, Seattle, Tacoma, and Everett would continue to trend toward development of high-rise buildings and other large-scale office, retail, and residential structures. Views might be altered or obstructed in some instances, especially from private property, but many views from public property and rights-of-way could also be protected. An increase in population in Tacoma, Bremerton and Everett would likely result in more extensive and larger scale development than exists presently, noticeably changing the character of parts of these communities, where density and scale currently diminish quickly with distance from the city center. In a city such as Seattle, which is already intensively developed, the change would still be quite noticeable as remaining parcels are developed and smaller-scaled buildings are replaced by larger ones. In some cases development and redevelopment might detract from visual and aesthetic character by replacing human scale development or buildings with unique or historic character with large, more modern structures.

Numerous beneficial changes could result as well, including providing attractive new structures and public/semi-public open spaces, renovating or replacing buildings that have poor maintenance or that have reached the ends of their designed usefulness, and planning development/redevelopment in a way that addresses changes in land uses and lifestyles. The growth anticipated by Growth Targets Extended could spur infill development or redevelopment of currently underutilized parts of metropolitan cities that have lost residents and businesses to outlying suburban cities. These improvements could enhance the built environment and also provide for a more vibrant public presence.

Natural features that are part of visual and aesthetic features of metropolitan cities could also be impacted or enhanced by Growth Targets Extended. For instance, denser development of private property might remove existing vegetation and leave less room for new plantings. Public parks, greenbelts, shorelines and other sensitive natural areas might be affected by increased numbers of visitors. Impacts from private development could be mitigated through thoughtful planning and the use of incentives to encourage developers to provide new and replacement plantings as part of their projects. On the other hand, redevelopment may create new opportunities for creating open space where none existed, to create a market for the reuse of historic facilities, and to redesign and rebuild streets to make them more pedestrian and environmentally friendly. In areas that currently have low aesthetic quality due to poor maintenance or land uses that do not lend themselves to scenic views (e.g., warehouses, industrial, parking), increased population could provide the financial basis for residential, retail, business, and recreation redevelopment with attractive structures, open spaces and street level activity that provides visual interest.

Supporting incentives from government agencies may provide the opportunity to encourage private parties to reuse historic properties to include open space and landscaping, and to develop distinctive designs. These elements could also be part of public sector developments.

Larger numbers of people who use visual and aesthetic resources such as public open spaces and recreational facilities could also impact the appearance of the resource. Planners and administrators of these facilities would need to provide corresponding increases in maintenance and upgrades, as well as planning for and providing new facilities like parks, trails, and natural area access.

Core Suburban Cities

The 14 cities in this category all have designated regional growth centers, which would presumably be the focus of much of the new growth envisioned in Growth Targets Extended. The rate of growth they would experience would be in the mid range in terms of the four alternatives. Development within these centers would likely occur as new medium- and high-rise buildings, potentially creating new skylines in the core suburban cities. New residential development, both multifamily and single family, would become a somewhat more dominant visual feature under Growth Targets Extended as roughly 100,000 housing units are built among the cities in this category.

Retail and office development, such as that currently found in Bothell's Canyon Park area, would possibly become a more common part of the built environment, while existing retail/business cores could become more extensive and more densely developed. Buildings in retail/business cores may tend to be taller and more intense to accommodate the needs of a larger number of residents. Some of the development in core cities could occur in what is currently undeveloped woodlands, wetlands, or former farmland. Large lots with single-family residences could be redeveloped at a greater level of residential density, and buildings from the early to mid-twentieth century could be replaced by new development. New or improved arterial roads might be needed, and more areas could be devoted to parking to accommodate population growth. In general, the visual character of core suburban cities would become more urban and more densely developed, which would impact the existing visual character.

Larger Suburban Cities

This class of 13 cities would see an increase of 150,000 residents and 80,000 jobs. These cities are currently developed at relatively low densities and large tracts of undeveloped land are limited. Growth would likely be accommodated through a combination of the subdivision of remaining large lots into a denser configuration, and the addition and densification of pockets of higher-density activity centers. This development could adversely affect visual resources like views, open space, natural features, and historic architecture. Carefully planned and designed new development could also result in attractive architecture (both private and civic structures), creation of vibrant public spaces like revitalized or entirely new downtown cores, parks, sports fields, urban plazas, and streetscapes that are inviting and safe for people on foot.

Smaller Suburban Cities

Smaller suburban cities include 52 smaller cities distributed throughout the region, which are generally on the periphery of the urban growth area, or in urban islands surrounded by rural or resource lands. The level of growth anticipated under Growth Targets Extended has the potential to modestly impact the existing visual and aesthetic character of these communities. Some existing undeveloped open space will likely be converted to other uses, while town centers and activity clusters will likely see modest redevelopment.

Unincorporated Urban Growth Area

Unincorporated urban growth areas within the four counties would experience high population and more modest employment growth under Growth Targets Extended. Currently, land use in the unincorporated urban growth areas consists of a wide variety of developed and undeveloped urban form, with a mixture open space, both single- and multifamily housing, and commercial areas. Small clusters of retail and business developments serve mostly local needs. Growth Targets Extended would likely result in additional amounts of the same type of development. Because the height and bulk of this potential development would likely be small to moderate, view blockage would be minimal. The overall visual character of the unincorporated urban growth areas would begin to trend toward suburban, but undeveloped open space in many areas might still be a notable visual and aesthetic feature.

Rural Areas

Populations and employment in rural areas would increase substantially under Growth Targets Extended. While the 230,000 new residents represented by Growth Targets Extended would be spread over a relatively large area, in some areas impacts would be more noticeable because of the conversion of currently undeveloped land. Residential cluster development in rural areas could possibly minimize some of these impacts. Specific visual resources, open views, agricultural land uses, natural resources, low density development, historic buildings or buildings which might be eligible for historic status might be either displaced or affected by changes in the surrounding visual and aesthetic character. Development would also tend to be less dense and would occupy more area per person than in urban areas, perhaps changing the overall character of some rural areas from a mixture of agricultural, open space and low density residential uses to one that is more largely low density residential.

METROPOLITAN CITIES ALTERNATIVE

Metropolitan Cities

In this alternative, 2040 populations of metropolitan cities are projected to be much larger than they are today. This would change the way that metropolitan cities look as compared to today. The most likely effects would be increased development density, increased bulk and height of buildings, loss of undeveloped open space to development, more obstructed views, more extensive transportation infrastructure, and conversion of land uses to accommodate population increase. The effects on visual resources would be similar to those described for metropolitan cities in Growth Targets Extended; however, the intensity would be far greater. Nearly 300,000 new housing units would likely be required among the five cities to house this population increase. Additional activity centers may be targeted to accommodate this level of growth. Changes to visual resources could be most notable in neighborhood activity centers outside central business districts, which currently have small- to medium-scale development supporting moderate residence-to-acre density.

Larger buildings, greater density, larger expanses of roadway, and higher traffic volumes would create an overall visual and aesthetic character decidedly more urban than currently exists. For example, development needed to accommodate increased population and employment could take the form of large to very large-scale structures — many of them



high-rise — if development were focused in a few areas. With development in a larger number of centers, including neighborhood centers, density and building scales would increase in more areas of a city. These might include multifamily residences, office buildings, commercial development, and civic buildings with shopping, entertainment, sporting events or governmental functions. Thoughtful zoning and provision of financial incentives, coupled with quality-of-life-driven market forces could help ensure that these new structures are beneficial additions to the visual environment. The future visual character of metropolitan cities could be enhanced if incentives were available. Ordinances could also emphasize the importance of carefully planned and designed streetscapes and public spaces in urban environments.

Core Suburban Cities

In the Metropolitan Cities Alternative, populations and employments of core suburban cities are predicted to increase substantially, changing these largely residential communities and the retail/business areas that serve them. The density and extent of retail/business centers of these cities would increase, and moderate to large-scale strip development could become more common along arterials and intersections. Numbers of multiple-family residences might greatly increase to accommodate more residences per acre, as could medium to large-scale retail and office structures. Regional transportation facilities would be added or expanded to serve growing transportation needs. Many existing private undeveloped open spaces could be developed, and both native and introduced vegetation could be displaced as part of new development. In some areas, available open space could be converted to public parks, athletic fields, and other types of recreational facilities to keep up with the demands of a growing population.

Larger Suburban Cities

Larger suburban cities could experience changes to visual and aesthetic resources similar to those described for Growth Targets Extended, with some specific views, historic structures, natural resources, and undeveloped open spaces being affected by new development. In some places an increase in density would make parts of these cities seem a little more urban. Overall, the visual resources of these cities will absorb these changes with modest noticeable effects.

Smaller Suburban Cities

Smaller suburban cities would experience changes to visual and aesthetic resources similar to those described for larger suburban cities in Growth Targets Extended. Although conditions vary by jurisdiction, specific views, historic structures, natural resources, and undeveloped open spaces could be affected by new development. In some places an increase in density could make parts of these cities seem more urban, and boundaries of the cities could become less distinct as they merge with adjacent areas.

Unincorporated Urban Growth Areas

The population and employment in unincorporated areas would grow much more modestly under the Metropolitan Cities Alternative. This relatively small increase of growth over time could be largely accommodated by existing housing, retail/business development, and transportation infrastructure. As a result, little noticeable change to visual and aesthetic resources would be expected.

Rural Areas

The rural population and employment would grow relatively little under the Metropolitan Cities Alternative. This low growth rate over time could be largely accommodated by existing housing, retail/business development, and transportation infrastructure. As a result, little noticeable change to visual and aesthetic resources would be expected.

