A Planning Template for Nonwork Travel and Transit-Oriented Development

Task 3 Report: Prototype Nonwork Database

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submitted to
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Maps in this report may be hard to see unless you use the Zoom function to make them larger. On map pages there is a red box like the one that you can click on to activate the Zoom function -- try setting maps to 125% to see details! The same function is on the Acrobat menu under "View"

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PROJECT OVERVIEW

This project seeks to improve the planning methodology for Transit-Oriented Development (TOD) by bringing into sharp focus the dynamics of the retail marketplace and nonwork travel demand. Specifically, it will:

- Analyze the current state of understanding of nonwork travel demand in the context of retail market dynamics on a national level.

- Review the state of the art in transportation planning with respect to nonwork travel.

- Create a planning template for transportation and land use planners who are pursuing TOD.

The central Puget Sound region (Seattle-Tacoma-Bellevue-Everett metropolitan area) will be used as a case study for development of the template. The nonwork travel environment of the region will be mapped and analyzed, and the findings generalized to other large metro regions. Of particular interest are "retail" activities that have flexible locations and that together generate more than half of all person trips: shopping for goods and services, eating out, entertainment, recreation, and other leisure pursuits.

The planning template will specify the major nonwork venues that should be mapped and spatially analyzed, the forces shaping urban retail form that need to be monitored, and the factors that will determine TOD regional (not just station-area) success.

EXECUTIVE SUMMARY

The second report in this series (December 1999) recommended the Backcasting Delphi procedure as an approach to regional planning that can encompass the complexity and uncertainty of the new information-based economy and its effects on land use and travel patterns. The Delphi procedure involves a panel of diverse experts who are asked to weigh the likelihood of several possible future scenarios and strategies for a metropolitan region, including the transit-oriented development (TOD) paradigm.

In this report, using the central Puget Sound region as a case study, we present examples of information that would be made available to the panel and that would serve as the initial database for their deliberations. Panel members would in all likelihood request more information beyond what is at first presented, and the database would expand as the process ensues.

Chapter One presents a cursory overview of the data and other information that is of interest in understanding the dynamically changing urban environment. Chapter Two describes the growth trends that have lead to the current settlement patterns in the case study area. It also establishes the relationship of the case study area to the larger urban region and ecosystem of which it is but one part.

An overview of the area's retail environment is presented in Chapter Three. For this prototype database, a considerable effort was made to map the retail structure that accounts for a large majority of all personal travel and is a key factor in transit-oriented design. A limited amount of analysis of the retail patterns is also provided.

The residential and work environment is broadly sketched in Chapter Four, with emphasis given to those features of housing and employment location that affect travel patterns most directly. The amenability of these features to change is briefly discussed.

Chapter Five presents key data for personal travel patterns with a focus on nonwork trips. Chapters Six describes the regional transportation system, both roadway and transit components, and summarizes current plans for its improvement. The genesis for and goals of the region's TOD planning efforts is covered in Chapter Seven, while Chapter Eight explains how progress towards these goals is being monitored. This chapter also discusses planning efforts that may lead to a modification of the current Metropolitan Transportation Plan.

Finally, Chapter Nine speculates that there are a number of societal forces that have not yet been taken into account by regional planners, yet they could have a large impact on future land use and travel patterns.

CHAPTER ONE

DATA AND INFORMATION NEEDS FOR BACKCASTING DELPHI

INTRODUCTION

Our Task 2 report presented a preliminary design for a transit-oriented development (TOD) planning template. The design is based on the Backcasting Delphi technique which involves an expert panel charged with considering the efficacy of various future scenarios in the context of empirical and other data describing land use, human activity and travel patterns. We termed the approach the Nonwork Travel Improvement Planning Process (NWTIPP).

The information requirements for a successful Backcasting Delphi exercise are substantial. Both past and current trends and future forecasts are needed to provide as complete as possible picture of the urban environment under consideration. In addition, other insight concerning the forces that are shaping human activity and urban land use and travel patterns is important, even though their actual effect on future patterns may not be predictable with any significant certainty. The object is to provide information essential to an understanding of the activity-travel-land use relationship without overwhelming panelists with excessive information.

This chapter reviews the basic data needs for the application of NWTIPP to a typical metropolitan area. It is an extension of the discussion we began in the Task 1 and 2 reports. In practice, some of this information may not be available, but it's importance should be recognized nonetheless, and reasonable efforts should be made to obtain it.

PLANNING AREA IN THE LARGER REGIONAL GROWTH CONTEXT

Growth planning, as it is practiced in the United States, tends to focus on manageable urban areas which generally do not exceed one or a few counties surrounding a major city. It seldom encompasses larger areas except for specific purposes such as environmental protection of watersheds, air sheds, and estuaries (Diamond 1996, Porter 1997). Yet many regions are obviously urbanizing and spreading beyond the area in immediate proximity to the major city. An urban area may, for practical purposes of transportation and environmental impacts, extend up to hundreds of miles from a central city and may include multiple counties and smaller, rapidly growing metro areas. It can, in fact, extend across a state and even a national boundary.

Thus, as a starting point for a planning database, it is important to view the extended area that is effectively attached to the planning area. Growth rates and development patterns across this larger area may be indicative of important forces that are shaping the urban environment. Some of these forces may be causing a greater decentralization of activity and development than is generally recognized, and consequently may have significant impacts on travel patterns.

IN-HOME AND OUT-OF-HOME ACTIVITY TRENDS

Societal changes have shifted the location of many personal and household activities. These changes include the growing proportion of woman in the work force, more working teenagers, the decrease in household size, increased disposable income, technological innovation, and the greater variety of leisure time opportunities. The effect has been a relocation of numerous activities that were formerly undertaken in the home environment, to out-of-home venues. Among these activities are day care, meal preparation and consumption, and a wide range of recreational activities.

In other cases, the shift has been in the opposite direction. The changing economy and work environment, combined with the information technology revolution, has increased home-based and other decentralized work activities. Information technology has also expanded the quality and quantity of in-home leisure choices. As information technology develops and becomes ubiquitous, it may also have a large effect on the location of the purchase transaction for goods and services; much more purchasing may be done using the Internet.

All of these activity and locational changes have important implications for personal travel patterns. Time saved in one activity will be available for other activities, both work and nonwork. Commercial travel in support of activities, whether in-home or out-of-home will also obviously be affected. These trends should be measured and tracked.

TRAVEL TRENDS

Measured patterns of personal travel are important components of the database, especially if collected over time to reveal historical trends. Surveys and travel diaries typically are used to collect data on trip purpose, mode, timing, and distance traveled. However, other aspects of travel are equally important to provide an understanding of the underlying demand for travel that is based in the need to accomplish activities. A more complete set of travel factors is shown in Table 1-1, for both personal and commercial travel. All are useful for elucidating the relationship of travel to activity and land use patterns, especially if cross-correlated.

RESIDENTIAL PATTERNS

Residential patterns and trends are complex and have a number of features that are obviously important to the travel environment and TOD (Table 1-2). Higher residential densities can support rail transit, yet residential concentrations need to be spatially located in patterns that can be served by relatively few transit corridors and stations compared to bus systems.

Topography plays an important role. TOD depends on pedestrian access to transit that can be limited by the natural terrain--hills and water bodies--and by physical impediments posed by the more dominant roadway system.

Table 1-1 Important Travel Factors

Personal Travel
Number of vehicles and vehicle ownership rate
Number of licensed drivers
VMT and trip length
Purposes for individual person-trips
Frequency and purposes of trips within a trip chain
Location of stops in a chain relative to land use
Trip purpose and frequency by time-of-day and day-of-week
Mode share
Vehicle occupancy
Commercial Travel
Number of trucks and vans in commercial service
VMT and trip length
General service categories (home goods delivery/pickup, store delivery, home service, passenger, rental)
Specific service categories (internet delivery)

Table 1-2 Important Residential Pattern Factors

Distribution of residential density
Topography of residential areas
Spatial dispersion of residential development/redevelopment capacity
Spatial dispersion of residential development relative to transit corridors/stations
Proportions of single family and multifamily
Home ownership rate
Spatial distribution of housing cost
Housing style and size
Locational amenities
Stated preferences for housing style, size, and locational amenities

The practical residential build-out capacity and it's spatial character also needs to be taken into account. Urban areas, especially the older parts, are in a continuous process of redevelopment and infill. A large amount of capacity for residential development typically exists in areas zoned

for multifamily and commercial/mixed land use. Whether this capacity is available to support a major transit investment called for by TOD will depend on its spatial distribution, as well as market factors.

Another set of interrelated factors pertains to the preferences people hold for the style, size, and locational attributes of their residence and the land it occupies, and the housing they can afford. Historical trends and current home ownership rates and single/multifamily ratios provide some perspective on future patterns. Similarly, the geographic location of similar housing at different price levels is important because people will trade distance (time and direct travel costs) to obtain housing that meets their needs and wants. Income definitely plays a role. As it grows in real terms and is distributed more evenly across the population, more people are able to exercise a greater range of housing choices. In effect, they may move up the housing quality and quantity continuum. Yet life stage may, and often does, dictate down sizing and relocation that provides greater accessibility.

When available, surveys that ask people to state their preferences for housing can also provide some indication of future patterns. These surveys should test the current planning assumption that denser housing that is packaged with amenities such as walkable commercial areas, public services, and convenient transit will attract people who would otherwise choose low-density, single-use, auto-dependent residential areas.

EMPLOYMENT PATTERNS

Employment factors of interest include both spatial location and job market characteristics (Table 1-3). The decentralization of workplaces is a significant ongoing trend that has important implications for TOD planning. Perhaps equally important are trends in the direction of more at-home work and to virtual work places (work at any location using information technology).

The structure and timing of work will also effect future travel patterns. Part-time work can change the timing of the daily commute, as can more flexibility in arrival and departure times that is allowed by employers. Another approach to the flexible timing of employment would be to spread the work week across 7 days and 24 hours, as has been advocated in some industries.

Table 1-3 Important Employment Factors

Location
Spatial density distribution of workplaces
In-home and out-of-home
Virtual workplace
Job Market
Part-time and temporary work
Change in timing of work day and work week (e.g., 24 x 7 work week)
Flextime and other employer responses to congestion

TRANSPORTATION SYSTEM

Data is also needed that describes the current utilization and performance of the transportation system, including roadways and transit (Table 1-4). Significant factors from a planning perspective are the indicators of mode preference and the travel volume relative to capacity. Typically, the roadway system is over utilized and the transit system underutilized.

Table 1-4 Transportation System Performance Indicators

Roadways
Performance: congested miles, hours of delay
Congestion costs: time, fuel, accident
Public Transit
Annual rides per capita
Vehicle utilization rate
Total System
Mode split

GOVERNMENT POLICIES TO IMPROVE MOBILITY

The current policy dimension must also be clear and apparent in the new planning process. Although current policies may not be conducive to a new planning approach such as NWTIPP, they do provide useful information. These include federal, state, regional, and local policies, all of which are interrelated through a regulatory hierarchy. Of special interest are major transit system investments under consideration or underway in the region, and their forecasted impacts on regional transportation system performance.

Table 1-5 Transportation Policies

Metropolitan Transportation Plan
- Major system investments under consideration or underway
- Current and available demand management policies
State transportation policies
Federal transportation policies affecting major system investments through land use criteria
County and (major) city strategies

TRANSPORTATION IMPROVEMENT COST/BENEFIT ACCOUNTING

Equally important to the transportation policies, are their costs and benefits. Congestion can produce significant costs that can be reduced with appropriate strategies, and underutilized transit implies the opportunity for benefits, again with appropriate strategies. And every investment has associated opportunity costs; a major investment in transit, for example, may require that other publicly identified needs be foregone. A total cost accounting as an input to the exercise is suggested (Table 1-6).

Table 1-6 Total Cost Accounting for Major Investment Decisions

Capital and operating costs
Direct benefits: time, fuel, accident cost savings
Indirect benefits: reduction of environmental externalities
Opportunity costs: alternative transportation, land use, and related investments

GOVERNMENT POLICIES TO MANAGE GROWTH AND TRAVEL DEMAND

Growth policies vary widely, but component jurisdictions of all metro areas typically have some measures in place to manage and control growth and the related impacts of increased traffic. Some metro areas have policies that are coordinated across constituent jurisdictions. In a few cases, these policies are mandated by state law. Table 1-7 indicates the range of policies that can be found currently that link land use and transportation.

Table 1-7 Growth Policies Currently in Use

Concurrent development of residential/commercial and transportation infrastructure
Impact fees to pay for transportation infrastructure
Designation of areas for concentrated growth served by transit
Density bonuses for development in designated growth areas
Tax increment financing of public amenities

FORCES POTENTIALLY SHAPING TRAVEL AND LAND USE PATTERNS

Based on past experience, it can be anticipated that a number of forces not currently recognized as determinative in shaping the land use and travel environment will arise over time. Table 1-8

indicates our guess as to what these forces may be. These are factors that we are aware of because they have been identified, or even partially considered and analyzed, but have not gained sufficient prominence to take their place with other planning or modeling variables. Yet these societal/demographic/technological forces may potentially have a significant impact on future activities, and associated land use and travel patterns.

All of these factors are to various degrees wild cards that we have some inkling of, perhaps a little data for, but no good way to predict their eventual impact. But they do need to be considered, along with others for which data is available. They are somewhat analogous to the factors that were missed 30-40 years ago (women in the work force, decreasing household size) by the travel forecasts of that time.

Table 1-8 Forces That May Potentially Shape Future Land Use and Travel Patterns

- Age profile, life span, life style (e.g., baby boomers)
- Social institution changes (e.g., family/household unit)
- Ethnic and cultural mix (e.g., resulting from immigration)
- Consumer and business purchasing over the Internet
- Electronic service delivery to consumers and businesses
- Telecommuting, teleconferencing, and other teleworking
- Intelligent Transportation Systems (ITS) applications
- Advanced vehicle propulsion (e.g., fuel cells)
- Global warming policy

CHAPTER TWO

THE CASE STUDY AREA: GEOGRAPHIC RELATIONSHIPS AND GROWTH

INTRODUCTION

The central Puget Sound region (Seattle metropolitan area) was selected for this case study because the authors are familiar with its land use and transportation patterns, and because its retail structure has been the subject of studies going back 50 years. Moreover, efforts to apply new urbanism principles by creating compact, transit-oriented, and mixed-use development are underway in the region.

GEOGRAPHIC SETTING

The central Puget Sound metropolitan region encompasses all of King, Kitsap, Pierce and Snohomish counties of Washington State, and lies near the center of the Puget/Georgia Basin (Figure 2-1). The basin, a natural bioregion and air shed, is defined by its geographic setting between two mountain ranges and its location on an inland sea. Extending from Olympia, Washington, on the south, to Vancouver, British Columbia, on the north, the basin includes twelve counties in Washington State and the two major metropolitan areas of British Columbia, Vancouver and Victoria, both of which contain numerous municipalities.

ORGANIZATION FOR DATA AND PLANNING PURPOSES

The US Census Bureau defines the region for data reporting purposes as the Seattle-Tacoma-Bremerton Consolidated Metropolitan Statisical Area (CMSA). The CMSA is composed of four Primary Metropolitan Statistical Areas (PMSA). The counties that comprise these areas are indicated in Table 2-1.