LARGER CITIES ALTERNATIVE

Metropolitan Cities

In the Larger Cities Alternative, the effects from growth in population and employment would likely be significantly somewhat less than those generated from Growth Targets Extended. New development would likely be denser, and structures would be taller and more intense. Undeveloped open space might be displaced by new construction in some areas, with an overall decline in both native and introduced vegetation. In some areas, population increase could provide the economic driver for redevelopment that would include attractive architecture and public spaces.

Core Suburban Cities

In the Larger Cities Alternative, the increase in population and employment would result in visual and aesthetic impacts similar to those of the Metropolitan Cities Alternative. Regional growth centers within these cities would likely develop into dense, medium- and high-rise mixed-use neighborhoods. Surrounding low- and medium-density neighborhoods would gradually become denser and come to include higher-intensity uses. Residential development, both multifamily and single family, could be a more notable visual feature, as could retail and commercial structures. Height and bulk of new development could likely be greater than now, and increased volumes of traffic might lead to increased expanses of both roadways and parking lots. Some of the development in core suburban cities would displace undeveloped woodlands and wetlands. Residential development would trend to higher residences per acre than now, with a greater reliance on multiple-family housing. In general, the visual and aesthetic character of core suburban cities would become more urban, more densely developed.

Larger Suburban Cities

The high amount of growth in population and employment levels allocated to these cities under the Larger Cities Alternative could affect visual and aesthetic resources of these cities in a number of important ways. Although residences may still be predominantly single-family in many neighborhoods, multiple-family residences could be a far larger part of the built environment. Retail, office, and business-related development would also increase in scale and frequency of occurrence, perhaps becoming regionally significant centers for non-residential land uses. Some of this increase in non-residential development could occur in and around retail/business districts near city centers. Moderate to large-scale strip development could become more common along arterials and major intersection. In general, density, scale, and bulk of structures in these cities would increase. New or expanded regional transportation facilities may become noticeable view elements. These might include expanded surface streets, extended or expanded limited access roads, high-capacity transit facilities, parking facilities, and related utilities. New development would likely displace existing undeveloped open space; however, public parks, athletic fields, and other types of recreational facilities might be developed to serve larger numbers of residents, adding to existing visual resources. Overall, the look and feel of these suburban cities would be noticeably more urban than now, and might come to resemble some of the existing core suburban cities.

Smaller Suburban Cities

The Larger Cities Alternative's small increase to relatively small population and employment levels, coupled with an ability to absorb change over time, could result in only minor changes to the visual and aesthetic character of these cities.

Unincorporated Urban Growth Areas

The growth in population and employment predicted for urban growth areas under the Larger Cities Alternative could cause mostly moderate to minor changes to visual resources. Although these changes may be noticeable, the potential to affect the overall visual character of these geographies is low.

Rural Areas

Effects on visual resources from the Larger Cities Alternative could be fairly minor, with low potential to change the visual character of these areas.

SMALLER CITIES ALTERNATIVE

Metropolitan Cities

The Smaller Cities Alternative would generate the smallest population and employment increase for metropolitan cities. Changes in resulting development and corresponding effects would be similar to those described for other alternatives, but far less intense. Visual and aesthetic features in metropolitan cities would likely not be impacted much by these relatively minor effects. However, there would also be fewer opportunities to incorporate development that adds public spaces and reuses or rehabilitates historic and other existing structures.

Core Suburban Cities

In the Smaller Cities Alternative, population and employment levels of core suburban cities would experience the smallest increase of the four alternatives, which might be absorbed over time with relatively little impact to the visual and



aesthetic character of these cities. As with metropolitan cities, there may be fewer opportunities for reuse of structures and the development of public spaces that could accompany new construction.

Larger Suburban Cities

Population and employment levels in larger suburban cities would increase more modestly in the Smaller Cities Alternative than in other alternatives, and consequently, visual and aesthetic features in these cities could potentially be less impacted. There could be fewer opportunities for reuse and rehabilitation of existing structures, as mentioned for metropolitan cities and core suburban cities.

Smaller Suburban Cities

Under the Smaller Cities Alternative, these 52 cities would absorb a half-million additional residents, where only 260,000 people live now. Perhaps more dramatically, employment would increase by 360,000 where only 100,000 work now. This increase would profoundly impact the visual and aesthetic character of these communities. To accommodate larger numbers of residents, both single-family and multiple-family housing would become far more dominant part of the built environment than they are currently. Corresponding retail/commercial development could expand the scale and extent of existing similar land uses and could also cause the development of areas that are currently residential or open space. Small- to medium-scale structures that are currently the most common elements of the built environment in smaller cities could be joined or replaced by new development that could trend toward medium- to large-scale. Transportation requirements of a growing population would result in expanded roadways and additional transit and parking facilities. Higher traffic volumes would result in busier roadways being a dominant visual feature in some places, which is somewhat different from what exists today.

These fundamental changes to the physical environment of smaller cities would cause a significant shift in the cities' overall visual and aesthetic character and could create potential for higher contrasts between or within neighborhoods and the surrounding area. However, carefully planned and designed new development could also result in attractive architecture (both private and civic structures), creation of vibrant public spaces like parks, sports fields, and urban plazas, and streetscapes that are inviting to and safe for people on foot.

Unincorporated Urban Growth Areas

In the Smaller Cities Alternative, unincorporated urban growth areas are predicted to experience a doubling of population, and a fourfold increase in employment. Visual and aesthetic features, such as agricultural land, natural resources, historic architecture, scenic views, human scale development, and compact retail/commercial centers, could be affected by population-generated development. Visual change could occur with the relatively large increases in single-family development, multiple-family development, strip retail, and greater expanses of roadway, transit facilities and paved parking needed to accommodate increases in travel. The capacity of the built environment to absorb these changes could in some cases be surpassed, altering the overall visual character from open space to built environment, from relatively low density residence-to-acre to relatively dense suburban. While potentially spread over the area, the employment could change the residential character of these places to a much greater mix of commercial structures with associated changes to visual appearance.

Rural Areas

Population and employment levels of rural areas could increase at a noticeable rate. Although specific visual resources could be affected by this increase, the overall visual character of rural areas may not be greatly affected. However, effects on specific visual resources could be significant and might include changes to or displacement of scenic views, agricultural land uses, natural resources, low density development, historic buildings or buildings which might be eligible for historic status. Similar to the unincorporated urban area, the residential character would likely change.

5.12.3 Cumulative Effects

At the scale of this review, most of the effects described above are cumulative in nature and consider a variety of direct and indirect impacts to visual and aesthetic character. On a localized level, portions of the urbanized area could be significantly altered over the next 35 years, while other parts could remain much as they are today. On a more regional scale, continued development outside the urban growth area could expand the trends toward increased construction, with both beneficial and adverse effects.

Examples of adverse effects:

- Loss of natural features, agricultural uses, and open spaces.
- Reduction of the inventory of historic properties.
- Lower overall quality of visual character.
- Loss of “human scale” settings.

Examples of beneficial effects:

- Rebuilt streets that are more aesthetically pleasing, more functional, and more pedestrian-friendly.
- Redevelopment of properties and neighborhoods that have become blighted.
- New development that provides vibrant public spaces.
- Opportunities for excellent architecture that provides local or regional character and civic pride.

5.12.4 Potential Mitigation Measures

Effects of population and employment increases to the visual environment could be mitigated by careful planning and design of new development, by limiting or avoiding development of specific areas that contain valuable visual resources, and by enhancing existing structures, public open space, and natural features to increase their value in local communities and the region at large. Specific measures may include:

- Commitment to architectural design standards, design ordinances, and design review.
- Main Street or Great Streets programs.
- “Complete streets” programs.
- “Green streets” programs.
- Clustering development to minimize open space displacement.
- Preserving, restoring, and enhancing natural features.
- Planning for and providing parks, athletic facilities, plazas, and other types of open space.
- Preserving historic and vernacular architecture.
- Planning for visually interesting and stimulating urban development — including designing for ground floor retail and utilizing pedestrian-friendly design practices.
- View preservation ordinances.
- Building provisions for sun and air access.
- Providing incentives for preserving and planting vegetation.
- Context-sensitive design.
- Developing and implementing street tree planting and greenway development.
- Engaging in transportation planning that minimizes the visual impacts of increased traffic volumes and extensive roadway and parking facilities.
- Sign standards and ordinances.
- Relocating utilities underground.

Each of the geographies potentially affected by the alternatives has its own unique visual character, based on landforms, ecology, human history, and current land uses. Successful mitigation of potential affects to the built environment will most likely be based on an approach to planning and design that fully considers all of these influences.

The alternatives presented here entail many challenges and opportunities, related chiefly to denser development and increasingly urban environments. Changes to the visual environment due to urbanization and density may be addressed with some success at the local or even site-specific level. However, a more comprehensive approach to planning and design would allow for sharing of objectives and planning/design resources, review to assess successful implementation



of goals beyond narrowly defined geographies, avoidance of unnecessary eclecticism, and creation of unified aesthetic character or spirit of place. For these reasons and others, comprehensive planning and design would likely be the most critical mitigation element with regard to visual resources and visual character.

5.12.5 Significant Unavoidable Adverse Impacts

Although the visual and aesthetic features of some areas within the region have the ability to absorb changes without affecting the overall look and feel, and growth and change have the potential to improve the aesthetic qualities from many perspectives, many areas in the region will experience fundamental adverse changes to both overall visual character and specific visual elements. Specific potential impacts would include:

- Obstructing or altering scenic views.
- Displacing natural resources.
- Displacing historic structures or structures with architecture that provides a sense of place.
- Development of open space.
- Increase in transportation related elements like roadway, parking, congested streets, and high traffic volumes.

Changes to the overall character of geographies could include:

- Increase in density (although this is not always an adverse impact).
- Low-density development patterns (not always adverse).
- Increase in height, bulk, and scale of structures (again, not always adverse).
- Loss of visual cohesion or intactness within a given area (e.g., extensive development within a historic neighborhood).