Table 2-1 Statistical and Planning Areas in Central Puget Sound Region

Primary Metropolitan Statistical Area	Counties
Bremerton	Kitsap*
Olympia	Thurston
Seattle-Bellevue-Everett	King*, Snohomish*, Island
Tacoma	Pierce*

* Members of Central Puget Sound Regional Planning Council

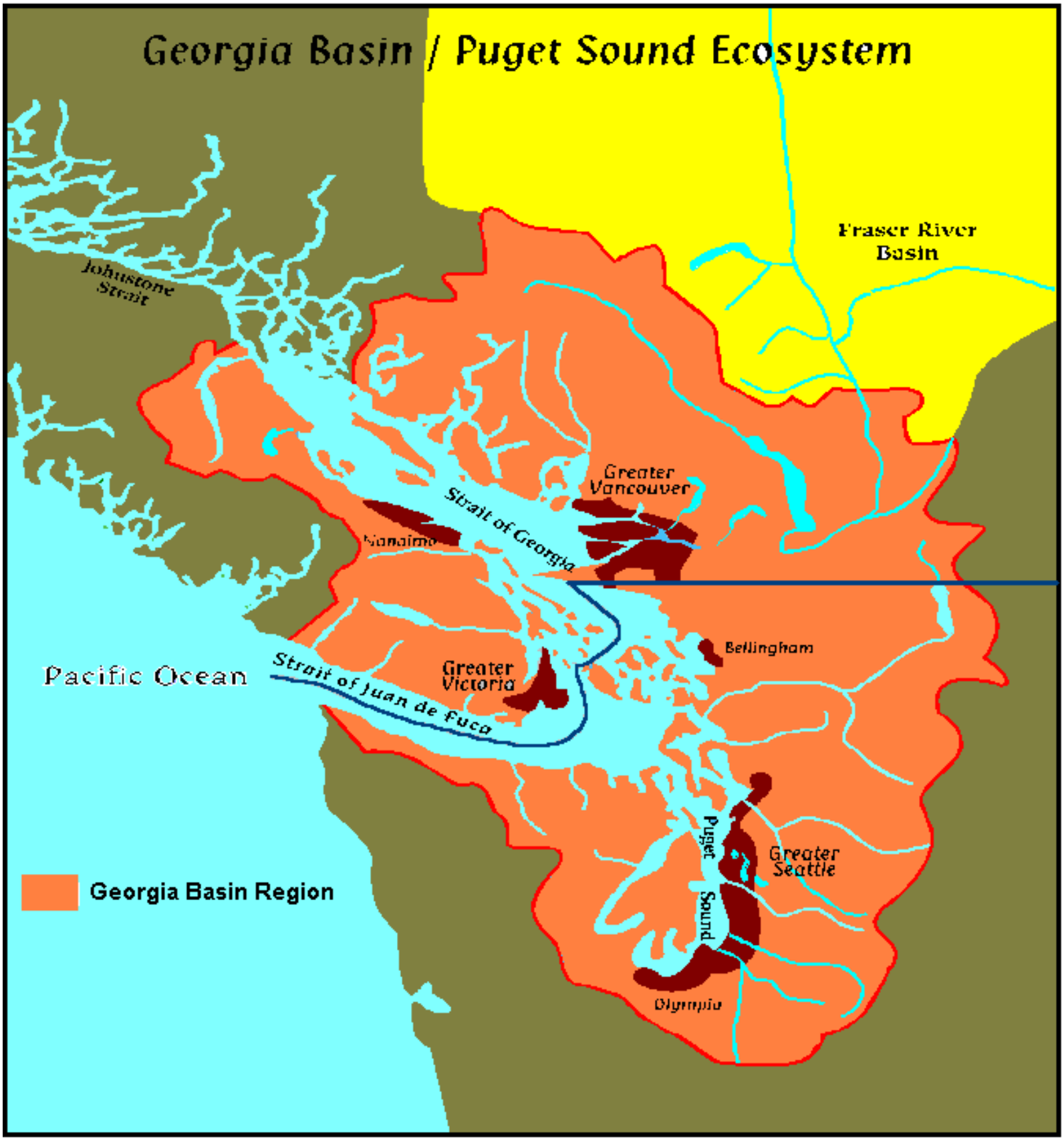


Figure 2-1 Puget/Georgia Basin

Source: http://www.pyr.ec.gc.ca/ep/enforcement/98pics/perc98fg2.gif

The four central counties are full members of the regional planning agency, and their land use and transportation patterns are included in the agency's regional data base. Island and Thurston Counties are associate members of the regional planning agency and are not officially involved in regional planning, nor are they in the regional data base. Consequently, these two counties were not included in this case study to maintain continuity with past work and to conform to the regional planning structure.

POPULATION TRENDS

Prior to the arrival of Europeans in 1792, an estimated 30,000 native North Americans inhabited the shoreland and upland areas surrounding the Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca. In the 200 years since, population in the Basin has grown at a steady pace through up and down economic cycles. Today it is home to more than 6 million residents (Table 2-2). Although the high growth rates experienced in the 1990's are expected to moderate, continued robust growth into the 21st century is forecasted for both the Washington and British Columbia parts of the Basin.

Table 2-2 Puget/Georgia Basin Population, Actual and Forecasted

	1960	1970	1980	1990	2000	2010	2020
Washington*	1,769,117	2,243,069	2,686,223	3,423,196	4,086,141	4,619,771	5,229,708
British Columbia**	824,057	1,082,187	1,268,183	1,602,502	2,116,272	2,501,833	2,871,317
TOTAL	2,595,134	3,327,226	3,956,386	5,027,688	6,204,413	7,123,614	8,103,045
Percent Change	--	28.2	18.9	27.1	23.4	14.8	13.7

Sources: Washington State Office of Financial Management 1995; Greater Vancouver Regional District 1999; Capitol Regional District 1999; Canada Yearbook 1999.

* Includes Clallam, Island, Jefferson, King, Kitsap, Mason, Pierce, San Juan, Skagit, Snohomish, Thurston, and Whatcom Counties.

** Greater Vancouver Regional District and Capital (Victoria) Regional District.

Both the US and Canadian parts of the basin are growing much faster than their respective countries and, in the case of the US part, considerably faster than the state as a whole (Table 2-3).

Table 2-3 Relative Population Growth Rates, Annual Average 1960-90

United States	1.29%	Canada	1.79%
Washington State	2.35%	British Columbia	3.38%
Puget Basin	3.12%	Georgia Basin	3.15%
Total Puget/Georgia Basin 3.12%			

Figure 2-1 Puget/Georgia Basin

About half the Puget Sound Basin's population is concentrated within or in close proximity to Seattle. However, population is dispersing throughout the basin. The 11 counties outside King County are growing at rates up to twice as fast this central and most populous county containing Seattle (Figure 2-2). By 2020 only about 40 percent of the Puget Basin's residents will reside in the central county.

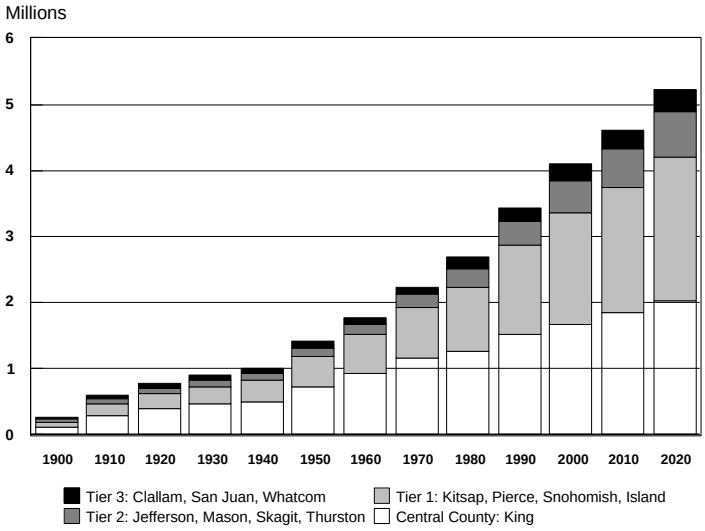


Figure 2-2 Population Growth in the Central Puget Sound Basin

URBANIZED LAND

The US Census Bureau has inventoried urbanized land area and population density in major metro areas since 1950 using consistent definitions for developed land. Figure 2-3 shows the current extent of urbanization in the central Puget Sound region as defined by the Census Bureau. Table 2-4 indicates the change over four decades for the Seattle-Everett urbanized area.

Land consumption rates were high in the 1950's and 1960's as low-density suburbs spread outward from the central city. But the rate of density decrease began to moderate in the 1970's, and by 1990 slight density increases were recorded as infill development occurred. Table 2-5 shows that the larger area comprising three contiguous urbanized areas (Seattle-Everett, Tacoma, and Bremerton) experienced a similar density increase in the 1980's. This area essentially coincides with the planning area for the four-county central Puget Sound region. Table 2-6 compares the population and land area of the urbanized areas to their respective totals.

Previous official reports had indicated that land was consumed at a more than twice the rate of population growth in the 1970 to 1990 period (PSCOG 1990). As a result, the Puget Sound region has been widely cited as an example of profligate land consumption and sprawl. The principal planner for the region's planning agency now has acknowledged that these numbers, produced by their regional model, "should not be trusted" (PSRC 1999a).

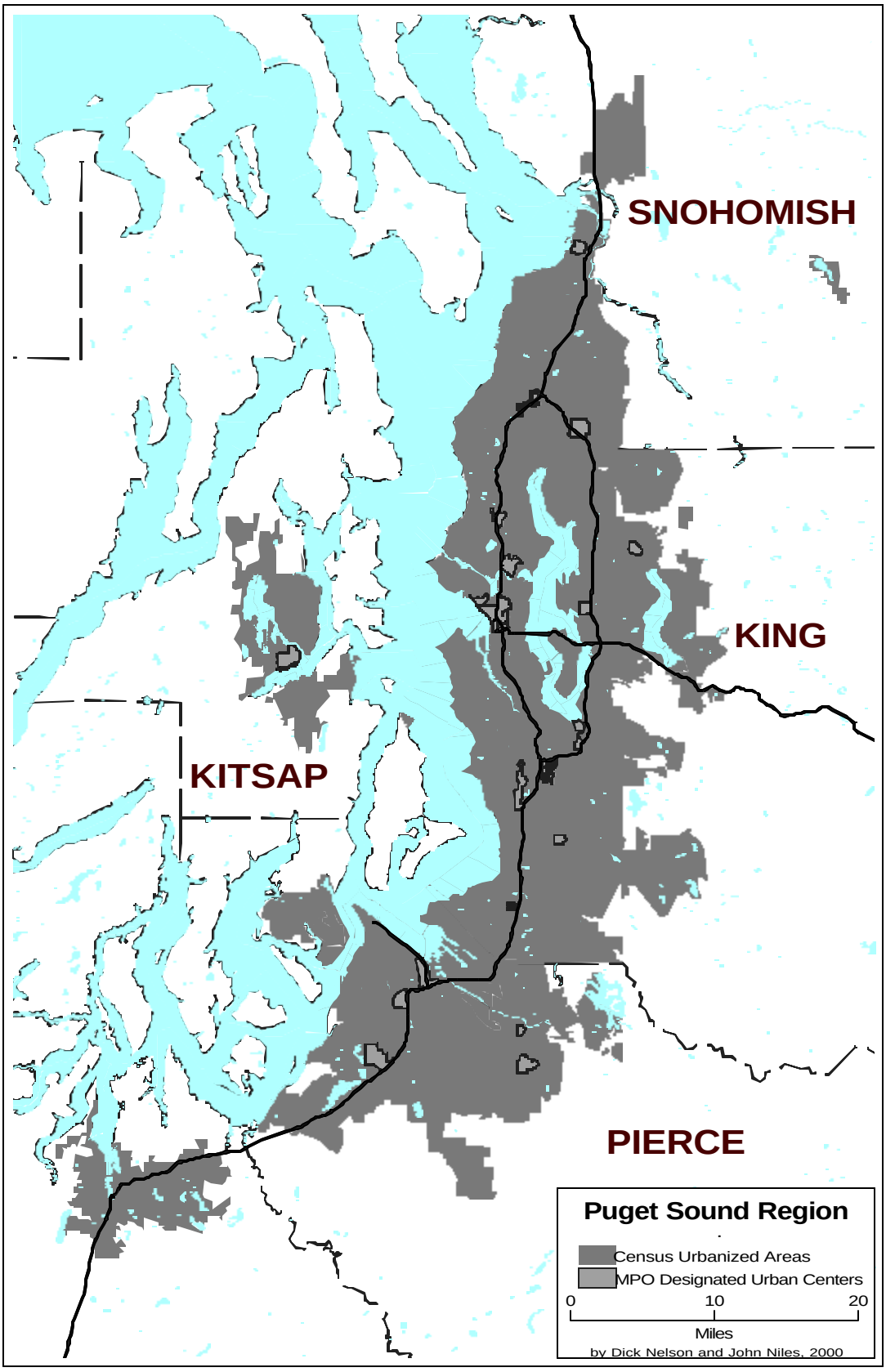


Figure 2-3 Urbanized Areas in the Puget Sound Basin, 1990

Source: Census Bureau boundary files

Table 2-4 Urbanization of the Seattle-Everett Area

Year	Population	Urbanized Land Area - sq. mi.	Density	Density Change
1950	621,509	122.9	5,057	--
1960	684,109	238.3	3,626	-28%
1970	1,238,107	413.1	2,997	-17%
1980	1,391,535	485.0	2,869	-4%
1990	1,744,086	587.9	2,967	+3%

Source: US Census Bureau

Table 2-5 Growth of Population and Urbanized Land in the Seattle-Everett, Tacoma, & Bremerton Urbanized Areas*

Year	Population	Urbanized Land Area (sq. mi.)	Population Change (%)	Land Area Change (%)	Density - (Persons/ sq. mi.)	Density Change (%)
1980	1,858,148	707.0	--	--	2,628	--
1990	2,354,273	875.9	26.7	23.9	2,688	2.3

* Bremerton urbanized area formed in 1980
Source: US Census Bureau

Table 2-6 Population and Urbanized Land Relative to Totals

Year	Metropolitan Area Population	Urbanized Area Population	Population, Proportion of Total	Metropolitan Land Area (sq. mi.)	Urbanized Land Area (sq. mi.)	Urbanized, Proportion of Total
1970	1,421,869	1,238,107	87.1%	4216.3	413.1	9.8%
1980	1,607,618	1.391,535	86.6%	4216.3	485.0	11.5%
1990	1,972,933	1,744,086	88.4%	4216.3	587.9	13.9%

Source: US Census Bureau

CHAPTER THREE

RETAIL ENVIRONMENT

INTRODUCTION

As we will show in Chapter 5, retail and other consumer service establishments in the central Puget Sound region are the destination or origin for about two of every three personal trips. By definition, every one of these trips is associated with a particular establishment or cluster of establishments. By the latter, we mean, for example, that five stores in a small mall that share a parking lot, or that are served by one transit stop, can be thought of as one retail destination. Since each of the five stores in this example may draw customers in different numbers, with different visit frequencies, and from different geographic ranges, the significance of each retail destination to transportation demand may be quite complex to determine.

In each particular case of a retail destination, there are alternative ways of customers getting there. In some cases they walk from their home, their places of work, or as a stop on the walk to or from a transit ride that is part of commutation to work. Sometimes, for some stores, a small share of the customers may use bicycles, taxicabs, or transit to travel directly. For stores with ample free parking adjacent or nearby, the dominant mode of access is by car. Travel diary studies from the central Puget Sound region indicate that trips to stores are made by automobile 91% of the time, by transit 3%, and by other means 6%.