Earth

This chapter analyzes the growth distribution alternatives in relation to the region's geologic features, which include earthquakes, landslides/erosion, volcanic hazards, flooding, and coal mine subsidence. Each could cause a disaster; however, the severity of the impact and number of people and properties affected could depend on where and how growth is distributed under the different alternatives.

5.13.1 Affected Environment

A. PHYSICAL SETTING AND REGIONAL GEOLOGY

The formation of the Puget Sound region has been shaped by the movement and subduction of the earth's crust and volcanic and glacial activity over millions of years. The region is a geologically active area. All or parts of the region are susceptible to the following hazards:

- Earthquakes
- Landslides/Erosion
- Volcanic Hazards
- Flooding
- Coal Mine Subsidence

The Puget Sound area landscape was largely carved and shaped by the glaciers that advanced and retreated during the period beginning about 26,000 years ago until nearly 10,000 years ago. Over time, the weight and movement of these glaciers carved the basins, valleys and hills between the Cascade Mountains to the east and the Olympic Mountains to the west. The deepest of these basins filled with water as the glaciers retreated, forming Puget Sound. In addition to shaping much of the topography of the region, the ice age glaciers deposited most of the soil that lies on or close to the surface. These soils affect many things, including where and how easily structures can be built, where farming and resource extraction is most appropriate and sustainable, and where natural geologic hazards are more likely to occur. Several principal classes of soils found in the region include:

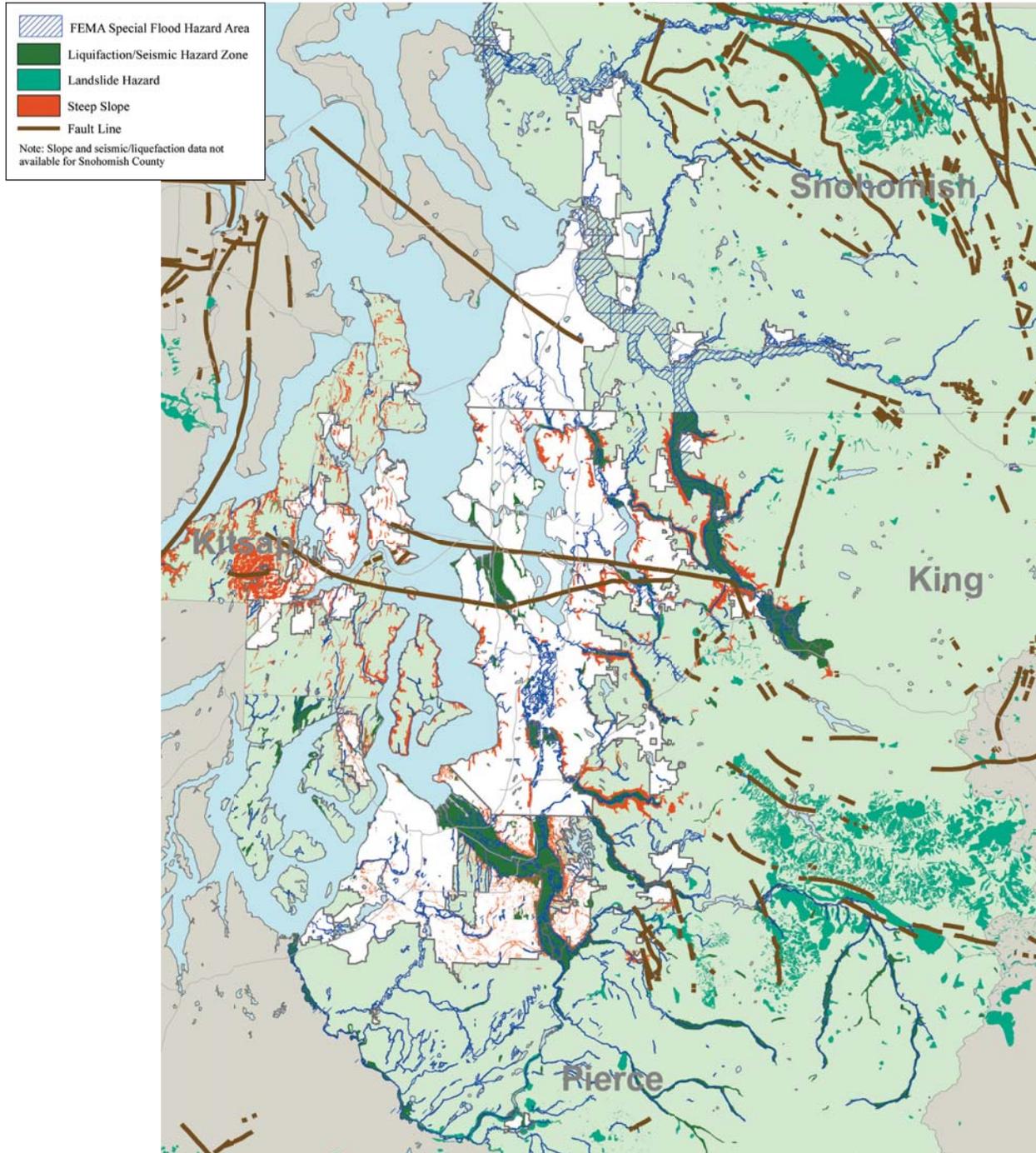
- Lakebed sediments (silts and clays)
- Deposits from glacial runoff (sands and gravels)
- Glacial till (very dense mixture of all types of deposits)

Additionally, stream deposits (less than 10,000 years old) and artificial fill can be found in many locations.



The topography (sloped or flat) and type of soil present can create landslide, liquefaction¹, and other geologic hazard areas in the region. Data from the King, Kitsap, Pierce, and Snohomish county Geographic Information Systems (GIS) have been collected to map the hazard areas in the region in Figure 5-13-1 (steep slopes/landslide, liquefaction, fault lines, floodways), including the main fault lines. Geologic hazard areas are often designated as Sensitive or Critical Areas and subject to additional restrictions or regulations by the local jurisdiction.²

FIGURE 5-13-1: GEOLOGIC HAZARD AREAS IN THE CENTRAL PUGET SOUND REGION



Source: City of Seattle, King, Kitsap, Pierce, and Snohomish counties, Washington State Department of Natural Resources, Federal Emergency Management Agency

¹ Liquefaction is the process by which loose, unconsolidated soils and fill respond to the shaking motion of an earthquake. This causes the soil to liquefy and flow like water, similar to quicksand, which strongly amplifies ground motion and is a major source of catastrophic damage.

² List of County Critical Areas Ordinances: Pierce County Critical Areas Ordinance Title 18E, King County Critical Areas Ordinance 21A.24, Snohomish County Critical Areas Regulations Chapter 30.62B, Kitsap County Critical Areas Ordinance Title 19.

B. PRIMARY GEOLOGIC HAZARDS

Seismic Hazard Areas

The Puget Sound region has many faults, as shown in Figure 5-13-1. Faults are cracks in the earth's crust and are the product of movement within the crust. The following are some of the major faults in the area:

- The Seattle Fault zone is a series of shallow crustal faults that stretches from Bremerton in Kitsap County east-west across King County to Issaquah.
- A shallow fault zone stretches from Gig Harbor to near the Tacoma Dome in Pierce County.
- The South Whidbey Island fault crosses the south end of the island and stretches southeast through the south Everett area in Snohomish County towards Duvall.
- The North Whidbey Island fault crosses the north end of the island, stretching southeast across northern Snohomish County.

These faults pass through or near several of the most populated cities in Washington: Bellevue, Everett, Seattle, and Tacoma. In addition to residential areas throughout the region, there are significant industrial land uses within these fault zones, specifically near the Boeing Plant in Everett, the Duwamish industrial area south of downtown Seattle, and near the Port of Tacoma. Major employment centers are also located in downtown Seattle, Tacoma, Renton, Bellevue, and Everett. An earthquake on one of the major faults could impact a large number of people and substantially disrupt businesses and industries in the region.

When a fault slips vertically or slides side-to-side, earthquakes can occur at shallow depths or miles below the surface. Huge earthquakes can occur in this region from the Cascadia Subduction Zone, which is located deep in the Pacific Ocean off the Washington coast. This is where the Juan de Fuca plate (a piece of the ocean's crust) is sliding underneath the North American plate. A subduction zone earthquake has the potential to exceed a magnitude of 9.0. Historically, at least seven huge earthquakes might have occurred along the subduction zone over the last 3,500 years, the last being around 300 years ago (University of Washington, 2005a).

More than 1,000 earthquakes occur each year, mostly in the western half of Washington state. Many are small and not noticed by the public, but since the late 1800s, more than 20 damaging earthquakes have hit Washington (WADNR, 2005). A Federal Emergency Management Agency (FEMA) study in 2001 ranked Washington as the state with the second highest risk for economic loss caused by an earthquake (Seattle Fault Earthquake Scenario Project, 2005). A major earthquake could cause a loss of life and property throughout the Puget Sound region.

In February 2001, the magnitude 6.8 Nisqually earthquake hit the region. This was a shallow crustal earthquake, with the epicenter about 10 miles (18 kilometers) northeast of Olympia and about 52 meters deep (University of Washington, 2005b). The total federal disaster recovery costs were estimated to be \$322 million dollars (FEMA, 2001). If the quake had lasted any longer, the costs and damage could have been much higher. This earthquake helped state, regional, and local agencies and the region's citizens recognize the need to plan and prepare for such events.

Earthquakes can cause settlement, soil liquefaction, or landslides, which contribute to the destruction of buildings, roads, and utilities. Damage is most likely to occur in areas where fill has been placed and valleys where soft sediments have been deposited. When soft soil is shaken, especially if it is wet, it starts to liquefy and flow. Notable liquefaction areas, depicted in Figure 5-13-1, occur along the Puget Sound shoreline, in the city of Seattle, between Woodinville and Redmond, at both ends of Lake Sammamish, along the Cedar River in Renton, in the area between Kent and Auburn, and in a large area of Pierce County between Mt. Rainier and Commencement Bay. Additionally, an earthquake could trigger a tsunami, impacting shorelines and low-lying areas.

Steep Slope/Landslide Hazard Areas

The Puget Sound region has many natural and human-made steep slopes covered with loose soil and rock. Loose materials on a steep slope create a landslide hazard area, where gravity tends to pull material down the slope. When the soil gets wet or saturated with water, the soil becomes increasingly unstable. Steep slopes can be very hazardous during an earthquake, when the motion can shake the loose material free. Wet soil on steep slopes can liquefy during an earthquake, with whole sections sliding away. Erosion from wind, water, lack of vegetation, or other reasons can also play a part in a slope becoming unstable and prone to sliding.



The steep slope and landslide hazard areas, which are present throughout King, Kitsap, and Pierce counties, are depicted on Figure 5-13-1. Note that steep slope data were not available for Snohomish County. The majority of the region's mapped landslide hazard areas occur in the eastern portions of Snohomish, King and Pierce counties, predominantly in natural resource and rural areas, and along shorelines of Puget Sound, Lake Washington, and Lake Sammamish.

Volcanic Hazard Areas

Just off the Washington coast, a piece of the earth's oceanic crust (called the Juan de Fuca Plate) is sliding underneath the Washington coastline. In addition to the potential for earthquakes, as the plate slides deeper into the earth, some of the crust melts, and some of the melted crust, called magma, begins to rise. When magma builds up and rises, it seeks a vent or volcano in the earth's surface. During an eruption, magma can be released, along with ash, steam, and other gases. The heat from the eruption can also melt glaciers and snow and cause large mudflows.

Volcanic hazard areas within the region are primarily linked to Mt. Rainier, and are largely located in Pierce County along the Carbon and Puyallup River valleys, although the risk of mudflows also extends into King County along river valleys that originate from Mt. Rainier. Historical data show that large mudflows, or lahars, have been triggered by volcanic activity (although not always preceded by an eruption) from Mt. Rainier, and have surged down the Puyallup River valley, reaching Commencement Bay. Rural areas in Pierce County, the city of Orting, and parts of the cities of Sumner and Puyallup could be covered by a large mudflow from Mt. Rainier. More extensive parts of the region could also experience ash fall from Mt. St. Helens if the winds were blowing towards Puget Sound during an eruption.

Flooding

Most floods in the region occur when there have been extended periods of heavy rainfall or rapid snowmelt runoff from surrounding mountain ranges. Many areas, especially valleys, throughout the region are within the FEMA 100-year floodplain. Flooding occurs to some extent every year and is the most common natural hazard in King, Kitsap, Pierce, and Snohomish counties. The major rivers in King, Pierce, and Snohomish counties are greatly influenced by the amount of rain and snow received in the Cascade Mountains. Valleys, low-lying areas, and land near waterbodies like lakes and streams are more likely to experience flooding and property damage during major storms or wet seasons. Flooding can occur along the Puget Sound when rains, high tides and/or the right direction and intensity of winds combine. Flooding problems could also occur if a dam were to break upstream of a neighborhood in the region. In urban neighborhoods, localized flooding can occur if the stormwater system is over capacity or drains are blocked.

Mine Hazards

Abandoned mines underlie several areas in King and Pierce counties and create the potential for significant damage if the ground above the mine gives way. There are no abandoned coal mines in Kitsap or Snohomish counties (WADNR, 2006).

C. CURRENT TRENDS

Recent and ongoing studies into the extent and types of risks associated with geologic hazards have resulted in a greater understanding of what types of uses are appropriate for certain areas. The United States Geological Survey and the University of Washington are actively involved in research into the nature and location of geologic hazards. This research will continue to be invaluable in reducing and mitigating the risk associated with the region's active geology because it is identifying localized conditions and likely effects of seismic activity in more detail, which allows the region to apply appropriate engineering measures in new development and in retrofitting existing facilities that might not be able to withstand potential seismic factors. Overall, the region is also increasingly recognizing the need for infrastructure that addresses risks posed by the region's geography. High levels of investment are being directed to address earthquake-vulnerable highways and bridges throughout the region, including the Alaskan Way Viaduct and State Route 520.

D. REGULATORY SETTING

Local land use regulations, such as Growth Management Act mandated critical areas regulations, typically restrict the type and location of development with regards to natural and geologic hazard areas. These development regulations vary between jurisdictions, but the Washington State Department of Community, Trade, and Economic Development has developed a model critical areas ordinance that covers recommended protections from erosion, landslide, seismic, mine, and volcanic hazards. The Federal Emergency Management Association has several programs that seek to limit

the number of structures within flood prone areas. In 2003, the Washington State Legislature adopted the International Building Code as the state standard building code. Provisions of this code mandate certain seismic safety standards for buildings located within the central Puget Sound region.

Each of the counties in this region have critical areas ordinances to implement the GMA:

- Pierce County Critical Areas Ordinance Title 18E
- King County Critical Areas Ordinance 21A.24
- Snohomish County Critical Areas Regulations Chapter 30.62B
- Kitsap County Critical Areas Ordinance Title 19

The purpose of these regulations is to protect critical areas from development and protect development from being impacted by a geologic hazard.

5.13.2 Analysis of Alternatives (Long-Term Impacts)

The timing, intensity, and location of events like earthquakes and other geologic hazards are very difficult to anticipate and greatly influence whether the impacts are minor or serious. Impacts from these natural hazards will also not occur uniformly across the region. Evolving research in the field of hazard mapping and risk assessment has resulted in information about the relative risks associated with different locations within the region. For this analysis, spatial data was assembled that identified known hazard areas within the region. The approximate amount of population and jobs that would be exposed to elevated risk within each alternative was then compared. Higher-risk areas for the following hazards have been mapped and analyzed: areas prone to liquefaction in an earthquake, areas subject to lahars from Mt. Rainier, FEMA 100-year floodways, and landslide prone areas.

A. IMPACTS COMMON TO ALL ALTERNATIVES

Local jurisdictions' critical area designations and regulations are a primary tool that would affect the number of people who would potentially be located in the areas where hazards are most likely to occur. Nonetheless, impacts from geologic hazards such as earthquakes, landslides, volcanic activity, and floods could include the following at any location in the region:

- Damage or collapse of buildings and transportation facilities
- Blocked access to buildings and roads
- Disrupted and damaged utilities
- Disrupted or disabled emergency and public services
- Altered physical landscape
- Economic loss
- Personal injury and loss of life

Areas within the region have the potential to experience these impacts regardless of the alternative selected. Development has already occurred in many areas that are particularly susceptible to these impacts. None of the alternatives anticipates decreases in existing development in these areas, although mitigation measures could help reduce the risks in these developed areas over time under all of the alternatives.

Urban Versus Rural Development

Areas such as metropolitan cities, core suburban and larger suburban cities typically have more comprehensive and some redundant utilities and roads to meet population demands. Similarly, there are typically several police stations, fire stations, and health clinics or hospitals in each of these heavily populated jurisdictions. If a natural disaster occurs, it is possible that alternate, functioning services and roads could be available or made usable in metropolitan cities, core suburban and larger suburban cities because more resources and options exist in those areas. In smaller suburban cities, unincorporated areas, and rural areas, there are potentially fewer duplicate services, which might make it more difficult to reach people affected by a natural disaster if major facilities, such as utilities and roads, are damaged.



With the exception of liquefaction/seismic hazard zones, growth in already densely populated areas might be less likely to be sited in presently undisturbed or undeveloped geologic hazard areas. Known liquefaction areas could significantly affect growth in some metropolitan and core suburban cities. Liquefaction areas in rural areas are largely in agricultural river valleys and along waterways, which might present limited development potential — and reduced risk to new development — due to existing critical areas regulations. Growth in smaller suburban cities and rural areas might have a greater potential to occur in or near landslide or volcanic hazard areas than growth in larger and metropolitan cities due to their greater proximity to Mt. Rainier and mapped landslide hazard and steep slope areas in the Cascade and Olympic mountain ranges.

Landslide Hazards

Landslide hazard areas exist in all four counties within the region. Growth in landslide hazard areas would only increase the risk of loss of life and property should a landslide occur and should be avoided. Certain activities such as vegetation and groundwater removal can make areas more prone to landslides. The majority of mapped landslide hazard areas in Snohomish, King and Kitsap counties are located in the eastern portions of those counties in designated natural resource areas, which have little potential for future development.

Flooding

Growth in flood zones (such as valleys, low-lying areas, and land near water bodies) is more likely to experience flooding than areas outside of flood zones. Creating new impervious surface area, such as roadways and parking lots, can add to flooding problems by reducing existing areas that presently naturally filter water, and by sending surface water to flow in new directions.

Seismic Hazards

Seismic hazards exist in all four counties within the region and there is no way of controlling seismic activity. Liquefaction areas and seismic faults depicted in Figure 5-13-1 occur throughout the region, in urban, rural, and natural resource areas. Existing structures should be retrofitted to be seismically sound and new structures should be built to comply with the standards set forth in the International Building Code.

Coal Mine Subsidence

Coal mines have the potential to cause settlement or collapse in their immediate vicinity, and can also affect groundwater levels and collect underground gases.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

For Growth Targets Extended, 50 percent of the population growth distribution would be in metropolitan, core, or larger suburban cities and the other 50 percent would be split between smaller cities, unincorporated urban growth areas, and rural areas. For example, 80 percent is located in metropolitan, core and larger suburban cities.