This chapter provides an introductory description of the retail environment of the Seattle metropolitan area. Our focus is on the current retail structure -- its variety and patterns of land use. We also summarize historical trends when there are available data. The purpose is not to be exhaustive, but to provide examples of significant nonwork trip generators that should be part of the database for the planning exercise in any major metropolitan area.

DATA SOURCES AND THEIR LIMITATIONS

Data that describe the current shopping structures and patterns of US metropolitan regions are not readily available. Nor have the general trends and changes in a very dynamic consumer marketplace been carefully tracked. One source is the US Economic Survey of retail trade and service industries which is conducted at five year intervals. Because the definitions and areas surveyed have changed over the years, major trends can not be analyzed with great precision. And the data does not always capture the fine structure of retail and service activities. For example, major and medium-sized retail centers in standard metropolitan statistical areas were disaggregated only in 1982. In other years, the finest disaggregation is for zip code areas which only allows retail activity of individual centers to be approximated. . Fortunately, our sources do provide a qualitative understanding of the ever-changing marketplace.
Except for some limited historical data, we found that one of the best reflections of marketplace dynamics are the yellow pages. While not providing empirical data that is particularly useful for

modeling or other analytical examination, these listings and their categorizations provide a snapshot of market structure. And their change over time reveals the ever-increasing complexity and diversity of the consumer-oriented retail goods and services industries, marketplaces that have had a profound impact on land use and transportation patterns. To facilitate analysis, somewhat current Yellow Pages listings are available on the internet, and addresses can be cut and pasted into address files that can serve as input to GIS mapping programs.

For information on entertainment and cultural activities, we turned to the daily newspapers and weekly newsmagazines in the region. The newspaper's weekly entertainment section is a dependable source of information about past and current venues and productions, including plays, musical productions, movies, etc. Recreation is more difficult, because it includes a wide range of both participant and spectator activities, and a multiplicity of venues.

The analysis of retail structure in this chapter was produced from "scratch" using these varied sources to assemble data bases to produce maps using GIS software. We are not aware of a similar systematic mapping of a major metro area.

CHANGES IN SEATTLE METRO AREA RETAIL STRUCTURE - 1948 TO 1982

Wagner's Pioneering Work: 1948 - 1958

The retail market structure of the Seattle-King County area was studied in considerable detail by Wagner between 1948 and 1958 (Wagner 1959 & 1962). Wagner grouped census tracts to approximate the trade areas for 49 commercial centers and tabulated the numbers of stores and sales volumes by business category for each center. Wagner's studies came just as the postwar urban restructuring was getting underway. For example, one of the first planned regional malls in the United States, Northgate, was completed between his first and second survey.

Wagner's data reflects many of the trends we see today. It evidenced the start of the decline in relative importance of downtown stores. It also revealed the trend to larger retail stores handling a greater variety of goods, particularly of the drug, grocery, and discount department store categories. And it showed the beginning stages of the clustering that today is predominant in regional centers outside the central business district. By comparing Wagner's data with recent survey data, we can also see the magnitude of change that has occurred in the neighborhood retail structure. We make one comparison later in this chapter.

Shakar's 1958 Survey of Highway 99 Businesses

In 1958, Shakar conducted a detailed survey of businesses along a 25-mile stretch of U.S. 99 between Seattle and Everett, which was then the major unlimited access route between the two cities (Shakar 1958). The highway dates from the 1920's when it essentially replaced the Interurban electric railway line serving the cities. Shakar found patterns of "nucleation" within

the continuous strip development. He counted businesses by category within the nucleated and arterial configurations.

We mention Shakar's work because it offers an opportunity to compare new development and change within existing commercial structures along a major linear commercial strip that has occurred over a four decade period. Uses have obviously changed in forty years, and the strip has obviously become much more significant as a locus for a wide range of businesses, including many of the new retail formats. However, the effort required for such a comparison was beyond the scope of the present study.

Morrill's Study of 1982 Retail Environment

Building on Wagner's work, Morrill investigated the structure of the larger King-Snohomish county metro area (Morrill 1987). Morrill based his study on the 1982 Economic Census of Retail Trade and Service Industries, which in a one-time effort disaggregated data by the major retail centers in Standard Metropolitan Statistical Areas (Census 1984). He found that the marketplace of consumer-oriented retail goods and services in the Seattle metropolitan area is highly diverse (Table 3-1). Morrill concluded that it's general spatial structure conformed to central place theory, with activities situated in a reasonably predictable hierarchy of centers, ranging in size from central business districts and major regional shopping malls to small neighborhood shopping districts and a few remaining corner stores. Morrill also concluded that there was little pronounced functional specialization in the retail structure as it existed in 1982.

Table 3-1 Hierarchy of Shopping in the Seattle-Everett SMSA, 1982

Level	Number centers	Total number estab.	% of estab.
Downtown Seattle	1	4,060	15
Major regional	6	4,665	17
Regional	9	4,180	15
District	18	4,220	15
Large neighborhood	38	4,725	17
Neighborhood	52	2,750	10
Small neighborhood	70	1,610	6
Suburban neighborhood	80	720	3
Corner	105	400	1
Special	20	400	1
METROPOLIS	399	27,600	100

Source: Morrill 1987

CHANGES IN THE RETAIL ENVIRONMENT SINCE 1982

Major changes have taken place in the retail structure of the central Puget Sound region in the past two decades. The Economic Census of 1992 indicated that the total number of retail and service establishments increased 50 percent more rapidly than population over a decade, and that the number of service businesses increased at a significantly faster pace (see Table 3-2). Data from the most recent Economic Census (1997) is not shown because the new North American Industry Classification System (NAICS) was used for the first time. New industrial categories were added within both retail and services sectors (e.g., information services), and there was some shifting between the two. Historical trends will again be possible when the next Census is done in 2002.

Growth of Retail and Services

Growth has been far less than uniform when individual business sectors are compared. Table 3-3 shows retail and services businesses that grew twice as fast as population or more.

Table 3-2. Growth of Seattle Metro Population, and Retail and Service Establishments With Payroll, 1982-1992

Year	Population	Retail estab.	Service estab.	All estab.
1982	2,340,000	13,131	15,251	28,382
1992	2,889,000	15,912	22,742	38,654
Growth	23%	21%	49%	36%

Source: US Economic Census

Table 3-3 Growth of Selected Retail and Service Activities, Seattle Metropolitan Area (Seattle-Bellevue-Everett, WA, PMSA) - 1982 to 1992

	Number Establishments		
	1982	1992	Change 1982-1992
Retail Trade			
Furniture, home furnishings	879	1,221	39%
Eating places	2,617	3,898	49%
Services			
Lodging	231	352	52%
Business	2,285	3,772	65%
Automotive	944	1,828	94%
Recreation	496	1,182	138%
Educational	95	234	146%
Social	330	822	149%
Professional	1,196	3,396	184%

Source: US Economic Census

Growth of Stores of All Sizes

The Survey of County Business Patterns from the U.S. Census Bureau reveals a trend toward both small and large stores growing faster than population (Table 3-4). Large stores have 50 or more employees; small stores have 5 to 49 employees. Very small stores, under 5 employees, are not included.

Table 3-4 Stores Size Trends, 1980-95

	Number of Small Stores	Number of Large Stores	Regional Population (millions)	Number of Small Stores per Capita	Number of Large Stores per Capita
1980	5,900	617	2.240	26.33	2.75
1985	7,462	678	2.422	30.81	2.80
1990	8,995	938	2.769	32.48	3.39
1995	9,344	1,035	3.005	31.10	3.44
Growth 1980-95	58%	68%	34%	18%	25%

Source: US Census Bureau County Business Patterns.

Growth of Large Stores

The previous table shows that the number of large stores in the region, 50 employees and up, is growing at a faster rate than the number of small stores with five to 49 employees each. This illustrates for this metro region a nationwide trend toward bigness in retail described in earlier sections of the report. In fact, the table shows that the 1995 figure of 31.1 small stores per 10,000 population is actually lower than the corresponding figure of 32.5 for 1990. There is no such reversal in the number of large stores per capita in 1990 and 1995.

Largeness in retail establishments is associated with the growth of big box discount department stores, home improvement centers, and superstores operated by national chains, also known as "category killers." These are stores with a large number of stock items in a particular category of merchandise. They cater to customers with higher efficiency and lower prices than the smaller retailers they replace, but they need to do a large turn over of business in order to be profitable. These and other larger stores are more difficult to locate in dense urban areas, because of the business requirement for large floor area, much parking, and reasonable rents. Still, there is a trend nationwide for chains known for large stores to place smaller versions in urban locations, perhaps as loss leaders to project image, maintain market share, and crush competition.

The categories of superstores currently seen in the central Puget Sound region is shown in Table 3-5. Although we have not tracked the historical development of these stores, we believe that most have come on the scene in the past 15 years.

Table 3-5 Number of Superstores by Category

Arts and crafts	6
Books	14
Car electronics	7
Computers	25
Drugs/variety	31
Electronic games	9
Home appliances	7
Home electronics	25
Home furnishings	10
Video tapes	41
Recorded music	12
Office supplies/machines	29
Pet supplies	27
Sporting goods	32
Thrift	4
TOTAL	279

Growth of Shopping Centers

There are currently twelve major regional centers (malls) and nine intermediate-sized sub regional centers. While the number of regional shopping malls has increased only slightly over the past two decades, a large number of new district level and smaller shopping centers have been added, and the total number of centers has risen steeply (Figure 3-1). However, most of the largest centers have seen expansion through the addition of floor area and smaller ancillary malls. In the case of Southcenter, there are now approximately as many stores in close proximity outside the mall as inside. And their floor area is also essentially equivalent. Although some planned centers have seen large changes in the types of establishments they contain, there has not been a significant abandonment of centers or conversions to noncommercial uses as has been experienced in some metro areas.

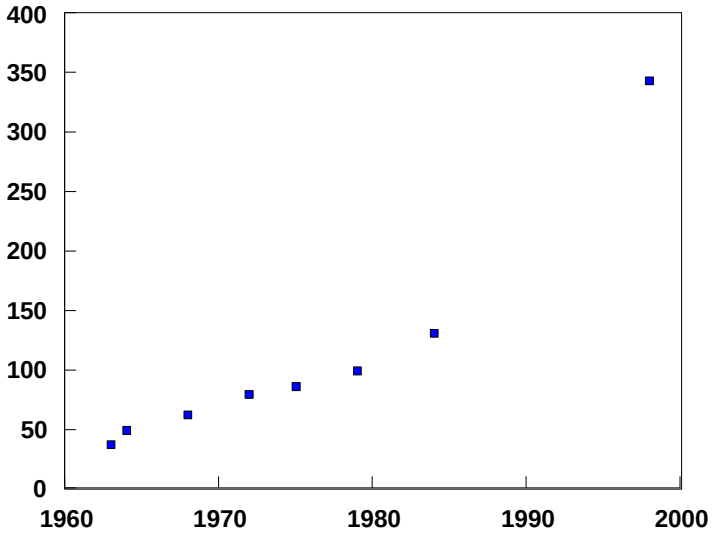


Figure 3-1 Growth of Planned Shopping Centers in Seattle-Everett PSMA

Source: Seattle Times Marketing Department; Proprietary database

Growth of Cuisine Restaurants

The growth rates for the number of retail establishments exceeds population growth for both small and large stores. This is consistent with economic growth generating variety as well as scale in the consumer sector. The central Puget Sound region illustrates a large variety of types of stores and service establishments. For example, the growth in the number and variety of cuisine restaurants over 10 years is shown in Table 3-6.

Table 3-6 Growth of Cuisine Restaurants in Greater Seattle Area

Cuisine	Number of establishments	
	1980	1998
American	14	30
Barbecue	5	23
Chinese	27	81
Indian	1	27
Italian	13	101
Japanese	10	77
Mexican	19	67
Pizza	13	26
Seafood	13	36
Thai	1	67
Vietnamese	1	24
Other (46 cuisines)	73	188
TOTALS	**190**	**747**

Change in One Neighborhood Shopping District: Wallingford

The changes that have occurred in the retail structure on the neighborhood level have been significant and are indicative of the changes in the metro area's overall retail marketplace. We chose Wallingford because it was studied by Wagner and it has been the subject of several recent studies regarding it's pedestrian environment and the commute patterns of residents (Rutherford 1996, McCormack 1995 & 1997, Moudin1997). Wallingford is an older in-city neighborhood that was essentially built-out by 1948. It's commercial core is a typical linear strip or "main street" (Figure 3-2). Most of it's stores are situated along one-half mile of a narrow cross-town arterial. Very little off-street parking is available. Although the arterial is heavily traveled, the retail environment is basically friendly to pedestrians.

Wallingford's commercial buildings have seen little change in the ensuing five decades. One public school building has been converted to a retail mall and condos, and several houses have been converted to shops and services. A number of stores that were scattered throughout the residential areas have been replaced by housing. An effort a decade ago to create a major shopping center at the site of a vacated girls home one block from the commercial center was defeated by neighborhood opposition.

Table 3-7 compares the number of establishments by retail category for Wallingford in 1998 and 1948.

Table 3-7 Retail Changes in Wallingford Over 50 Years

Store category	1948	1998
Grocery	10	1
Misc. food	27	10
Eating place	17	49
Variety	6	0
Home furnishings	9	0
Gas station	11	2
Other (incl. boutique, specialty)	39	87
TOTAL	119	124

Figure 3-3 Wallingford Neighborhood and Commercial Area
Source: WSDOT

Of importance to this study of retail structure and trip generation are the following changes that have occurred in Wallingford:

- The number of food stores decreased to about one fourth. Today, the food market is dominated by one major store and a handful of convenience and other specialty food stores.

- Eating places have doubled in number and offer a wide variety of cuisines.

- Home furnishings stores have all but disappeared.

- Full service gasoline stations have decreased from 11 to 2, but have not been replaced by automotive services which tend to cluster and serve a larger market area

- The variety of kinds of stores, particularly boutiques and other specialty shops, has approximately tripled

In essence, Wallingford has evolved into a drive-to destination for a shopping, eating out, and a recreational experience. Even though it is used by nearby residents, it's commercial center advertises and attracts customers from around the city.

DECENTRALIZATION OF RETAIL

Past Trends

The central Puget Sound region has been experiencing an increasing dispersion of retail locations, especially of larger stores. When data is disaggregated to the county level, we see a higher rate of growth from 1990 to 1995 in the number of large stores per capita in the outlying counties of Pierce, Snohomish, and Kitsap than in Seattle-dominated King County (Table 3-8). This probably reflects the continuing urban decentralization that began after World War II. As suburbs mature, they develop business centers that offer most of the commercial activities found in a central city. That process is now taking place in the second and higher tier of suburbs in the region. The per capita number of large stores in the outlying counties should converge in time with King County, which seems to have reached a saturation level.

On the other hand, the overall 15 year growth rate in the number of small stores per capita is higher in King County (23%) than in any of the three outlying counties, which probably indicates increased specialization to meet the needs of a more diverse population. Again, note that per capita means stores per 10,000 population estimate for year shown. Large stores have 50 or more employees. Small stores have 5 to 49 employees. Very small stores, under 5 employees, not included.