With Growth Targets Extended, growth allocated to the more densely developed urban areas could be impacted by the presence of liquefaction prone and seismic hazard areas. Major faults pass through or near the cities of Bellevue, Everett, Seattle, and Tacoma, which would experience significant population and employment growth in this alternative. In addition, there are significant industrial land uses within these fault zones, specifically near the Boeing Plant in Everett, the Duwamish industrial area south of downtown Seattle, and near the Port of Tacoma, all of which would continue to serve as major employment centers in this alternative. Major employment centers are also located in downtown Seattle, Tacoma, Renton, Bellevue, and Everett, all of which are located near fault lines or liquefaction prone areas. An earthquake on one of the major faults could impact a large number of people and substantially disrupt businesses and industries in the region.

The 50 percent population growth and 20 percent employment growth in smaller suburban cities, unincorporated urban and rural areas might also be sited in locations within or adjacent to known hazard areas. Growth Targets Extended could increase population in areas, such as southeastern Pierce County, that could be impacted by volcanic activity, such as an eruption of Mt. Rainier.

METROPOLITAN CITIES ALTERNATIVE

The Metropolitan Cities Alternative would concentrate 70 percent of population growth and 85 percent of employment growth in metropolitan, core, and larger suburban cities, with 30 percent of population growth and 15 percent of employment growth in smaller cities, unincorporated urban growth areas, and rural areas. As geologic hazards are somewhat localized, impacts arising from an event in the region's largest cities in the more densely populated portions of the region would affect a greater number of people than if more growth were more widely distributed in less populated areas. However, there are more redundant transportation, utility and emergency services in larger cities, which could be a benefit if infrastructure were damaged by a geologic hazard.

Under the Metropolitan Cities Alternative, the 30 percent of population growth and 15 percent of employment growth in smaller cities, unincorporated urban growth areas and rural areas could increase the number of people who live areas like the Puyallup Valley. If a natural disaster such as a volcanic eruption or flood were to occur, the people might need to evacuate, which could be increasingly difficult in more populous smaller suburban cities that had limited evacuation routes. More dispersed development patterns in these areas, however, might mean that fewer people are impacted by localized hazard events.

The Metropolitan Cities Alternative would concentrate growth in areas that are already densely populated and largely covered with impervious surfaces. Existing stormwater management and treatment systems, along with upgrades to systems made as redevelopment occurs, have the potential to manage any increased stormwater associated with impervious surfaces. Growth in smaller cities, unincorporated and rural areas is more likely to create new impervious surface area as previously undeveloped areas are converted to more urban uses, which could require the development of new stormwater management systems to prevent flooding problems.

LARGER CITIES ALTERNATIVE

The Larger Cities Alternative would concentrate 80 percent of the population and employment growth distribution in metropolitan, core, and larger suburban cities, with 20 percent in smaller cities, unincorporated urban growth areas, and rural areas. The potential impacts for the Larger Cities Alternative could be very similar to the Metropolitan Cities Alternative. Slightly more growth would be concentrated in the large cities where more people could be affected if a natural hazard event impacted densely populated urban areas. Possible impacts in smaller cities, unincorporated urban growth areas, and rural areas would be similar to those described in the Metropolitan Cities Alternative.

SMALLER CITIES ALTERNATIVE

The Smaller Cities Alternative would concentrate 25 percent of the population and employment growth in metropolitan, core, and larger suburban cities, and 75 percent in smaller cities, unincorporated urban growth areas, and rural areas. In this alternative, fewer people would be concentrated in the region's more densely populated urban areas, reducing risk from natural hazard events that have the potential to heavily impact liquefaction prone and seismic fault zones in the region's larger cities. Wider distribution of population and employment around the region in smaller-scaled structures could minimize impacts in the event of a localized natural hazard event.

The wider distribution of growth in King, Kitsap, Pierce, and Snohomish counties has the potential to increase pressure to allow development in greater proximity to some identified hazard areas in designated natural resource areas. Responding to impacts caused by a geologic hazard could be more difficult in those unincorporated and rural areas that are more distant from emergency service facilities and multiple evacuation routes. Development in outlying suburbs, especially in Pierce County, has a greater potential to be close to landslide and volcanic hazard areas from Mt. Rainier.

The Smaller Cities Alternative would likely create some amount of new impervious surface area as a result of new developments in the outlying suburbs, requiring the installation of new stormwater management facilities to prevent localized flooding.



5.13.3 Cumulative Effects

Possible geologic impacts are both localized and regional in nature. Most geologic conditions would be relatively unaffected by factors outside the region. However, for flooding, cumulative effects of growth activities upstream would have a direct impact on downstream cities and towns in that, as cities and towns upstream build within floodplains, the fluvial³ characteristics become less predictable, and thereby put downstream populations at a greater risk of flooding.

5.13.4 Potential Mitigation Measures

Potential mitigation measures to limit the risk of adverse impacts from geologic hazards could include many approaches; a few are listed below.

- Existing regulations such as local jurisdictions' critical areas ordinances and the International Building Code could be strengthened to require additional protections for structures locating within hazard areas. These protections could include increased setbacks from steep slopes or potential landslide areas, or restrictions on the type and intensity of development within floodways.
- Protections could also include strict building standards for new structures in the region, all of which are exposed to some risk from earthquake damage, and higher standards for structures locating within particular hazard areas, such as liquefaction zones or areas where the underlying geology could serve to amplify seismic waves.
- Further protection from earthquakes could be provided by programs that aim to retrofit existing buildings and infrastructure, instead of waiting for them to redevelop. These programs can be costly, but very effective at mitigating the risks associated with a major earthquake.
- Educational programs and disaster response planning can help mitigate the impacts of disasters by teaching and reminding people of what to do in the event of a disaster and could also improve government response to a disaster, limiting additional impacts that often occur after the actual disaster has happened. Examples of local jurisdiction plans include Pierce County's volcanic hazards response plan (Pierce County, 1999) and Orting's emergency evacuation plans if a volcanic event were to occur at Mt. Rainier.
- Additional research into the risks of geologic hazards.

5.13.5 Significant Unavoidable Adverse Impacts

None of the alternatives completely prohibits development on sites that are at risk for geologic hazards. Because single-family residences are allowed on most legal lots, often including those lots within designated critical areas or known hazard areas, development on these sites within known hazard areas will always pose some risk of adverse impacts from geologic hazards. This is true for all alternatives.

In addition, the central Puget Sound region is susceptible to earthquake and volcanic disasters that will severely impact many, if not all, residents in the region regardless of the alternative selected. These severe impacts could occur even if all potential mitigation measures are carried out.

³ The word fluvial is used in geography and earth science to refer to all topics related to flowing water. Fluvial usually refers to rivers, streams and sometimes through flow, overland flow and percolation.



Noise

This chapter discusses noise impacts based on past noise modeling performed in the region and on other relevant noise-related information. It focuses on transportation-related noise sources as well as ambient noise characteristics under different development patterns. It then analyzes the potential noise impacts under each of the growth distribution alternatives.

5.14.1 Affected Environment

A. BACKGROUND

The human ear can perceive a range of noise levels. The range of perceptible magnitudes is so large that noise levels are generally expressed on a logarithmic scale in units called decibels (dB). Noise levels are affected by a number of variables, including elevation, terrain, distance from the source and weather. A break in the line of sight between a source and receiver (e.g., buildings, hilly terrain) generally reduces sound levels by 5 dBA.¹ In addition, noise levels decrease with distance from a noise source. The change in noise level depends on the type of terrain (hard or soft), as well as the type of source (e.g., roadway, transit center). Weather conditions alter both noise levels and the transmission of noise from a source to where it is received. The human ear perceives changes in sound levels more effectively than absolute sound levels. While a 3 dB increase is barely perceptible to the human ear, a 5 dB increase sounds as if the noise is about one and one-half times as loud. A 10 dB increase is perceived as a doubling in noise level to most listeners.

At high intensities, environmental noise directly affects human health by causing hearing loss. Although the science is currently inconclusive, noise is also suspected of causing and aggravating other health problems. Environmental noise affects general human welfare by interfering with thought, sleep, and conversation. According to the Environmental Protection Agency, environmental sound levels below 55 dBA L_{dn} ² should protect human health and welfare with a margin of safety for areas with outdoor uses. However, this level is not a standard. Rather, it identifies a safe level of noise exposure without consideration of other factors, such as cost of mitigation (EPA, 1974). Environmental sound levels in most urban environments are greater than 55 dBA L_{dn} . Sound levels typical of various environments are shown in Figure 5-14-1.

¹ The human ear can best perceive frequencies or pitches between 1,000 and 5,000 hertz (Hz). Environmental sounds consist of many frequencies. Frequency weighting combines all of the frequencies into one sound level that simulates how an average person hears sounds. The commonly used frequency weighting for environmental sounds is A-weighted decibels (dBA).

² L_{dn} , or the day/night noise level, describes the daily noise environment, with an added penalty for higher noise levels at night.



FIGURE 5-14-1: TABLE OF TYPICAL OUTDOOR SOUND LEVELS IN VARIOUS ENVIRONMENTS

Description of Environment	L_{dn} (dBA)
City (Downtown Major Metropolis)	75 - 80
Very Noisy Urban	70
Noisy Urban	65
Urban	60
Suburban	55
Small Town and Quiet Suburban	45 - 50

Source: Environmental Protection Agency, 1974

In addition to its effects on humans, noise can also affect wildlife (for more information see *Chapter 5.5 – Ecosystems*). While research on the impacts of noise on ecosystems has produced a range of theories and results, most experts agree that noise can affect wildlife behaviorally and physiologically. If noise is a constant stress, it can exhaust wildlife, affecting reproductive success and the likelihood of survival. Projecting actual consequences of noise on wildlife is difficult, however, because responses will vary between species (Radle, 2006).