Table 3-8 Retail Size Trends Across the Counties of the Central Puget Sound Region, 1980-95 (Stores per Capita)

	King County		Pierce County		Snohomish County		Kitsap County	
	Small Stores	Large Stores	Small Stores	Large Stores	Small Stores	Large Stores	Small Stores	Large Stores
1980	28.7	3.58	23.9	1.67	23.0	1.92	21.7	1.16
1985	34.8	3.42	25.5	1.87	26.6	2.31	24.9	1.77
1990	36.7	4.10	27.4	2.40	27.2	2.84	28.0	2.14
1995	35.4	4.03	26.1	2.63	26.7	3.21	25.8	2.17
Growth 1980-95	23%	13%	9%	57%	16%	67%	19%	87%

Source: Census County Business Patterns

Future Trends

Another way of seeing retail growth in the more outlying areas of the region comes from looking at forecasts of future growth as well as past growth as published by the MPO for forecast analysis zones. (Note: The 1990-2000 forecast is dominated by the reality of available 1997 actuals, whereas the 21st century forecasts are more speculative and policy-driven.)

Table 3-9 Actual and Forecast Retail Employment Growth Rates for Past and Present Decades in Selected Retail-Dominated Forecast Analysis Zones (FAZs) (Growth rates above 30 percent emphasized in bold type)

Forecast Area	1970-80 actual	1980-90 actual	1990-2000 forecast	2000-10 forecast	2010-20 forecast
Burien	***49.8***	10.3	-26.1	2.7	11.7
Seattle CBD	13.0	19.6	-3.6	11.7	5.8
Bellevue CBD	***97.5***	***75.5***	16.9	14.9	18.7
Northgate	23.7	6.6	21.8	5.7	21.1
Woodinville	***81.8***	***47.5***	28.2	18.3	16.1
Wallingford-Fremont	23.6	***42.2***	***32.8***	4.0	-2.0
Southcenter	***261.0***	***39.2***	***67.6***	0.6	5.9
Issaquah	***139.6***	***125.0***	***120.4***	4.2	2.0

Source: PSRC 1995a

With respect to the actuals, the strong retail growth in the suburbs of Bellevue, Woodinville, Southcenter, and Issaquah is generally visible, although the effect of the newer, larger Southcenter shopping center on the older, smaller more community-oriented Burien shopping area is apparent. Wallingford-Fremont shows the strength of King County small-store retail seen in the previous table. The low forecast future growth rates for Southcenter, Issaquah, and Woodinville are inexplicable, and suggest to us that the forecasting methodology needs to be closely examined.

Figure 3-3 shows the location of commercial and mixed use zoning in the central Puget Sound region, as compiled by the MPO from submissions by local jurisdictions. This zoning illustrates that the location of retail and commercial services is unlikely to be constrained by public policy to urban centers and to urban growth areas.

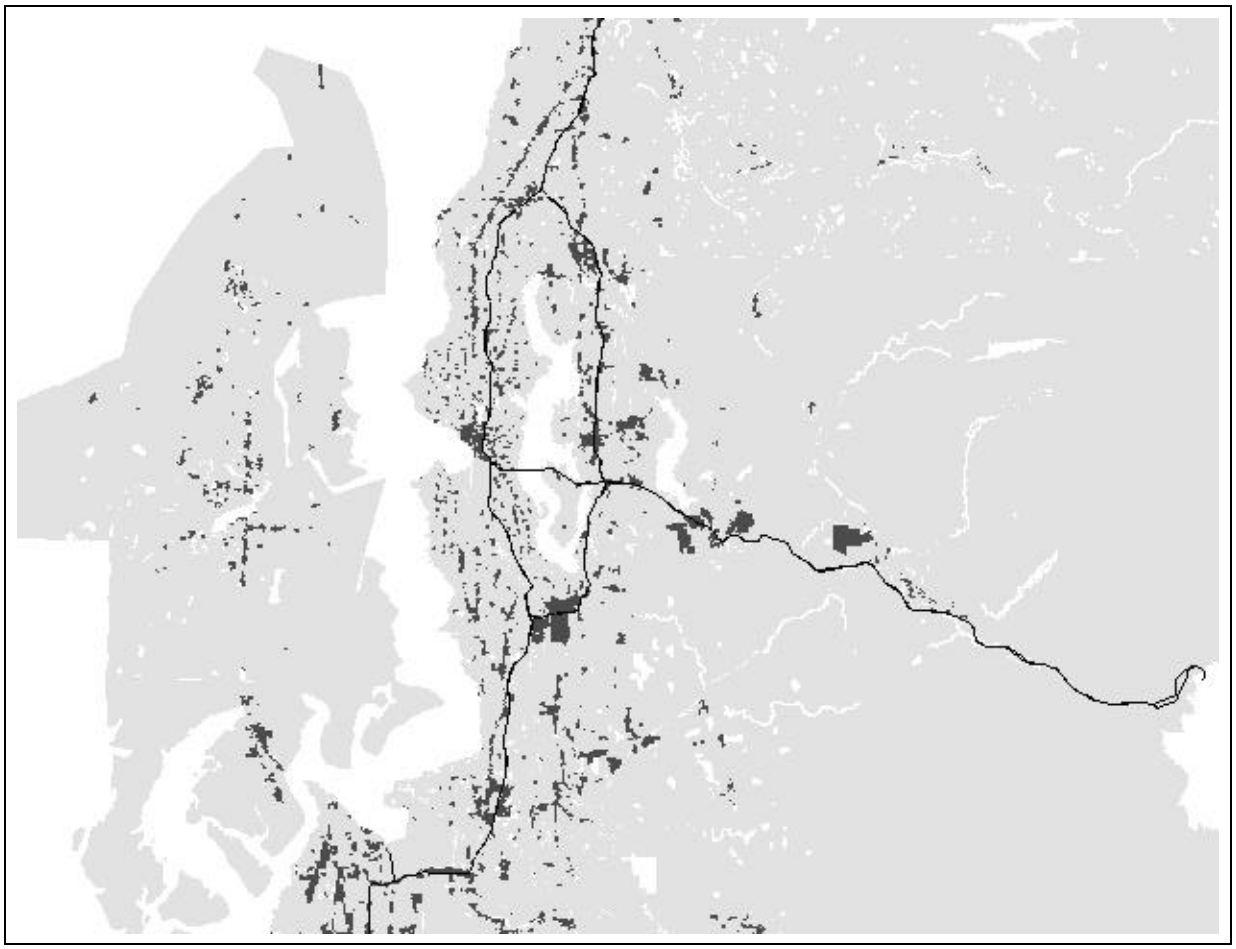


Figure 3-3 Commercial and Mixed Use Zoning
Source: PSRC 2000a

VARIETY AND DISPERSION: MAPPING

To illustrate the wide dispersion of consumer destinations in the central Puget Sound region, we developed a series of maps. These maps are listed in Table 3-10 which also indicates the count of separate locations for each retail category. Since our purpose is to show spatial patterns and not achieve precise coverage, we imposed the limitations noted in order to manage the amount of effort required. Although we tried to identify all of the sites within each limited category, we undoubtedly missed some. Also, complete geocoding of all identified sites was not achieved given time constraints. So we have undoubtedly erred on the conservative side in terms of the number and spatial dispersion of locations. The reader should also note that important features such as the state highway system and transit corridors are not shown to simplify pattern identification. Only the Interstate highways are included to provide a frame of reference.

The reader is directed to the maps in Appendix A. We comment here on some of the features the maps appear to show.

Planned Shopping Centers

Planned shopping centers are a dominant format for store locations in the region and account for a large share of all retail sales in the region. There are approximately 450 shopping centers in the region with a total of about 80 million square feet of built floor space. At least 50 million square feet of this floor area is outside the 21 designated urban centers. Map A-1 shows the location of 348 of these shopping centers, with map symbols corresponding to the classification shown in Table 3-11. Regional centers are the major malls that encompass at least 700,000 square feet and serve customers from many different locations. Regional Center examples are Southcenter, Bellevue Square, Alderwood Mall, and Kitsap Mall. Sub regional centers are smaller versions of the regional malls. Strip malls lie along arterials, and power centers contain three or more single category super stores. Community and neighborhood malls serve smaller areas, and mixed centers are part of office buildings or hotels.

Interest in the power center format continues to be strong in the region. Even the small town streetscape atmosphere created at the new Redmond Town Center mall has had to make way at its periphery to a more "big box" character (Ervin, 1998).

Superstores

Map A-2 provides a picture of the dispersed locations of 148 of the superstores or category killers described earlier. The number that fall outside of the 21 designated urban centers is 110 (74%).

Home Improvement Stores

Large home improvement stores are a special category of superstore that we have counted and mapped separately in Map A-3. We show the Eagle, Home Depot, and Home Base brand. Each of these chains can be thought of as a network of locations that blanket the region.

Maps are in mapbook.pdf

Table 3-10 List of Retail Maps (See Appendix)

A-1	Planned Shopping Centers	348 locations geocoded from a database of 486 shopping centers from a private source in November, 1998
A-2	Superstores	148 locations of "category killer" superstores such as Toys R Us, Walgreens, PetSmart, Office Depot, Barnes & Noble, and Big 5 Sporting Goods compiled from 1998 US West Dex Yellow Pages
A-3	Home Improvement Stores	29 locations of Eagle, Home Depot, and Home Base stores from Yellow Pages at www.mapsonus.com, 1998
A-4	Discount Chain Department Stores	51 locations of Target, Fred Meyer, Costco, K Mart, Target, Wal-Mart, and Sam's Club stores compiled from Yellow Pages at www.mapsonus.com, 1998
A-5	Grocery Stores	238 locations of Albertson's, QFC, Safeway, Thriftway, and other large grocery stores compiled from 1998 US West Dex Yellow Pages.
A-6	Post Offices	83 locations from a list provided by the US Postal Service, 2000
A-7	Major Medical Centers	32 hospitals and major clinics compiled from 1999 US West Dex Yellow Pages
A-8	Fitness Centers	189 locations of gymnasiums and health clubs compiled from Yellow Pages at www.mapsonus.com, 2000
A-9	Fast Food Restaurants	256 locations of McDonald's, Burger King, Jack in the Box, and Dairy Queen compiled from 1999 US West Dex Yellow Pages
A-10	Movie Theaters	72 indoor and drive-in movie theaters compiled from 1999 US West Dex Yellow Pages
A-11	Night Clubs	106 locations compiled from the Seattle Weekly in June, 1999 and 35 from the same source in June, 1989
A-12	Parks and Playgrounds	327 locations identified in a U.S. landmarks database compiled by Caliper, 1999
A-13	Regional Malls: Approximated Trade Areas	12 locations from Map A-1
A-14	Home Improvement Chain: Approximated Trade Areas	12 Eagle Hardware & Garden locations from Map A-3
A-15	Northgate Mall Area	Subset of superstores, discount department stores, and home centers from maps above.
A-16	Southcenter Mall Area	Subset of superstores, discount department stores, and home centers from maps above
A-17	Selected Consumer Destinations	1,879 locations from maps A-1 through A-12.

Table 3-11 Size Classification of Shopping Centers in Central Puget Sound Region

Type	Approx. Size Range Square feet	Approx. Number
regional center	700,000 or more	12
sub regional center	500,00 to 700,000	10
community center	20,000 to 370,000	157
strip mall	14,000 to 223,000	68
neighborhood center	20,000 to 150,000	105
power center	120,000 to 600,000	15

Source: Proprietary database; National Research Bureau 1999

Discount Department Stores

The large discount department stores are another kind of "big box" store that blankets the area. We include the discount warehouses such as Costco in this category. We show 51 of these on map A-4. Most of these tend to be stand-alone stores, not part of planned shopping centers. Only 3 are part of or next to regional/sub-regional malls; 34 of these (67%) are more than a mile away from these larger malls.

Grocery Stores

Map A-5 illustrates the location 0f 238 large grocery stores. These also tend to be independent of shopping centers. In an earlier chapter we discussed the trend of grocery stores to become larger and less numerous. There are 25 of these grocery stores (11%) inside of the urban centers; 89% are outside of the urban centers.

Post Offices

U.S. Post Offices in the region are shown in Map A-6. They are a reminder that even traditional services are quite dispersed. In this case, the Postal Service chooses locations that are convenient for the loading, unloading, and dispatch of postal vehicles as well as customers who arrive in private vehicles.

Major Medical Centers

Hospitals and major clinics are displayed in Map A-7. There are 32 shown, and 27 (84%) are outside of urban centers.

Maps are in mapbook.pdf

Maps are in mapbook.pdf

Fitness Centers

People are quite healthy in the central Puget Sound Region, and many like to use health clubs and gymnasiums. Map A-8 shows the location of 189 of these facilities. They are widely dispersed; 33 (17%) of them are within the Urban Centers, and 156 are not.

Fast Food Restaurants

Drive-through windows for several fast-food chains, most branch banks, and some drug stores reminds us of how retail operations strive to serve people in ways that reflect how they live. Map A-9 provides a picture of locations of fast food restaurants in only four of the chains, many with drive through services. 208 of the 256 (81%) are more than a mile from an urban center.

Movie Theaters

Cinemas are tending toward a large, multi-screen format. The location of 72 movie theaters are shown in Map A-10. These facilities do tend to co-locate with shopping malls; the GIS system computes that 32 of these theaters (44%) are with 1/5 of a mile of a shopping center.

Night Clubs

In Map A-11 we show an example of service growth, a comparison of the night clubs in Seattle now and ten years ago. The number of clubs listed by the *Seattle Weekly* in 1989 was 35, while the 1999 edition of the same source lists 107 nightclubs. Many of these, but not all, are in the urban centers. Ten of the addresses listed in 1989 show up ten years later.

Parks and Playgrounds

Outdoor activities are widely dispersed as well. Map A-12 shows the location of 327 parks and playgrounds in the region.

LOCATION STRATEGIES

Store location decision making is complex with several types of organizations involved, including land developers, building owners, and retail chain site planners. The locations of retail establishments are driven by a combination of responses to market conditions, availability of land and buildings, regulatory constraints and incentives, and to managerial/owner preferences that may or may not make business sense. In general, store location decision makers try to place retail locations to be accessible to residential and employment locations, so that customers can easily get to the stores.

Map A-13 illustrates mechanically, computer-calculated “areas of influence” (Thiessen Polygons) for the 12 regional and sub regional malls in the four county central Puget Sound

Region. Any location within one of these areas is closer to the mall contained within, than to any other mall. These areas are the rough equivalent of trade areas, that is, the areas that tend to draw customers who are looking for the closest mall. The only difficulty is the presence of geographic barriers like Puget Sound and Lake Washington, which the mechanical calculation did not take into account.

Even with these caveats, one can see how the major malls "divide up the territory" of the region in a uniform fashion.

Mega Agglomerations at Malls

There is a visible tendency for stores to locate outside of, but also in the vicinity of, existing retail malls. Map A-15 shows the location of stores that exist around Northgate Mall, and Map A-16 shows stores that have sprung up near Southcenter Mall. Both of these malls are the major tenant in an urban center. In both cases, a shopper needing to traverse the distance between stores on opposite edges of the respective malls would normally need to use a vehicle. The dispersion of stores around malls like these suggests that regional high capacity transit service to them will require some sort of circulator service to move people between the station and the stores.

Stand-alone Stores

At the same time, some retail chains have a business strategy that causes them to establish locations that are totally separate and distinct from existing shopping centers. Map A-14 shows the dozen stores in the Eagle Hardware chain and their approximated trade areas, which provides a pattern strikingly like that of the dozen major malls, only not matching up with those malls because Eagle stores are *not* in or close to big malls. We are confident that the analogous map for chains like Walgreens Drug Store or Fred Meyer would show a similar trade area pattern. Fred Meyer has recently established a new large store not near any others on the north shore of the Ship Canal in Seattle. Despite the City of Seattle's policy to encourage commercial development in urban villages, this store is located approximately half way between two urban villages, Fremont and Ballard. Its location is a measure of the strength of the commercial marketplace and the relative weakness of public policies.