B. REGULATORY SETTING

Federal and state noise regulations and guidance provide a framework for evaluating noise impacts from transportation sources. The Federal Transit Administration, Federal Highway Administration, and Federal Aviation Administration each have established noise exposure measurement procedures (both modeling and monitoring) and noise impact criteria. The Federal Transit Administration’s criteria apply to federally funded transit projects and vary depending on project type. For fixed guideway and transit facilities, Federal Transit Administration project exposure criteria apply. The Federal Highway Administration regulates noise associated with busways, access ramps, and other projects connected to roadway systems. The Federal Aviation Administration primarily regulates airport land use, aircraft noise, but also provides assistance to airport operators in developing and implementing noise abatement and compatibility programs.

Noise Criteria for Transit Projects

Under Federal Transit Administration transit criteria, a noise impact occurs when a proposed project would cause $L_{eq}(h)^3$ or L_{dn} noise levels to increase overall noise between 1 and 10 dBA, depending on the existing noise level and land use (FTA, 1995). In general, the greater the existing noise level, the less a project may increase the overall noise level. Land uses sensitive to noise are divided into three categories (see Figure 5-14-2). Other uses, such as retail and industrial, are generally not considered noise-sensitive.

FIGURE 5-14-2: FEDERAL TRANSIT ADMINISTRATION-ESTABLISHED NOISE-SENSITIVE LAND USES

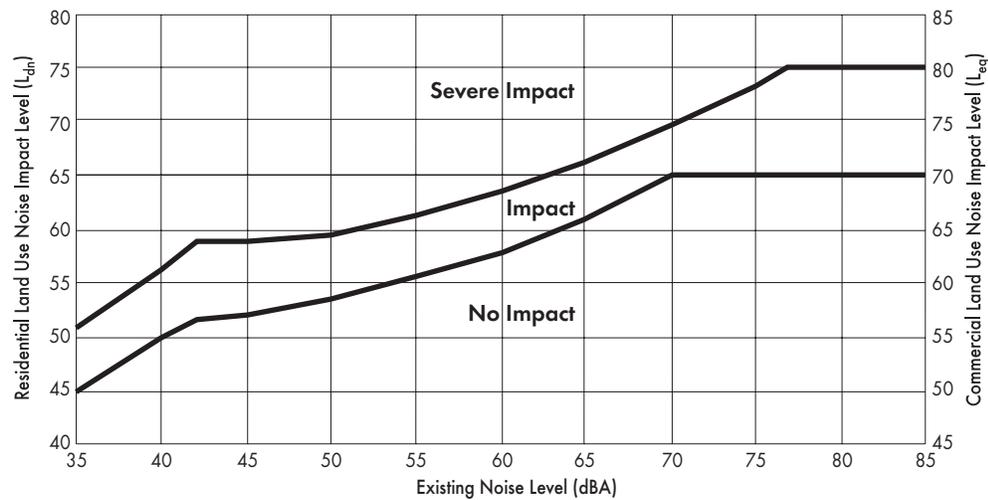
Land Use Category	Description
1	Most sensitive areas where quiet is essential (e.g., outdoor amphitheatres)
2	Places where people sleep (e.g., homes, apartments, hotels, hospitals)
3	Least sensitive areas (e.g., schools, libraries, medical offices, concert halls)

Source: Federal Transit Administration, 1995

Noise impact levels, as defined by the Federal Transit Administration, are presented in Figure 5-14-3. These noise exposure levels include only noise generated by a specific project and not other noise sources that contribute to the overall noise level in the project area. In urban areas with existing L_{dn} noise levels ranging from 60 to 75 dBA, noise impacts from light rail lines would occur at noise-sensitive locations (such as residences) within 50 to 100 feet of the tracks, depending on local conditions. In suburban areas with existing L_{dn} noise levels of 50 to 60 dBA, noise impacts would occur within approximately 100 to 150 feet of park-and-ride lots. Impacts would occur within approximately 25 to 50 feet of commuter rail lines with one commuter train per hour.

³ L_{eq} , or the equivalent sound level, is a common descriptor for environmental noise is the equivalent sound level. L_{eq} is a sum of all sounds over a given period of time. L_{eq} measured over a 1-hour period is the hourly L_{eq} , denoted $L_{eq}(h)$.

FIGURE 5-14-3: PROJECT IMPACT CRITERIA FOR TRANSIT PROJECTS



Source: Federal Transit Administration, 1995

Noise Criteria for Roadway Projects

For roadway projects, noise impacts occur when predicted traffic noise levels approach or exceed the Federal Highway Administration’s noise abatement criteria or substantially exceed existing noise levels (23 Code of Federal Register, Part 772.5). The Federal Highway Administration noise abatement criteria specify different $L_{eq}(h)$ noise levels for different land use categories (Figure 5-14-4). For receptors where serenity and quiet are of extraordinary significance, such as National Parks and National Monuments, the noise criterion is 57 dBA. For residences, parks, schools, churches, and similar areas, the noise criterion is 67 dBA. Mitigation is considered when the noise abatement criteria are approached or exceeded.

FIGURE 5-14-4: FEDERAL HIGHWAY ADMINISTRATION’S NOISE ABATEMENT CRITERIA

Activity Category	$L_{eq}(h)$	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B.
D	-----	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 Code of Federal Register Part 772

Noise Criteria for Airports

The Federal Aviation Administration is primarily responsible for the regulation of aircraft noise, although the agency also supports state and local efforts to ensure compatible land use near airports. Airport operators develop noise exposure maps to describe how airport operations will affect the compatibility of land uses in the area (14 Code of Federal Register, Part 150). According to the Federal Aviation Administration regulations, residential and recreational land uses are generally compatible with noise levels below 65 dB L_{dn} . Most commercial and industrial land uses are compatible with noise levels up to 70 dB L_{dn} , although few land uses are recommended over 70 dB L_{dn} without mitigation. For land uses with existing exposure levels over 65 dB L_{dn} , the Federal Aviation Administration considers an increase of 1.5 dB L_{dn} to be significant (Port of Seattle, 2002). If any change in airport operations would cause a substantial new noncompatible use or significantly reduce noise over existing incompatible land uses in an area depicted on the noise exposure map, the airport must submit a revised map (14 Code of Federal Register, Part 150). Airports who have submitted acceptable noise maps may develop and submit for Federal Aviation Administration approval a noise



compatibility program (14 Code of Federal Register Part 150.23). The purpose of such programs is to identify existing and future airport noise, reduce noise impacts in surrounding communities, and reduce or eliminate present or future noncompatible land uses in the area. After Federal Aviation Administration approval of an airport's noise compatibility program, the airport is eligible to receive Part 150 noise funds to help implement the program.

State Noise Criteria

The Washington State Department of Ecology (Ecology) regulates noise levels at property lines adjacent to a noise source (WAC Chapter 173-60). Although traffic and transit noise is exempt from property line noise limits, the limits apply to construction noise during certain hours and to other operations such as park-and-ride lots. Figure 5-14-5 illustrates the level of allowable noise, based on the land use of the noise source and the receiving property, or the Environmental Designation of Noise Abatement (EDNA). Most jurisdictions in the Puget Sound region have adopted the Ecology property line limits with minor changes, such as lower limits in residential areas during nighttime hours. Aircraft in flight are exempt from the provisions of WAC 173-60. In addition, aircraft engine testing and maintenance are exempt from the provisions between 7:00 a.m. and 10:00 p.m.

FIGURE 5-14-5: MAXIMUM PERMISSIBLE NOISE LEVELS BY ENVIRONMENTAL DESIGNATION (dBA)

EDNA of Noise Source	EDNA of Receiving Property Residential	EDNA of Receiving Property Commercial	EDNA of Receiving Property Industrial
Residential	55	57	60
Commercial	57	60	65
Industrial	60	65	70

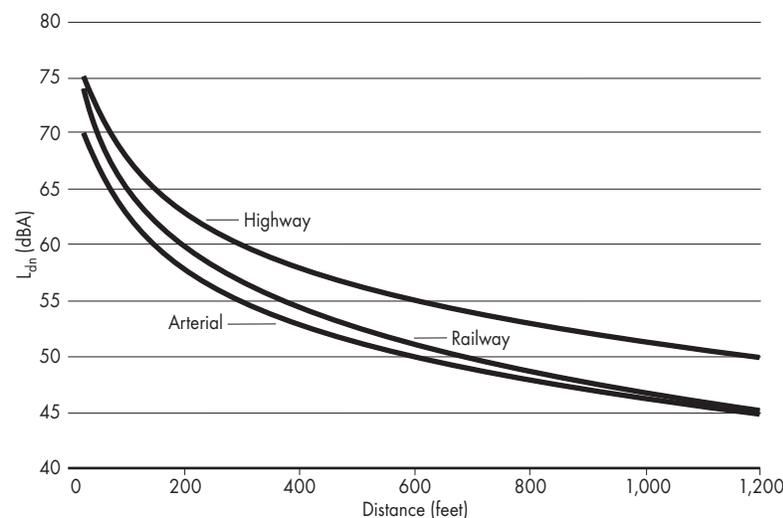
Source: Washington Administrative Code, 1989

C. EXISTING CONDITIONS

Background environmental sound levels vary widely in different environments. The Environmental Protection Agency evaluated L_{dn} sound levels at population centers of various densities and developed qualitative descriptions of the sound environments (Figure 5-14-1).