In Summary

Map A-17 shows all 1,879 of the current destinations from maps A-1 through A-12 discussed above. As the map clearly shows, the vast majority of these destinations are outside of urban centers, although most of this retail activity does lie within Urban Growth Areas.

TRANSFORMATION AT RETAIL LOCATIONS

One of the characteristics of prime retail locations is the characteristic of changing enterprises to fit the consumer demands of the times. In an earlier section of this report, we have already seen

the example of the inner city neighborhood of Wallingford changing its retail mix over several decades. Another example is the Aurora Village shopping center in North Seattle, which during the 1990s transformed from a traditional regional shopping center into a power center with several big box stores, including Costco, Home Depot and Computer City. In downtown Seattle, the failure of Frederick & Nelson's flagship store opened up a new main store location for Nordstrom. And traditional big box stores are finding their way into available space in traditional malls. An example is the Toy R Us store -- a pioneering big box category killer -- located within the Northgate Shopping Center in North Seattle.

Another example: The Ernst Home Center chain of home improvement stores went bankrupt in 1996 under the onslaught of new big box market entrants Eagle Hardware and Home Depot. Ernst closed all of its stores in January 1997. The Seattle Times reported in the spring of 1999 that all of Ernst's East King County locations in shopping malls were in the process of being recycled for other uses, only one of which is in the retail home-and-garden-store business. That continuity exists at the Renton Highlands store, where Ace Hardware shares the space with a Pic n Save variety store. Other replacements include the home-furnishing store Linens 'n Things in Bear Creek Village in Redmond; off-price clothing store T.J. Maxx in downtown Woodinville; Gart Sports, Kaufman's Tall and Big Men's Shop, and Kinko's Copies in downtown Bellevue; Car Toys and Ross Dress for Less at Totem Lake Malls; and Illusionz, an amusement center at Town & Country Square in Issaquah (Ervin, 1999). At Factoria Mall, the Ernst space was leased to Old Navy.

OPPOSITION TO BIG BOX RETAIL

Although not emerging as a widespread force in the central Puget Sound region, in other parts of North America there is occasionally local government or organized citizen opposition to the construction of new big box retail stores, especially on undeveloped areas of the community. This opposition is multifaceted, often related to local interest in protecting existing retail businesses and shopping areas from competition by out-of-town businesses.

One example of this in our region: In 1996, a Gig Harbor citizens group, Peninsula Neighborhood Association, led the successful opposition to an attempt by Wal-Mart to build a 133,000 square foot store two miles from the center of the small town. In January, 2000, the Fred Meyer retail chain submitted plans to build a 140,000 square foot store on the same 26 acre site, as part of a master planned development that includes nine other buildings, tree-lined plazas, a nearly 4-acre public park, an open space incorporating a wetland and existing vegetation, and land for future residential development. The Peninsula Neighborhood Association and the city government have announced their opposition to the project, saying the new store would be better built near the site of a new Target discount department store and Albertsons Grocery Store in the Gig Harbor area. This alternative would put Fred Meyer near competitors, which does not appear to be a Fred Meyer's business strategy in other parts of the region.

INTERNET SHOPPING

The central Puget Sound region is as much affected by the growth of online shopping as any other region in the country. Although coming off of a small initial base, online shopping is roughly doubling every year as the century turns. The rise of Internet shopping creates leaves very large questions of how conventional store-based shopping will be affected, and how travel to store-based shopping and other destinations will be affected.
One scenario is that the Internet will cause people on average to spend more time at home or at work, and engage in less nonwork travel. A second scenario is that the Internet will become integrated far more with the bricks and mortar world, and stimulate even higher interest in trips to interesting stores and recreational venues, with people perhaps finding new time through efficiencies in on-line shopping for groceries and other necessities. Part of this scenario might be the emergence of new retail venues that are integrated with online purchasing. For example, an online electronics dealer that maintains a demonstration center allowing merchandise sold on the internet to be touched and tried out.

In this case, online shopping involves personal travel. It also clearly generates commercial trips for the purpose of home delivery, albeit shorter in length on average compared to the combined trip for conventional shopping which involves truck delivery to a store where the customer must go to purchase and take home.

A third possibility is basically one of little change in the amount of local travel. Some combination of scenarios one and two keeps travel at about the same level

CONCLUSION

The tables and maps in this chapter provide a consistent picture of variety, dispersion, and the likelihood of continuing change for the retail environment of the central Puget Sound region in the years ahead. This is the net result of increased consumption per capita and continued technological change leading to consumer-oriented businesses seeking to satisfy customers cost-effectively, and consumers responding to retail store and service locations. This dynamic yields a number of observable spatial trends in the retail environment:

- A growing number of distinct, significant retail locations per capita.
- A growing variety of stores and services, including restaurants.
- Relatively high growth in the number of larger retail stores.
- Retail growth in the suburbs exceeding growth in downtown Seattle.
- A large and growing number of shopping centers.

- A retail industry strategy that locates some chain stores nearby -- but not in -- existing retail malls.

- Other retail chains with stand-alone locations that are distinct from and not near existing shopping centers.

- A process of change in prime retail locations that shows decline of some establishment types, and the rise of others.

- Significant activity outside of urban centers and outside of CBDs of other places.

- Drive to and through convenience growing

- A recent sharp rise in online buying and associated home delivery.

The limited historical data for the Seattle metro area indicates that commercial centers--building structures and their arrangement--of older neighborhoods change slowly. Even where zoning allows higher uses, the market and resident' attitudes hinder change. Most of the change has been in the kind of establishments that occupy existing buildings. Some key sectors have experienced consolidation: grocery stores, drug stores, and hardware stores. Several types of stores have moved out of neighborhoods centers and have relocated along arterials.

Although some of the change in the commercial areas of existing neighborhood centers in the Seattle metro is supportive of TOD because it has created walkable destinations, e.g., coffee shops, convenience stores, specialized food stores. Other change is less or not supportive because it is specialized and attracts customers from a much wider area. On a regional level, much of the retail growth is on a scale -- unit size or cluster size -- that is not compatible with a walkable or transit-accessible core commercial center.

CHAPTER FOUR

RESIDENTIAL AND WORK ENVIRONMENTS

INTRODUCTION

As we indicated in Chapter One, the key aspects of the residential and job environments from a TOD planning perspective relate to their density, spatial distribution, and the preferences demonstrated by the marketplace for location, size and style. For the central Puget Sound region, the current patterns of residential and workplace development are the result of incremental private and public decisions made over the 150 years since the first European settlement that became Seattle was established. Although individual buildings have been replaced and renewed in that period, several times in many cases, historical spatial relationships have endured and determine current activity and travel patterns. They will greatly affect future travel patterns as well.

We can only summarize a few of the patterns here that seem to have the greatest import for planning involving strategies that would reshape regional land use and travel patterns. The region has embarked on a growth monitoring effort that will produce detailed information on residential and employment land use and on the efficacy of current growth management policies (see Chapter 8). These resources will be available to the NWTIPP.

RESIDENTIAL DENSITY AND ITS DISTRIBUTION

Population density is a crucial factor in judging a region's propensity to shift from cars to transit and walking. Density can be measured and compared on several geographic scales, and all should be used to provide a true picture of residential distribution and dispersion. Of special interest is the localized density within sub areas and along potential transit corridors within each of these larger areas. This is the scale that may decide the efficacy of what is termed by the Federal Transit Administration as the "minimum operable segment." In addition, some measure of the capacity for increased residential development and population density through infill and redevelopment is needed.

Urban Area and Central City Density

Table 4-1 compares the population density for the urbanized area of the planning region and the central city with those for other major urban areas and their central cities. The central Puget Sound region has a moderate population density compared to the thirty-two other urban regions with a population of one million or more. It's urbanized area ranks seventeenth and its central city ranks fifteenth. This is characteristic of most western cities (San Francisco is an exception) that developed largely after the arrival of the automobile.

Table 4-1 Density of Urbanized Areas with Population of One million or More, 1990

Urbanized Area/Central City	Population of Urbanized Area (millions)	Population Density (Persons per square mile)	
		Urbanized Area	Central City
New York	16.04	5,409	23,705
Los Angeles	11.40	5,801	7,426
Chicago	6.79	4,287	12,252
Philadelphia	4.22	3,627	11,736
Detroit	3.70	3,303	7,412
San Francisco	3.63	4,152	15,502
Washington, DC	3.36	3,560	9,884
Dallas	3.20	2,216	2,941
Houston	2.90	2,465	3,020
Boston	2.78	3,114	11,865
San Diego	2.35	3,402	3,933
Atlanta	2.16	1,898	2,990
Minneapolis	2.08	1,956	6,710
Phoenix	2.01	2,707	3,465
St. Louis	1.95	2,673	6,409
Miami	1.91	5,429	10,072
Baltimore	1.89	3,190	9,109
Seattle	**1.74**	**2,967**	**6,153**
Tampa	1.71	2,630	2,576
Pittsburgh	1.68	2,158	6,653
Cleveland	1.68	2,638	6,566
Denver	1.52	3,309	4,212
San Jose	1.44	4,241	4,567
Norfolk	1.32	1,994	4,856
Kansas City	1.28	1,674	1,891
Fort Lauderdale	1.24	3,785	4,757
Milwaukee	1.23	2,395	6,536
Cincinnati	1.21	2,370	4,716
Portland	1.71	3,021	3,507
Riverside	1.17	2,543	2,915
San Antonio	1.13	2,578	2,811
Sacramento	1.10	3,285	3,836
New Orleans	1.04	3,851	5,683

Source: US Census Bureau 1993

Sub Area Density

The central city has the highest localized densities in the region. However, Seattle's moderate population density is characteristic of most of the city's census tracts. Only a few tracts exceed twice the city's average of 6,200 persons per square mile. One way to gauge Seattle's subarea density is to compare it to the average density of a city of similar size but with a larger per capita transit ridership. We choose Boston for this comparison. Seattle has 13 of 123 census tracts that have a density greater than Boston's average density of 11,865 persons per square mile. These ten tracts account for 7.9% of Seattle's 1990 population and lie in the University district, and in the downtown and the nearby First Hill neighborhood (Figure 4-1).

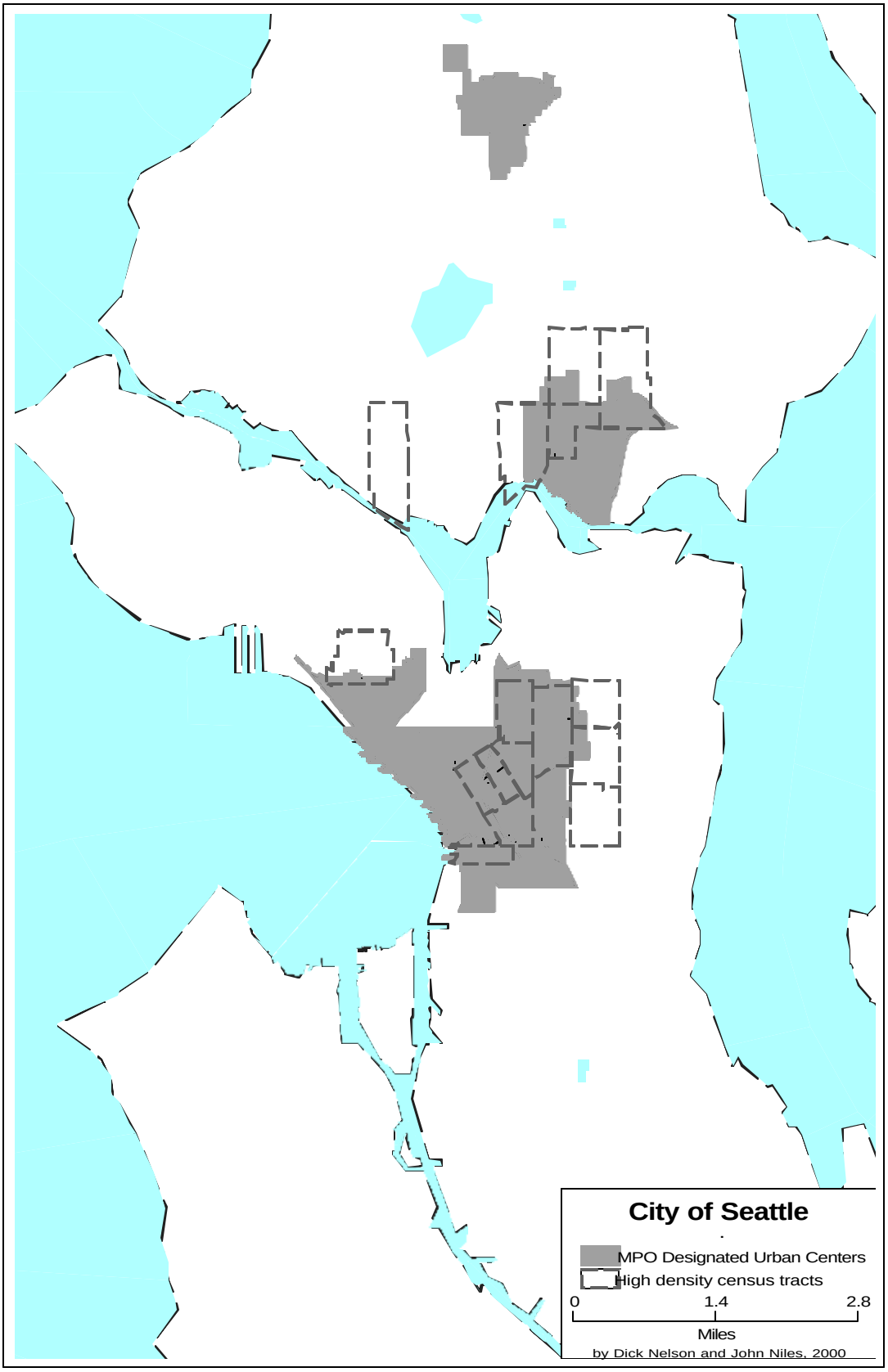


Figure 4-1 Seattle Census Tracts with a Population Density Greater than Boston's Average Density

Remaining Development Capacity

Future population density is highly dependent on existing zoning patterns and zoned capacity which tend to be hard to change. The zoning of the central city was established in the 1920's and has undergone relatively slight modification since zone boundaries were first drawn. Newer cities in suburban areas have largely inherited the density that was allowed under the central county's unincorporated area land use rules. Generally, all of these patterns are characterized by a distribution of available capacity for residential infill and redevelopment in multifamily and mixed-use zones that are located along arterial streets and which buffer single-family zones from traffic noise and aesthetics impact.

Seattle's current population by zone and the estimated remaining capacity available under current zoning is shown in Table 4-2. The estimates for single and multifamily zones have been discounted by a 15 % "market" factor to reflect the probability that not all parcels will be developed and that some will be developed at less than allowable densities. Seattle is zoned for approximately 250,000 more residents, or a 50% increase over current population. This is additional population that may be added over time. Figure 4-2 shows the distribution of remaining residential development capacity for the City of Seattle. Most of the capacity is in areas zoned for multifamily and commercial land use. Although the capacity for development is significant, the available areas are distributed wildly in narrow strips and isolated plots.

Table 4-2 City of Seattle Zoned Residential Development Capacity

Zone Category	Residential Capacity (units)	Existing Units (1990)	Potential Percent Increase	Capacity as Percent of Total
Single Family	14,320	128,341	11	12
Multifamily	42,310	95,518	44	34
Commercial	49,147	18,301	269	40
Downtown	18,641	6,738	277	14
TOTAL	124,418	248,898	50	100

Source: City of Seattle, 1997

Residential Dispersion

Figure 4-3 provides a snapshot of the location of new housing permits in 1998 in the region, relative to designated urban centers and urban growth areas. The growth outside the urban growth areas is related to the large number of existing land use rights that were in place when the growth boundary was established ten years ago. However, there is clearly a large amount of residential development occurring within the boundary in the second tier of counties, Kitsap, Pierce, and Snohomish. This decentralization of population is predicted to accelerate as indicated earlier.

Figure 4-2 Distribution of Development Capacity in the City of Seattle
Source: City of Seattle 1993

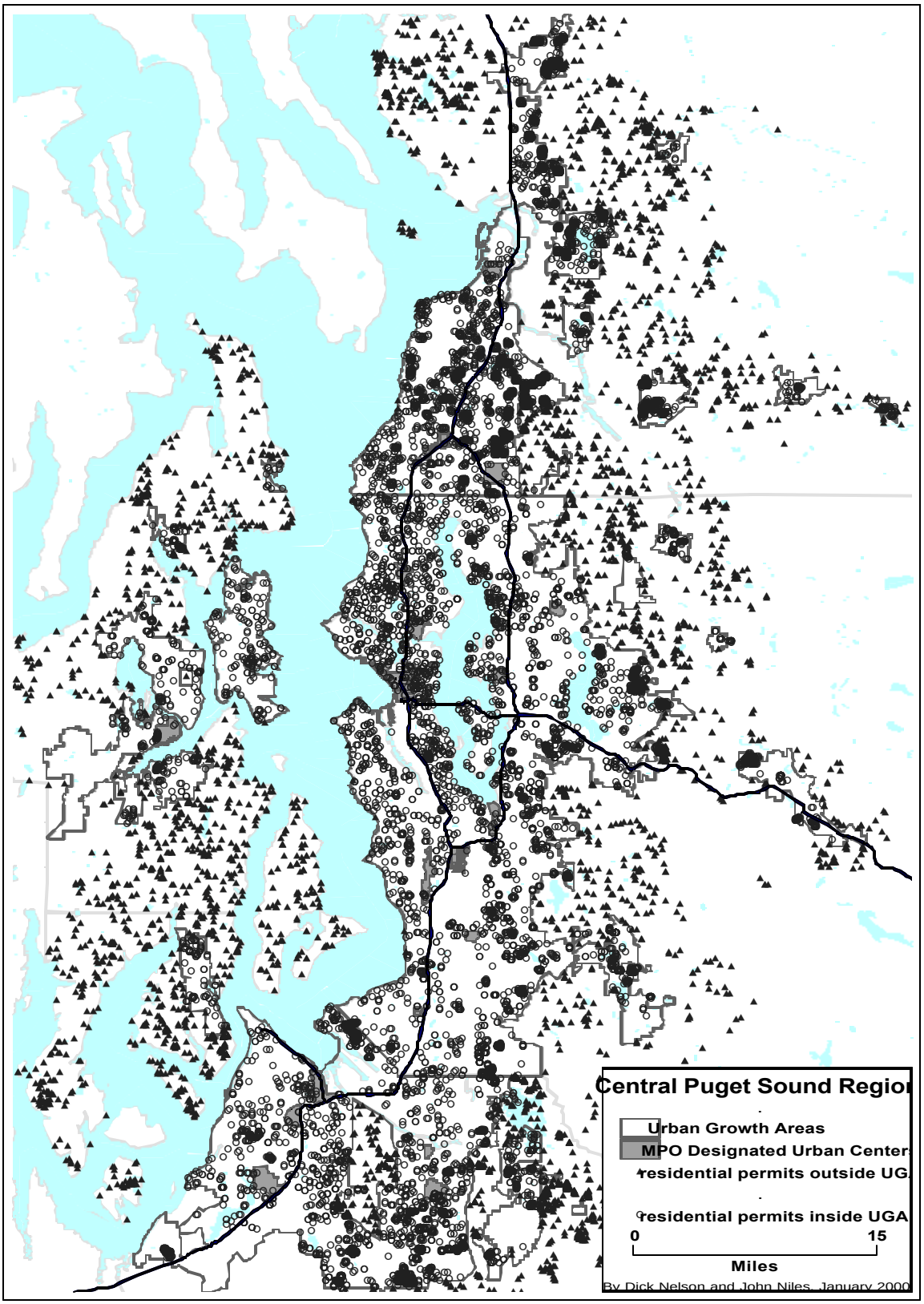


Figure 4-3 1998 Housing Permits and Urban Growth Areas
Source: PSRC 2000a

TYPES OF RESIDENTIAL STRUCTURES

An important factor in TOD planning is the preference for attached single family and multifamily housing. The premise underlying the TOD paradigm is that traditional urban design and proximity to commercial services and public amenities will induce a greater proportion of households to choose compact residential settings, perhaps units with a smaller floor area. Historical trends are of interest, but they may not be easily understood in causative terms.

The trend over the past three decades in the case study area has been toward moderately higher levels of multiunit and attached single-unit structures (Table 4-3). Since much of the change occurred before government policies encouraging TOD were introduced beginning in the 1990's, it is clear that market factors contributed to the observed increase. Since these factors may continue to be operative in the future, it may difficult to separate the effect of government polices from other factors that determine demand (see discussion of household size below).

Thus the structural type data for the case study area, although indicating a trend to multifamily housing, should not simply be extrapolated to predict future demand and residential patterns. More tracking will be needed to establish it as a real trend. .

Table 4-3 Percent of Units in Residential Structures by Type

Year	1-detached	1-attached	2+	MH/tr/other*	All single-family**
1970	70.6	1.3	25.2	2.9	74.8
1980	65.8	1.0	29.4	3.9	70.7
1990	60.1	2.5	30.6	6.9	69.5
1999	61.1		31.5	7.4	68.5

* MH = Mobile home, tr = trailer

** Sum of 1-detached, 1-attached, MH/Tr/Other

Source: Census; OFM 1999

Household Size

Trends in household size provide a way to understand the demand for different types of housing. The average number of persons per household in the planning region has declined continuously over the past three decades reflecting basic changes in family structure and the demographics unique to a rapidly growing region (Table 4-4). Several factors can be expected to control household formation and size. Among them are: the age distribution of the population, employment and personal income levels, and divorce rates. A population that is becoming older can be expected to choose smaller and perhaps multifamily dwellings as children leave the household and one spouse dies. Higher rates of divorce and single-persons living alone can have the same effect. And higher income levels can cause family members, including grown children, and unrelated individuals to establish independent households. All of this can create increased demand for multifamily housing.

Table 4-4 Average Household Size Trends

County	1970	1980	1990	% change 1970-1990	1999 (est.)
King	2.89	2.49	2.40	-18.0	2.37
Kitsap	2.95	2.68	2.65	-10.2	2.53
Pierce	3.02	2.66	2.62	-13.2	2.52
Snohomish	3.22	2.76	2.68	-16.8	2.64
4-county	2.96	2.58	2.50	-16.0	N/A.

Source: Census; OFM 1999

RESIDENTIAL MOBILITY

The American Housing Survey provides information, albeit limited, on the reasons people move and their considerations for choosing a new residential location. The survey returns to the same housing units year after year, and thus can analyze the movement of households through housing, both renter and owner occupied. It can help elucidate the importance of transportation in the housing decision. The most recent data available is from a 1996 of the Seattle-Everett metro area (Census 1997). We list the major reasons stated for moving and choosing a new location in Tables 4-5 and 4-6.

Table 4-5 Frequency of Major Reasons Cited for Moving

Reasons for Leaving Previous Unit	Percentage Citing*
Employment related (includes new job or job transfer, to be closer to work/school)	21.6
Family/personal (includes married, widowed, divorced, separated)	12.7
Establish own household	9.1
Need more space	8.8
Improve housing quality	8.8
Lower housing costs	6.6
Change from renter to owner	4.4
Change from owner to renter	1.0
Owner induced displacement (includes owner to move into unit, conversion to condo)	2.8
Government induced displacement	1.1
Other housing related	7.2
Other	14.3
Not reported	2.6

* More than one reason may apply to particular unit.
Source: Census 1997

Among the many reasons cited for leaving a previous home, reasons relating to employment were mentioned most frequently, followed by personal life stage and household makeup (Table 4-5. The desire to establish one's own household and the need for more space also ranked high Among the top reasons for choice of neighborhood, its convenience to job and the attributes of the house itself were given most often, while convenience to public transportation was seventh on the list, just 3.4 percent of all reasons cited (Table 4-6). The frequency of these answers is strikingly similar to those given by the national panel.

Table 2-4 Reasons Cited for Choice of New Residential Location

Reason	Percentage Citing*
Convenient to job	19.1
House itself	13.4
Looks/design of neighborhood	11.1
Convenient to friends/relatives	10.0
Good schools	6.3
Convenient to leisure activities	5.2
Convenient to public transportation	3.4
Availability of other public services	2.9
Other	25.2
Not reported	2.6

* More than one reason may apply to particular unit.
Source: Census 1997

SPATIAL DISTRIBUTION OF EMPLOYMENT

There are two key employment considerations for TOD planning purposes: the spatial distribution of jobs in the region and the origin-destination patterns of work trips. We address the first here, and the second in Chapter 5.

As the Puget Sound region has grown outward from the central city and county, new employment centers have been created both inside and outside suburban centers. The resulting metropolitan employment pattern is both multi-centered and dispersed. This shift of employment from central city to suburban center to scattered exurban sites has been dramatic. For example, in 1970 approximately 40% of all jobs in the region were located in Seattle. By 1994, just 17% of regional employment was inside the central city, with another 17% situated in the designated urban centers outside Seattle (Table 4-7). Almost two-thirds of all jobs were located in areas outside of the designated urban centers.

Table 4-7 Job Distribution in the Study Area

Employment Area	Number of Jobs	Percent
Downtown Seattle urban center	165,000	11
Other designated Seattle urban centers (4)	95,000	6
Satellite urban centers (16)	244,000	17
Outside urban centers	966,000	66
Total -- Metro area (4 counties)	1,470,000	100

Source: PSRC 1996

CHAPTER FIVE

NONWORK TRAVEL PATTERNS AND TRANSIT USAGE

INTRODUCTION

In this chapter we describe the current patterns of travel in the region. Our focus is on nonwork personal travel and transit ridership. The principal source of travel data is the Puget Sound travel panel (PSRC 1997a). The Puget Sound Regional Council conducts a longitudinal travel survey to ascertain the changing travel behavior and patterns of area residents. The survey has been carried out 8 times since 1989. Survey data is useful, but travel behavior is imperfectly understood at the regional level, and we will point out where improved data could assist planning efforts.

PERSON TRIPS BY PURPOSE

Table 5-1 gives the percent of person trips by purpose and mode. Since the panel data showed no significant trends over the six waves, only the most recent survey (1997) is presented. Data have been adjusted by primary commute mode (transit, carpool, SOV) and by county of residence to correct for over-sampling of bus and carpool users and Kitsap County residents. The largest nonwork categories are free time (principally eating out and other social recreational purposes) and personal business. Table 5-2 shows the daily trip frequency by purpose and mode. The average person makes about four trips by vehicle each weekday.

Table 5-1 Percent of Person Trips by Purpose and Mode

Trip Purpose	Travel Mode*					
	SOV	**HOV**	**Transit**	**Non-motor**	**Other**	**Total**
Work	16.4	3.0	1.1	1.1	0.1	21.7
Shopping	5.1	3.7	0.2	0.4	0.0	9.4
School	0.2	0.6	0.0	0.0	0.2	1.0
Visiting	1.1	1.1	0.1	0.1	0.0	2.4
Free time	4.1	4.9	0.2	0.5	0.1	9.7
Personal business	7.9	8.5	0.1	0.6	0.0	17.1
Appointments	2.0	1.2	0.1	0.1	0.0	3.4
Home	20.0	11.0	1.4	1.5	0.3	34.2
College	0.5	0.1	0.2	0.1	0.0	0.9
Total	57.3	34.1	3.4	4.4	0.7	99.9

Source: PSRC 1999b. * **HOV** - carpool, vanpool; **Transit** - bus, paratransit, ferry; **Non-motor** - walk, bike; **Other** - taxi, motorcycle, school bus, monorail, boat, train, airplane.

Table 5-2 Average Daily Trips Per Person by Purpose and Mode

Trip purpose	Travel Mode					
	SOV	**HOV**	**Transit**	**Non-motor**	**Other**	**Total**
Work	0.67	0.12	0.04	0.04	0.01	0.88
Shopping	0.21	0.15	0.01	0.01	0.00	0.38
School	0.01	0.02	0.00	0.00	0.01	0.04
Visiting	0.05	0.05	0.00	0.00	0.00	0.10
Free time	0.17	0.20	0.01	0.02	0.00	0.40
Personal business	0.32	0.35	0.01	0.02	0.00	0.70
Appointments	0.08	0.05	0.00	0.00	0.00	0.13
Home	0.82	0.45	0.06	0.06	0.01	1.40
College	0.02	0.01	0.01	0.00	0.00	0.04
Total	2.33	1.39	0.14	0.18	0.03	4.07

Source: PSRC 1999b

TIME OF DAY FOR TRIPS BY PURPOSE

Figure 5-1 shows the distribution of trips over the 24-hour weekday by starting time. All trips have been aggregated in five categories to indicate the amount of travel that starts at home, work and other locations, and travel that is direct in comparison to travel that involves stops. Home to work and work to home are direct commute trips without stops. Home/other trips and home/shopping include both legs of single purpose trips. For example, a trip to a supermarket that begins at home and returns to home is counted as two home/shopping trips. Non home-based trips are trips of any kind that start from a location other than home or work. An example is a trip from work to home with an intermediary stop at a daycare center to pick up a child. This is counted as two non home-based trips.

The graph indicates that most nonwork travel (non home-based, home/shopping, home/other) occurs from 9 am through the evening peak period. Even when direct work to home trips peak at about 5 PM, the majority of travelers are making trips that involve other destinations. A similar graph could be drawn for the same categories by miles of trip length. It would show a larger amount of home to work travel because work trips tend to be longer than nonwork.

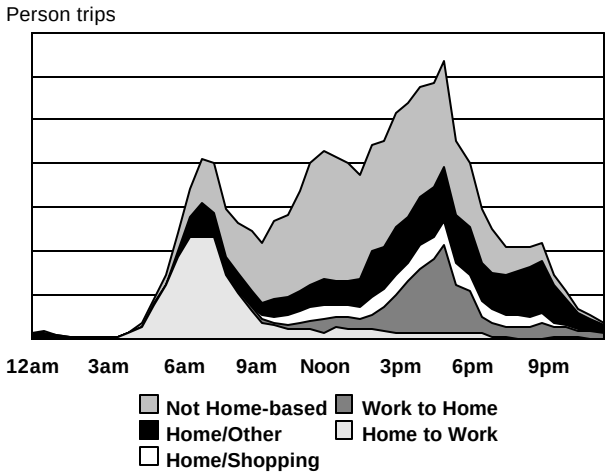


Figure 5-1 Time of day of Trips by Major Category

PERSONAL VEHICLE TRIPS

Table 5-3 gives the percentage, daily frequency, and average length for all personal vehicle trips by purpose. These trips, which include single and multi-occupancy trips, account for more than 9 of 10 person trips. Again, data for just the last wave (1997) of the panel survey is shown since there is no significant trend in the data for the seven waves.