Although a number of human activities contribute to noise exposure levels, transportation sources are the largest contributor to ambient noise in urban and suburban areas. Noise levels from transportation sources vary with the volume, speed, and type of vehicle. Typically, an increase in any of these factors increases traffic noise levels.

FIGURE 5-14-6: TYPICAL L_{dn} NOISE LEVELS NEAR TRANSPORTATION FACILITIES



Source: Federal Transit Administration, 1995

Roadway Noise

Noise from mobile sources consists of noises from the engine, tires, and exhaust. Heavy trucks are significant contributors to overall traffic noise levels. The exhaust and mechanical systems, increased tire to pavement contact, and poor aerodynamic design of heavy vehicles contribute to higher traffic noise levels. Roadways with greater amounts of truck traffic will have higher noise levels than roadways without truck traffic. Ambient noise levels can generally be estimated based on distance to transportation sources. Typical L_{dn} noise levels, as a function of distance from highways, arterials, and rail lines, are shown in Figure 5-14-6.

Noise levels measured in the Puget Sound region tend to be consistent with the values in Figure 5-14-6 and Figure 5-14-7. For example, Seattle urban area noise levels were documented in the Central Link Environmental Impact Statement to range from 61 to 76 dBA L_{dn} (Sound Transit, 1999).

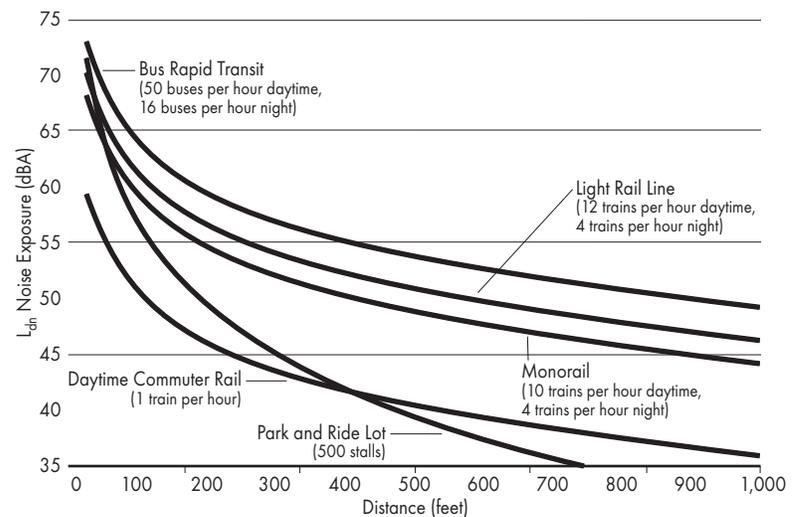
Railway Noise

Measurements taken in residential areas for the Interstate 405 Corridor Program Environmental Impact Statement along the Burlington Northern Santa Fe rail line on the east side of Lake Washington ranged from 56 to 68 dBA L_{dn} (WSDOT, 2002).

Transit Noise

Existing transit noise sources in the Puget Sound region include buses, light rail, and commuter rail. Typical L_{dn} noise exposure levels from transit vary based on the mode or facility. For example, typical noise levels for a commuter rail system operating one train per hour during the day at 50 mph would be approximately 55 dBA at 50 feet from the track. If trains idle for long periods of time at stations, the L_{dn} exposure levels in the vicinity of the stations would increase. Noise exposure levels from a 500-stall surface-level park-and-ride lot operating with 10 buses per hour during the day would be about 64 dBA at 50 feet from the lot. Noise levels associated with transit also vary by vehicle size and engine type. Electric and gasoline buses, for example, are quieter than diesel buses. On heavily traveled roadways, the contribution of bus noise to total traffic noise is generally very limited.

FIGURE 5-14-7: TYPICAL L_{dn} NOISE LEVELS NEAR TRANSIT FACILITIES



Source: Parsons Brinckerhoff, 2005

Airport Noise

Aircraft noise is a contributor to noise exposure levels in the Puget Sound region. Noise levels from individual aircraft events can range from 53 to 78 L_{max}^4 dBA depending on the type of aircraft, height above the ground, and other factors (Port of Seattle, 2002). The Puget Sound region is home to several airports, and Seattle-Tacoma International Airport (Sea-Tac) is the region's primary commercial and international service airport. Five other airfields serve as general aviation and reliever airports. In addition, there are 23 other general aviation airports throughout the region. Aircraft produce noise while on the ground and flying over populated areas, as well as during takeoff and landing.

In 2002 the Federal Aviation Administration approved the Seattle-Tacoma International Airport FAR Part 150 Study Update. The study identifies areas affected by existing and forecast future airport noise, and outlines a comprehensive program for reducing noise impacts in the communities around the airport (Burien, Des Moines, Kent, Normandy Park, Federal Way, Tukwila, SeaTac, and areas of unincorporated King County). The Port is now implementing the Noise Study recommendations using Federal Aviation Administration Part 150 funds and airport funds.

In 1996 the Puget Sound Regional Council adopted Resolution A-96-02, which amended the Metropolitan Transportation Plan, adding plans for a third runway at Seattle-Tacoma International Airport. The Resolution included 31 action steps (conditions) to address noise impacts in the communities around Sea-Tac Airport. As of March 2006, 21 action steps were complete and 10 were underway. Updating the Sea-Tac FAR Part 150 Study (completed in 2002) was among the required action steps. The Resolution also required the Port of Seattle to work with the Highline School District to implement a program to reduce airport noise impacts in schools throughout the district. This program (known as "Sound Environment for Education") is funded by the Federal Aviation Administration, the Port, the State of Washington, and the Highline School District. Implementation is currently underway.

A Part 150 Noise Study and Airport Noise Compatibility Program for King County International Airport (Boeing Field) was completed in 2004, and is being implemented. This program is helping to reduce the impacts of airport noise in the areas around Boeing Field.

⁴ L_{max} is the highest noise level that occurs during a given measurement period.



At Snohomish County Airport (Paine Field) the most recent airport master plan was completed in 2002 and included preparation of an official FAR Part 150 Noise Exposure Map. The noise analysis shows significant existing and forecast (2008) aircraft noise (above 65 L_{dn}) is mostly contained within the airport boundary. Therefore no FAR Part 150 Noise Compatibility Program was done.

The region's 25 other airports generate aircraft noise, but similar to the Paine Field situation, most aircraft noise occurs within airport properties.

5.14.2 Analysis of Alternatives (Long-Term Impacts)

Urbanization affects noise exposure levels by changing the physical environment, such as replacing vegetation with paved surfaces and buildings. Noise decreases with distance from the noise source, and vegetation absorbs noise more effectively than hard terrain. Urbanization also increases the number of noise sources in an area, such as lawn mowers, vehicles on streets and highways, railroads, and aircraft in flight. Population density, therefore, is highly correlated with noise exposure. As an area grows, construction and maintenance operations increase, emergency vehicles are more prevalent, and more people are concentrated in areas with more noise sources. As cities and regions grow under each of the alternatives, the number of noise sources could increase. The extent of the perceptible change in sound levels, however, will depend on where and how the growth occurs, and on any potential mitigation measures employed.

Generally, increased population and employment in rural areas has the potential to result in low-density growth patterns. While noise sources may increase, the receptors could likely be spread out over a large area and are unlikely to perceive a noticeable change in sound levels. Unincorporated urban growth areas present a wide variety of growth patterns, from completely undeveloped to more mature urban areas. New residents in presently undeveloped areas of the urban growth area may be exposed to lower levels of ambient noise, similar to those in rural areas. Potential exposure in presently developed areas could be more similar to that in metropolitan or core suburban cities, where noise levels are already high, and changes in noise levels associated with significant growth may only be slightly perceivable.

A. IMPACTS COMMON TO ALL ALTERNATIVES

Alternative plans for urbanization differ in where uses and activities are concentrated and how people and goods move between areas. For example, concentrating growth in an area could likely increase traffic and associated noise levels on nearby roads. The effect of transportation-generated noise depends on the proximity of noise-sensitive land uses to the noise source.

Due to the logarithmic nature of the decibel scale, increases in traffic volumes do not cause proportional increases in noise levels. A doubling of traffic, for example, would result in only a 3 dB increase in noise levels. Traffic would need to *triple* to result in a readily perceivable (5 dB) noise increase (CDOT 2004). For this analysis, noise impacts were analyzed based on changes in vehicle trips compared to existing conditions and to a comparison of transportation benchmarks in 2040 for the various alternatives. Although this approach does not reveal all areas that would experience noise impacts, it identifies locations where traffic noise would noticeably increase and compares the alternatives to one another. Areas that experience substantial increases in travel demand may require additional transportation capacity in the future. Transit and roadway enhancements would produce localized noise impacts in the project corridor. Impacts resulting from additional transportation facilities would be similar to those depicted in Figures 5-14-6 and 5-14-7 shown on previous pages.

B. ANALYSIS OF EACH ALTERNATIVE

GROWTH TARGETS EXTENDED ALTERNATIVE

Growth Targets Extended would extend currently adopted plans and targets to the year 2040. Growth under Growth Targets Extended would be more evenly distributed among geographies than under existing conditions. Half of the population growth would be distributed between metropolitan cities and the unincorporated urban growth area, while the majority of employment growth would occur in metropolitan cities and core suburban cities. Because much of the projected population growth in the unincorporated urban growth area would not be highly dense urbanized growth, it is unlikely to result in readily perceivable increases in noise levels. Under Growth Targets Extended, daily vehicle trips

in some metropolitan cities could double, but on average traffic would increase only 60 percent. Similarly, vehicle trips in core suburban cities are projected to increase 75 percent on average. As mentioned above, traffic would need to triple to cause a perceivable change in noise levels.

In comparison to the other alternatives, the most population growth in rural areas is expected under Growth Targets Extended. Regionally significant habitat areas occur at the greatest density in rural areas. Noise impacts on wildlife would therefore be possible as rural areas and adjacent resource lands are potentially developed and noise levels increase (see *Chapter 5.5 – Ecosystems*).

METROPOLITAN CITIES ALTERNATIVE

Under the Metropolitan Cities Alternative, growth would be focused in metropolitan cities and core suburban cities. Although the densities associated with this growth pattern would result in the fewest vehicle trips in the region, it would cause the greatest increase in vehicle trips within urbanized areas. On average, vehicle trips in metropolitan cities would double, though select cities could experience a tripling in daily trips. Similarly, a few core suburban cities may see increases in vehicle trips over 200 percent. On average, however, the number of trips would double, not yielding a readily perceivable increase in noise levels. Outside of the metropolitan and suburban core cities, the Metropolitan Cities Alternative would result in the least increase in noise compared to the other alternatives.

Because a substantial amount of growth under the Metropolitan Cities Alternative would be within urban areas, most investments in transportation capacity would likely be to the existing infrastructure. In the case of transportation, improved transit headways and additional road capacity can cause slight increases in noise levels. As density increases in metropolitan and core suburban cities, however, other noise sources (such as ambulances) could likely contribute to rising noise levels in those areas.

LARGER CITIES ALTERNATIVE

Under this alternative, about 60 percent of growth would be focused in core suburban and larger suburban cities, with another 20 percent in metropolitan cities. Vehicle trips in metropolitan cities vary greatly under the Larger Cities Alternative, actually decreasing in some areas while more than doubling in others. On average, vehicle trips would increase by approximately 40 percent in metropolitan cities. In core suburban cities, vehicle trips would double on average, but are estimated to triple in a few locations. Unlike the Metropolitan Cities Alternative, more growth would be dispersed to larger suburban cities, where increased traffic could likely be expected. Most of the regional growth under the Larger Cities Alternative, however, would be near existing transportation infrastructure. No new transportation-related sources are likely to be created. Other new noise sources related to increased urbanization, however, can be expected in core and large suburban cities.

SMALLER CITIES ALTERNATIVE

This alternative would disperse growth throughout the urban growth area, with the most growth focused in smaller suburban cities and the unincorporated urban growth area of any of the alternatives. Compared to existing conditions, traffic volumes regionwide are estimated to increase more under the Smaller Cities Alternative than any other alternative. Traffic within metropolitan and core suburban cities is estimated to increase only 3 percent and 34 percent, respectively. Traffic-related noise levels are therefore unlikely to increase in metropolitan and core suburban cities under the Smaller Cities Alternative.

In the remainder of the region, vehicle trips are estimated to almost double. Travel under the Smaller Cities Alternative is estimated to be widely dispersed throughout the region. While average noise levels in currently rural areas could likely increase, dense urbanized growth — and therefore a perceptible change in sound levels — is unlikely. As growth spreads across the region, areas may find a need for added capacity in the form of new or expanded transportation facilities. New facilities could likely cause some noise impacts for nearby land uses (see Figures 5-14-6 and 5-14-7).

Similar to Growth Targets Extended, 10 percent of growth would occur in rural areas under the Smaller Cities Alternative. As described in that alternative, while impacts to human populations are anticipated to be minimal, impacts on wildlife may occur as rural areas and adjacent resource lands are potentially developed and noise levels increase.

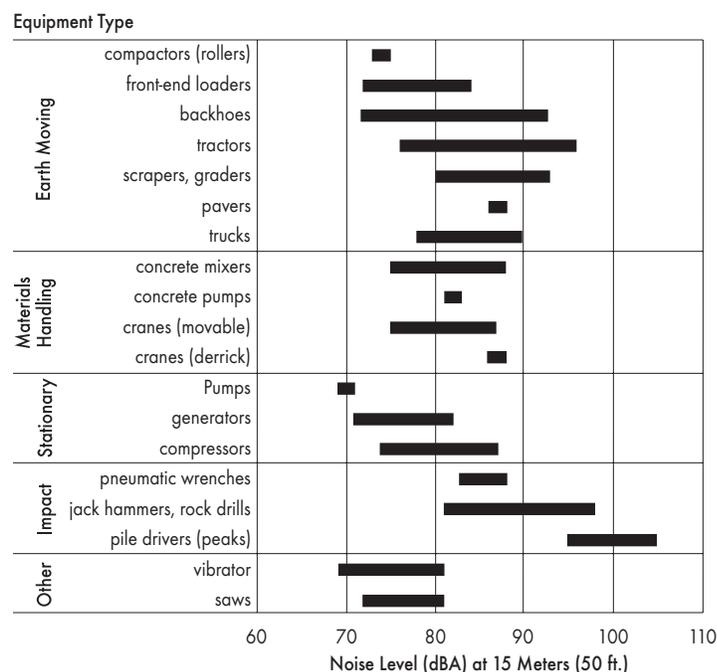


5.14.3 Cumulative Effects

Each of the alternatives would result in construction activity in various areas throughout the region, and construction in all alternatives would be likely throughout the time period to 2040. Noise during construction could be bothersome to nearby residents and businesses. Construction would vary widely in hours of operation and noise impacts, depending on the size and type of project. Specific impacts would be analyzed and addressed during future project-level planning and environmental review of individual projects.

The predominant source of noise at most construction sites is the internal combustion engine. Earthmoving equipment, material-handling equipment, and stationary equipment are all engine-powered. Sound levels associated with mobile equipment vary in a cyclic fashion, while sound levels from stationary equipment (e.g., pumps, generators, and compressors) are fairly constant. Trucks are prevalent during most phases of construction and are not confined to the project site. Noise from trucks, therefore, tends to affect more receptors. Other noise sources include pneumatic, hydraulic, or electric impact equipment and tools such as pile drivers.

FIGURE 5-14-8: TYPICAL CONSTRUCTION EQUIPMENT NOISE LEVELS



Source: Parametrix, Inc.

Construction noise associated with any project would likely be intermittent, varying throughout the construction period and occurring at different locations in the project area. Noise levels would depend on the type, amount, and location of construction activities. Figure 5-14-8 represents typical maximum noise levels from construction equipment.

As Figure 5-14-8 illustrates, maximum noise levels from construction equipment could range from 69 to 106 dBA L_{max} at a distance of 50 feet. Construction noise decreases at a rate of 6 to 8 dBA for every doubling of distance from the source. Because construction equipment could idle, power off, or operate at less than full power at any given time and because construction machinery is typically used to complete short-term tasks at various locations, average Leq daytime noise levels near construction projects could be lower than the maximum noise levels shown in Figure 5-14-5.

5.14.4 Potential Mitigation Measures

Evaluation of individual project impacts and the need for mitigation measures would occur during future project-level planning and environmental review. Mitigation is generally required only where frequent human use occurs and a lower noise level would have benefits. Noise may be controlled at the receptor (e.g., increased insulation in windows, doors, and walls), at the source (e.g., quieter engines and mufflers), and along the noise path (e.g., noise walls, shielding, and increased distance). Noise mitigation at the receptor is generally not consistent with federal or state noise abatement policies.

A range of mitigation measures could be implemented as necessary to reduce noise impacts. Different methods of mitigation are appropriate for different noise sources and should be evaluated on a case-by-case basis to determine whether the approach is feasible and reasonable.

Potential mitigation measures for roadway and transit projects include:

- Acquiring land for buffer zones or for construction of noise barriers.
- Airport noise abatement and mitigation programs, and airport compatible land use programs.

- Aligning roadways or tracks further from noise-sensitive land uses.
- Designing and maintaining tracks and wheels to reduce squeal, rail corrugations, and gaps.
- Reducing engine noise by maintaining transit vehicles.
- Constructing noise barriers or berms.
- Installing noise insulation in buildings within the noise contour.
- Promoting alternative modes of transportation to reduce traffic-generated noise.
- Encouraging vehicle trip reduction.
- Requiring trucks to use designated truck routes.
- Employing traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, and modified speed limits).
- Increasing vegetation and planting street trees.
- Urban design and building siting.

Noise from construction activities may be mitigated by:

- Constructing enclosures or walls to surround equipment.
- Installing mufflers or other noise-reducing devices or using quieter equipment.
- Maintaining equipment.
- Imposing time restrictions on equipment use.
- Positioning stationary equipment away from noise-sensitive receptors.

As provided for by the Federal Aviation Administration, several airports in the Puget Sound region have developed noise exposure maps and noise compatibility programs to ensure minimal noise impacts to residences adjacent to the airfields and along flight paths. The Port of Seattle has also initiated a noise remedy program that involves the insulation of schools, homes, and condominiums within Sea-Tac Airport’s noise-impact boundaries. The Port is also purchasing property adjacent to the airport, installing sound insulation, and reselling it. Several regional airports have implemented noise abatement programs that restrict aircraft engine maintenance run-ups and monitor noise levels and aircraft compliance with abatement procedures. The Port also attempts to minimize noise impacts by outlining specific flight headings and altitudes. For example, flight paths over the Duwamish Industrial Area, Elliott Bay, and the Puget Sound create fewer noise impacts than flight paths over residential areas. These procedures are followed to the maximum extent possible, air traffic conditions permitting.

5.14.5 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse impacts from noise are expected under the Growth Targets Extended, Metropolitan Cities, Larger Cities, and Smaller Cities alternatives. However, the potential mitigation measures are likely to be necessary in site-specific locations, and can likely add benefit regionwide as well. Future project-level environmental review would determine if applicable noise criteria are exceeded at specific locations. Where this occurs, potential mitigation for such impacts would be evaluated and implemented as appropriate to address the impact.