Table 5-3 Vehicle Trips by Purpose

Trip Purpose	Percent of All Vehicle Trips	Average Daily Trips Per Person	Average Trip Length (miles)
Work	23.00	0.75	7.81
Shopping	9.20	0.30	1.66
School	0.50	0.02	0.09
Visiting	2.30	0.07	0.78
Free time	8.70	0.28	2.13
Personal business	18.40	0.60	3.65
Appointments	3.40	0.11	0.87
Home	33.90	1.11	9.37
College	0.70	0.02	0.26
Total	100.00	3.26	26.61

COMPARISON WITH NATIONWIDE PERSONAL TRANSPORTATION SURVEY

The PSRC employs fewer and somewhat different trip purpose categories than does the USDOT in its Nationwide Personal Travel Survey. Thus some numbers of these two surveys are not directly comparable. Table 5-4 provides the correspondence between the trip purpose categories in each. Also, unlike the NPTS, the survey is a weekday survey rather than a full week survey. This means that nonwork trips represent a lower percentage of all trips than they would if trips were recorded in 7-day diaries.

Table 5-5 compares weekday and weekend trips using data from the 1995 NPTS. Although nonwork trips account for a greater share of all trips on weekends, shopping trips are actually more frequent on weekdays; 77 percent of shopping trips take place on weekdays which make up 71 percent of the days of the week. The social/recreational category dominates weekend nonwork travel. It is also notable that weekend trips are longer on average.

Table 5-4 Trip Purpose Correspondence, Nationwide Personal Transportation Survey and Puget Sound Travel Panel Survey

NPTS	PSRC Panel Survey
To work	Work
Work related business	Work
Return to work	Work
Shopping	Shopping
To school	School or College
Religious activity	Free time or Personal business
Medical/dental	Appointments
Other family/personal business *	Personal business
Take someone somewhere	Personal business
Pick up someone	Personal business
Vacation	Free time
Visit	Visiting
Went out to eat	Free time
Other social/recreational	Free time
Change means of transportation	Personal business
Other purpose	Personal business
Home	Home

* Includes purchase of consumer services

Table 5-5 Comparison of Weekday and Weekend Travel (National)

Daily Travel Statistic	Weekday	Weekend
Person Trips		
Person trips per person	4.43	3.96
PMT per person	37.7	41.1
Average person trip length (mi.)	8.63	10.5
Vehicle Trips		
Vehicle trips per driver	3.81	2.99
VMT per driver	33.5	28.9
Average vehicle trip length (mi.)	8.85	9.73
Average time spent driving (min.)	59.5	48.1
Vehicle Trips by Percent of Purpose		
Work trips	*31.9%*	*12.5%*
Nonwork trips	*68.1%*	*87.5%*
Family and personal business	*49.8%*	*50.4%*
Social and recreational	*14.2%*	*29.8%*

Source: USDOT 1995

TRANSIT USAGE AND RIDER PROFILE

King County Metro Transit annually conducts a comprehensive survey of riders and nonriders. This survey provides a wealth of information regarding the demographic characteristics of transit users and the frequency and purposes of their trips. It also probes the reasons most people use transit infrequently or not at all, and it sheds light on the some of the issues facing TOD planners and the particular problem of increasing transit usage for nonwork purposes. Table 5- 6 summarizes some of the major findings of the most recent published survey (METRO 1997).

VEHICLE OWNERSHIP

The number of vehicles per capita rose steadily until the last few years (Figure 5-2). Although the data provides some indication that vehicle ownership may at last be reaching saturation, drivers at the same time are rapidly buying larger vehicles.

CENSUS OF COMMUTING

The US Census includes questions concerning work trip destination, length, time of departure and mode. Mode choice for commute trips from the past two censuses for the planning area are summarized in Table 5-7. The data is for commuters who reside in the 4-county area and work within or outside it.

Table 5-6 Major Findings of METRO Transit's Survey

- Most transit rides are taken by a small percent of the population; 72% of respondents had not taken even one transit trip in the last 30 days, while 6% use the bus for all personal travel.
- Riders and nonriders are generally demographically similar except at the very upper and lower ends of the income spectrum.
- 77% of regular riders (5 or more rides in last 30 days) have one or more cars available for their use. 98% of nonriders have a car available.
- Half of riders, both regular and infrequent, use the bus primarily to travel to work. 30% use the bus primarily for nonwork purposes--shopping, recreation, visiting friends.
- Three-fourths of commuters (two-thirds of respondents) have free or reduced fee parking. The majority pay nothing.
- Although there is no difference in commute trip length for the three primary modes (drive alone, carpool/vanpool, bus), the average travel time by bus is significantly longer than by car--41 minutes compared to 23 minutes..
- Half of drive-alone commuters (two-thirds of all commuters) find the idea of using the bus "not at all appealing." The same number of all nonriders find the idea of using the bus for their personal travel "not at all appealing."
- Flexibility is mentioned most often as the greatest barrier to transit ridership; for commuters not being able to get home if have to work late; for all respondents, not being able to get home in case of emergency. Lack of service to primary destination and service frequency are also of concern.

Source: METRO 1997

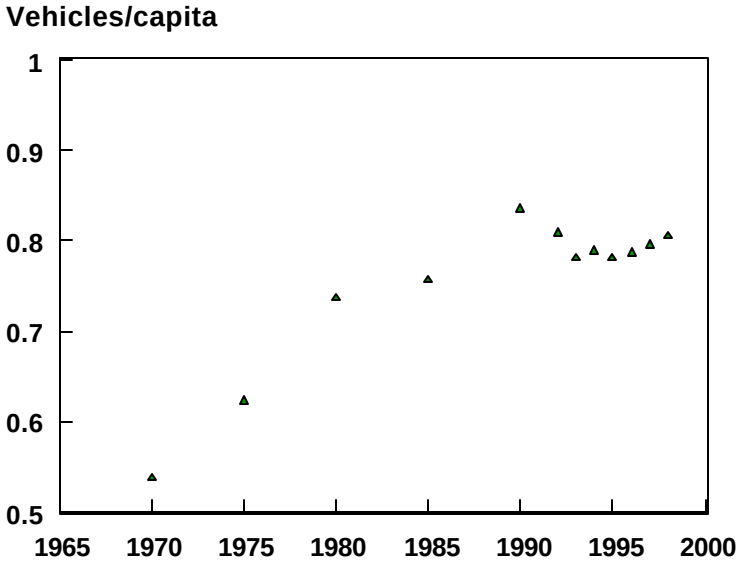


Figure 5-2 Vehicle Ownership in the Puget Sound Region
Source: Washington State Department of Licensing

Table 5-7 Commute Trip Trends (Percent of Total Person Trips)

Mode	1980	1990
SOV	65.1	75.5
Car & 1-passenger	14.0	10.2
Car & 2+ passengers	5.2	2.4
Transit	8.0	6.2
Walk	5.6	4.3
Other	2.0	1.5

Source: Census 1993

OPPORTUNITIES TO IMPROVE NONWORK TRAVEL DATA

Several changes to the regional panel and transit rider/non rider surveys would assist TOD planning and would provide a much better understanding of nonwork travel patterns.

- Travel surveys should collect information for weekend as well as weekday travel.

- Trip purposes should be disaggregated to reveal the several important sub categories of family/personal business and social/recreational trips

- Linked trips (tours) should be identified and analyzed, including the spatial location of stops on commute trips.

- Transit riders who have cars available and who make trips for nonwork purposes should be queried as to the reason for their choice of mode.

CHAPTER SIX

TRANSPORTATION SYSTEM, ITS CURRENT PERFORMANCE, AND PLANS FOR IMPROVEMENT

INTRODUCTION

In this chapter we describe the general outlines of the current regional transportation system, including county level transit services, and how the system is performing. We also summarize the plans that have been adopted for the system's improvement. These plans involve land use policies and strategies that are discussed in more detail in Chapter Seven.

REGIONAL TRANSPORTATION SYSTEM CONFIGURATION

The regional surface transportation system comprises roadways -- freeways, including an HOV lane network, arterials, and local streets -- six county and local transit systems, a large part of the state ferry system, and a county-operated ferry and several privately operated ferries. Although tolls have in the past been used to build major bridges, all parts of the current system are "free" or heavily subsidized by public tax dollars.

Roadway System

The region's major roadways and ferry routes are shown in Figure 6-1. Not shown are minor arterials and local streets. Table 6-1 provides a breakdown of the state roadway system in the region and its usage in 1998 by functional classification. It indicates that the interstate network accounts for more vehicle miles carried, although in centerline miles it is a smaller part of the total state roadway system. Note that these numbers do not include VMT on local arterials and streets owned by counties and cities.

The capacity of the region's interstate roadway system has been expanded over the past two decades through the addition of centerline miles and new lanes, but VMT has increased more rapidly than capcity (Figure 6-2). There was about a 6 percent increase in center line miles of interstate freeway and a 60 percent increase in average VMT in the period 1983-98. The capacity of the regional interstate system was also increased through additions of both general purpose and HOV lanes . However, lane mile data, the truest measure of roadway capacity, is available only for the 1990-98 period. In that period lane miles increased 5 percent compared to a 27 percent increase in average VMT. Unfortunately, these data do not distinguish between HOV and general purpose lanes.

Figure 6-1 Central Puget Sound Region Highway System
Source: PSRC 1995

Table 6-1 Size and Usage of State Roadway System in Region by Functional Classification, 1996

Functional classification	Centerline miles	VMT (millions)
Interstate highway	200	8.06
Principal arterial, including state highway	464	5.53
Minor arterial	391	0
Collector	2,187	0.2

Source: WSDOT 1998

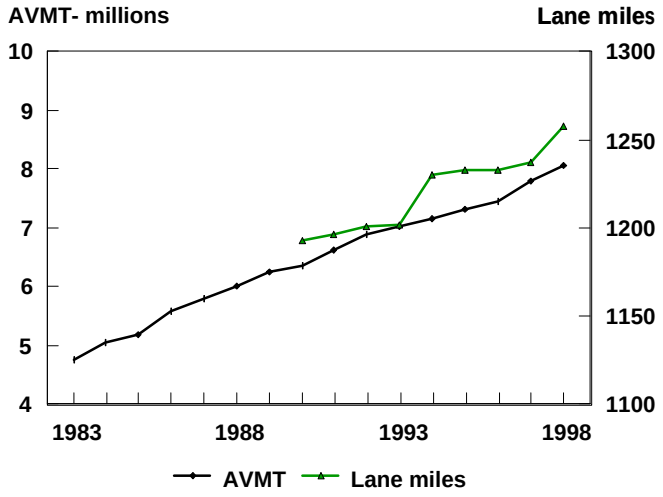


Figure 6-2 Expansion of the Regional Interstate System and Growth of Average VMT
Source: WSDOT 1983-98 & 2000

HOV Lane Network

The central Puget Sound region has one of the nation's most extensive freeway HOV lane networks (Table 6-2, Figure 6-3). Although the network, with buses providing express service, essentially constitutes a high capacity transit system, it is not organized as such. Several entities are involved in the construction and operation of the network. The state funds most of the lane construction and controls lane operation. The state patrol enforces the lane operating rules (vehicles with 2+ occupants, buses, motorcycles). Buses of three local transit agencies use the lanes throughout the day. Additionally Sound Transit, the regional agency, contracts with these

local agencies to provide express service to workplace destinations within the City of Seattle, principally the central business district and the University of Washington. Demand management incentives designed to increase the use of buses operating on the lanes are the responsibility of local transit agencies and private employers.

A "core" HOV lane network for the region has been designed as a key component of the Metropolitan Transportation Plan. When built out in 2005 as initially proposed, it will involve approximately 400 lane-miles stretching across the four counties. Approximately 50 percent of the network has been constructed.

Lanes are funded by state legislative appropriation in biennial budgets. With the passage of Initiative 695 which severely cut motor vehicle excise tax revenues, future appropriations and lane network completion are problematic. However, the Sound Transit budget contains funding for network improvements in the form of fly over ramps allowing transit vehicles to exit from the medium lanes without having to cross general purpose lanes.

Table 6-2 Central Puget Sound HOV Lane Network Statistics

Current lane miles	200 (approx.)
Build-out lane miles	400 (approx.)
Date of first segment opening	1972
Expected network completion date	2005

Transit System

All four counties have transit systems that operates bus and vanpool vehicles (Table 6-3). Three counties, Kitsap, King, and Pierce also operate demand response service. Snohomish County has a separate demand response service provided by a Senior agency. All operate commuter routes to some degree in adjoining counties. In addition, the City of Everett provides bus and demand response services. The state ferry system connects the Kitsap County with the other three counties. Pierce County and several private ferries also operate. And the landmark Seattle Monorail largely carries visitors within the city.

Figure 6-2 Regional HOV Lane Network
Source: PSRC

Table 6-3 Per Capita Ridership and Utilization Efficiency of Transit Systems

County	System	Modes	Service Area Population	Annual Unlinked Trips	Unlinked Trips per Capita	Average bus vehicle utilization (passengers per vehicle in revenue service)
Kitsap	Bremerton-Kitsap Transit	Bus Demand response Vanpool Ferryboat	229,400	5,495,805	24.0	12.8
Snohomish	Community Transit	Bus Vanpool	381,440	8,064,873	14.4	14.3
	Everett Transit	Bus Demand response	84,230	1,510,620	17.9	4.7
	Senior Services	Demand response	441,200	158,840	N/A	N/A.
King	METRO (King County)	Bus Trolley bus Demand response Vanpool	1,646,200	96,389,937	58.6	14.6 (12.7 trolley bus)
Pierce	Pierce Transit	Bus Demand response Vanpool	674,300	13,927,598	20.7	10.1

Source: FTA 1997

SYSTEM PERFORMANCE

Freeway/Arterial Loading and Congestion

Several measures of roadway utilization all confirm that many segments the region's freeways and major arterials are being loaded far beyond their designed capacity during significant periods of weekdays and on weekends. Regional performance measures include computer graphics techniques that can show color patterns of averged congestion on segments of the freeway system by time of day, real-time graphical displays of the same information, and modeling studies that are calibrated against measured roadway speeds. The region is also compared, and unfavorably so, against other 39 other medium to large metro areas in an ongoing national study of congestion and its time and monetary costs.

We present here just three data sets from a large body of information on the region's current freeway and arterial system performance. Table 6-4 shows baseline data for the derived from the MPO's modeling studies. Table 6-5 provides a summary of data derived from the national comparison study. Figure 6-4 presents the two-year growth in weekday volume by time of day at several measuring points on freeway general purpose and HOV lanes.

Table 6-4 Average Weekday Performance of the Freeway/Arterial System, 1995 Baseline for 1998 Modeling

Performance Indicator	Off Peak	AM Peak	PM Peak		24-hrs
Average speed (mph)	31.6	29.1	28.2		30.2
Hours of delay (thousands)	106.3	69.2	96.1		281.4
Percent of network congested	--	--	Freeways	20%	--
			Arterials	5%	

Source: PSRC 1998a

Table 6-5 Congestion Ranking for Region from National Metro Area Study, 1996

Index	Rank
Annual person-hours of delay	2
Travel speed	1
Annual total costs of congestion	11
Annual per capita costs	2
Composite congestion index	6

Source: TTI 1999

Figure 6-3 Highly Congested Segments of the Regional Roadway System
Source: PSRC 1998

Per Capita Transit Usage

Table 6-6 gives the average annual per capita rides (unlinked trips) for each of the systems. Per capita ridership needs to be compared with other systems to get a sense of the level of transit usage. For example, Boston residents used their system an average of 131 times per year in 1977. These numbers, of course, do not reveal the distribution of ridership across the population. In general, a relatively small segment of the population makes a great majority of all transit trips. Most citizens use transit very seldom or not at all.

Table 6-6 Utilization of Local Transit Systems, 1997

System	Average Annual Per Capita Rides *
Bremerton-Kitsap Transit	24
Community Transit (Snohomish County)	21
Everett Transit	18
METRO (King County)	59
Pierce Transit	23

* Unlinked trips per resident of service area
Source: Federal Transit Administration

Transit Capacity Utilization

Another measure of transit usage, essentially an efficiency measure, is the average number of riders on a vehicle in service or load factor. Utilization is dependent on routing and land use. Routes that connect suburban bedroom communities to central city employment centers will have highly unidirectional loading. Service equity also often dictates that low-density and low transit ridership areas be served, and that there is late night and week end service, so that the transit dependent are provided a reasonable level of mobility. This number also does not indicate the reality that vehicles on some routes at some times are filled to capacity, but it does suggest opportunity for accommodating more riders at very little additional cost. The average utilization rate is approximately 14 riders for the METRO system's bus fleet that averages about 53 seats per vehicles (Table 6-7).

Peak Period Load Factor

A potentially more useful measure of available capacity is the load factor in peak periods. Underutilized peak period capacity may offer a cost-effective way to address traffic congestion, if it can put to use with the application of targeted strategies. Although there has not been a systematic study of underutilized capacity and the opportunities its presents, we have some published data indicating that the existing transit system has a significant amount of available capacity. King County Metro reports that less than 3 percent of scheduled bus trips have load factors in excess of 90 percent (Metro 1995). About half of these occur on trolley routes entirely within the City of Seattle and on routes that serve a heavily congested urban center (the

University district) in the city. Perhaps the most significant fact is that during the PM peak period (3 to 6 pm), only 56 percent of the seats on buses leaving downtown Seattle are filled. Load factors are even lower on buses leaving the Bellevue CBD and the University District.

Table 6-7 King County METRO Transit Performance, 1997

Performance Indicator	Measure
Operating cost per passenger trip, bus	$2.97
Operating cost per passenger trip, trolley	$1.47
Operating cost per passenger trip, demand response	$21.50
Fares as fraction of operating costs	22%
Fares as fraction of total costs	16%
Average number riders per bus (53 seats)	14
Seat utilization, PM peak, from Seattle CBD	56%

Source: FTA 1997; METRO 1995

HOV Lane Utilization

The performance of the HOV lane network is annually monitored at specific locations (Ishimura and Hallenbeck 1999). Vehicle volumes and occupancy are measured for both private vehicles and buses. Lane throughput, in terms of persons and vehicles, can be compared to the adjacent general purpose lanes. Table 6-8 shows data collected in 1997 at a location on Interstate 5 north of Seattle for traffic moving southbound in the AM peak period. At this point, the freeway has one HOV lane and four general purpose lanes. Private vehicles containing two or more persons, motorcycles, and transit buses are allowed to use the lane. The HOV lane accounts for more than one-third of the person throughput and just 14 percent of the vehicle through put. On a lane to lane comparison, the HOV lane carries about four times the number of persons in the same number of vehicles.

Table 6-8 Example of HOV Lane Performance (I-5 SB at NE 137th Street During AM Peak Period)

Throughput Measure	Percent / Count	
	HOV Lane (1)	General Purpose Lane (4)
Persons	37%	63%
Vehicles	14%	86%
Persons / Lane	12,515	5,309
Vehicles / Lane	3,273	5,020

Source: Brown 1999

Most of the persons are carried on buses heading for central city work destinations including the University of Washington and the central business district. Estimates of average transit vehicle occupancy (AVO) indicate that the lanes could carry significantly more transit riders during peak

periods in the same number of existing buses and without requiring a change in the rules of vehicle occupancy (Table 6-9). Buses currently operating on HOV lanes having a seated capacity in the range 41 to 72 seats. At only one point and time, Albro Place on I-5 in the morning commute, does AVO approach the higher seated capacity.

Table 6-9 Average Transit Vehicle Occupancy at Monitoring Points on the HOV Lane Network

Weekday Time Period/Network Location	Estimated Transit AVO
AM Peak Period	
I-5 SB @ 112th SE	20
I-5 SB @ NE 137th St.	34
I-5 NB @ Albro Place	70
I-405 SB @ NE 85th St.	28
I-90 WB @ Floating bridge midspan	45
I-90 WB @ Newport Way	5
SR 520 WB @ 84th Ave. NE	29
SR 167 NB @ S 208th St	6
PM Peak Period	
I-5 NB @ NE 137th St.	36
I-5 SB @ Albro Place	38
I-90 EB @ Floating bridge midspan	22
SR 520 WB @ 84th Ave. NE	9

Source: Nee 2000

METROPOLITAN TRANSPORTATION PLAN

The Metropolitan Transportation Plan is the transportation element of the regional growth management strategy, VISION 2020. Adopted in 1995 by the Puget Sound Regional Council, it was amended in 1996, and is scheduled to be updated in 2001. Progress in the plan's implementation was documented in a report issued in 1998 (PSRC 1998a). Of central interest is the plan's impact on transportation system performance.

1995 Plan

The major elements of the adopted plan are shown in Table 6-10. The total capital cost of the plan was estimated to be $11.5 billion when completed. The rail elements, light rail and commuter rail, were estimated to cost $7 billion and $500 million respectively.

Table 6-10 Major Elements of the 1995 Metropolitan Transportation Plan

Light rail	124 miles (up to 65 stations)
Commuter rail	40 miles (up to 10 stations)
Regional express bus	interim until replaced by rail
Local bus	expanded feeder
HOV lane network	384 new lane miles
Park & ride	38,000 new stalls
Growth policy	some growth channeled to 21 centers
TDM	transit subsidies, SOV parking charges, etc.

Source: PSRC 1995a

Forecasted System Performance

Estimates of the impacts of TOD in the central Puget Sound region for several alternative redevelopment and transportation infrastructure improvement scenarios have been made using the regional travel demand model and interactive simulation (PSRC 1995a & 1998a). The major benefit of the policies is increased mode share for work trips by transit. However, as VMT continues to grow more rapidly than population, the modeling suggests that driving conditions on the freeway/arterial network will continue to deteriorate. Only a small amount of additional traffic will cause considerably more congestion.

The results of applying the regional model to estimate roadway system performance under the plan in the year 2020, the planning horizon, are summarized in Table 6-11. Performance is given in both absolute numbers and percentage increases relative to the base year. Forecasted mode choice for work, nonwork, and all trips has also been estimated as indicated in Table 6-12.

Both of these tables show the results of an update that was produced in May 1998 (PSRC 1998a). The new estimates indicate a large shift toward lower levels of performance, as measured by congestion and transit mode share. The new congestion figures indicate that growth in daily hours of delay will be considerably higher than previously predicted for the off peak and AM peak periods, and less than predicted in the PM peak. The 1998 forecast suggests that a large part of trip growth will occur in off peak hours, and that congestion will not spread as much in the network.

Transit share for all motorized trips was originally estimated at 5.9%. The 1998 forecast reduced it to 4.5%. This compares to 4.0% in 1990, the base year for the 30-year plan. So instead of a 48% increase, transit mode share is now predicted to rise 13% by 2020. This is the result of spending $13 billion to complete the 125-mile light rail system, the 81-mile commuter rail system, and the trunk bus routes, as well as HOV lane network. TDM and land use strategies in

Table 6-11 Estimated Freeway/Arterial System Performance with the MTP

Performance Indicator	1990 Base Year	2020 (1995 Forecast)	1995 Base Year	2020 (1998 Forecast)	Change 1990-2020 (1995 Forecast)*	Change 1995-2020 (1998 Forecast)*
Daily Vehicle Miles Traveled (millions)	63.4	99.9	65.7	103.8	+57.6%	+63.7%
Off peak	30.9	49.0	32.5	60.7	+58.6%	+96.4%
AM peak	12.3	19.8	13.1	18.9	+61.0%	+53.7%
PM peak	20.2	31.1	201.1	24.2	+54.0%	+19.8%
Average speed (mph)						
Off peak	30.8	29.3	31.8	27.7	-4.9%	-10.1%
AM peak	29.6	27.1	30.1	25.7	-8.4%	-13.2%
PM peak	26.2	21.6	26.9	23.4	-17.6%	-10.7%
Hours of delay (thousands)						
Off peak	25.3	81.3	23.2	287.6	+221%(+350%)	+1037%(+397%)
AM peak	38.1	98.9	35.3	149.4	+160%(+280%)	+292%(+340%)
PM peak	150.0	431.0	120	251.3	+187%(+367%)	+67%(357%)
Daily total	213.4	611.2	178.5	688.3	+186%	+223%
Total vehicle hours of travel (thousands)	2,040.0	3,840.0	2,200	3,630	+88.0%	+77.9%
Percent of travel hours lost to delay	10.5	15.9	8.1	19.0	+51.4%	+81.0%
Percent of network experiencing congestion						
Freeways	27.2	47.3	28.4	31.5	+73.9%	+15.8%
Arterials	8.1	21.8	8.0	8.2	+169.1%	+1.2%
Overall	12.0	23.0	9.9	10.8	+91.7%	-10.0%
Regional Population	*2,749,000*	*4,133,000*	*3,030,000*	*4,263,000*	*+50.3%*	*+55.0%*

Sources: PSRC 1995a and 1998a

*Numbers in brackets were published; number not in brackets were calculated from data supplied to authors by PSRC.

Table 6-12 Estimated Daily Person Trips and Vehicle Mode Choice (Percent) for the MTP

Mode	1990 (Base Year)		2020 (1995 Forecast)		1995 (Base Year)		2020 (1998 Forecast)	
	Person Trips (millions)	% Mode Choice	Person Trips (millions)	% Mode Choice	Person Trips (millions)	% Mode Choice	Person Trips (millions)	% Mode Choice
Nonwork trips	7.00		11.47		7.53		11.64	
SOV	4.30	61.4	5.43	47.3	4.52	60.0	6.62	56.9
Carpool	2.53	36.1	5.63	49.1	2.90	38.5	4.69	40.3
Transit	0.18	2.5	0.41	3.6	0.11	1.5	0.33	2.8
Work trips	1.96		3.13		2.13		3.18	
SOV	1.42	72.8	2.22	71.1	1.57	73.7	2.07	65.3
Carpool	0.39	19.7	0.54	17.3	0.41	19.3	0.76	23.8
Transit	0.15	7.5	0.36	11.6	0.15	7.0	0.35	10.9
All trips	8.96		14.60		9.65		14.81	
SOV	6.06	67.7	8.45	57.9	6.09	63.1	8.69	58.7
Carpool	2.53	28.3	5.28	36.2	3.31	34.3	5.45	36.8
Transit	0.36	4.0	0.86	5.9	0.26	2.7	0.67	4.5

Sources: PSRC 1995a and 1998a

the MTP also contribute to transit ridership. Neither document breaks out the effect of the separate actions. However, the EIS for the Regional Transit Project of 1994 estimated that half of the new transit riders could be attributed to the additional express bus service and HOV lane improvements.

The new estimates are the result of "new data and new methodologies." How much each accounts for was not indicated in the update document. The PSRC relies on a set of data sources as inputs to its models: the travel panel now in its eighth wave (survey year); transit system ridership; traffic counts by the state and local jurisdictions; and actual land development patterns. New trends observed in these sources may have contributed to the revised predictions.

Note that two sets of numbers are given for the percent increase in hours of delay. The MPO's earlier published data were different than that given to the authors. Note also that when estimates with different base years are compared, inconsistencies appear, e.g., the apparent decrease in the portion of the network experiencing congestion.

STARTER RAIL SYSTEM

In November 1996, voters of the region approved a plan to build a 25-mile "starter" light-rail system. The $2.5 billion system is the center piece of a larger high-capacity transit plan that will also provide commuter rail service on 74 miles of existing track from Tacoma to Everett, make improvements to the regional HOV lane network, and operate a number of long-haul bus routes. This plan, to cost approximately $4 billion over 10 years, is funded by incremental increases in the sales tax and the motor vehicle excise tax.

Prior to the vote, two separate cost-benefit analyses were conducted. One was done independently and peer-reviewed by a national panel of transportation economists. This analysis used both independent assumptions and transit agency assumptions. The other was done by a local consulting firm for the regional transit agency, the Central Puget Sound Regional Transit Authority (Sound Transit). The results are shown in Table 6-13 .

Table 6-13 Comparison of Benefit-Cost Analyses of Regional Transit Plan: Net Benefit (Cost) Over 30 Years

Independent Analysis*		**Transit Agency Analysis****
Independent assumptions	With transit agency assumptions	With transit agency assumptions
($2.5 billion)	($985 million)	$1 billion

* ECONorthwest 1996; ** Porter & Associates 1996

The expected performance of the light rail system has been modeled (Sound Transit 1999). Table 6-14 shows two measures of the impact of the system on vehicular travel after the system has

been in operation four years. The number of daily boardings is estimated as 133,000. There is no documentation of the portion of these that will be former bus riders.

Table 6-14 Estimated Impact of Light Rail Transit on Performance of Regional Transportation System*

Measure	1995 Base Year	2010 No-Build	2010 LRT	LRT Impact
Daily Vehicle Miles Traveled (VMT)	68.00 million	68.24 million	68.06 million	0.26%
Daily Vehicle Hours Traveled (VHT)	1.88 million	2.30 million	2.29 million	0.43%

* Assumes North terminus at Northgate, at additional segment cost of up to $460 million.
Source: Sound Transit 1999

TRANSPORTATION'S AIR QUALITY IMPACTS

Air quality has been an important transportation-related issue in the region. However, recent modeling suggests that all gaseous emissions will decrease in absolute quantities through the year 2010, and on-road sources will stay even with or decline relative to other sources (Table 6-15). This reflects continuing improvements in vehicle pollution control technology and fuels that will offset growth in population and travel. Pollutant air emission impacts of the LRT system are compared to the 1995 base year and the 2010 no-build alternative in Table 6-16.

Table 6-15 Estimated Pollutant Emission Trends by Source, Tons/Day and (Percent)

Source	CO		VOC		NO_x	
	1995	2010	1995	2010	1995	2010
On-road	1290 (68)	1253 (68)	222 (28)	159 (22)	266 (68)	218 (61)
Non-road	211 (11)	198 (11)	136 (17)	132 (18)	81 (21)	98 (27)
Stationary area	317 (17)	3220 (18)	119 (15)	134 (18)	20 (5)	18 (5)
Point	62 (3)	62 (3)	20 (3)	20 (3)	24 (6)	24 (7)
Biogenic	--	--	291 (37)	291 (39)	--	--
Totals	1879 (100)	1833 (100)	788 (100)	737 (100)	391 (100)	357 (100)

Source: PSRC 1998b

Table 6-16 Impact of Light Rail on Pollutant Emissions, Metric Tons/Day

Emission	1995 Base Year	2010 No-Build	2010 LRT	Impact of LRT Compared to No-Build
CO	1,454.1	1,094.6	1,091.8	-0.26%
VOC	150.3	117.4	117.1	-0.26%
NO_x	180.1	150.3	149.9	-0.27%

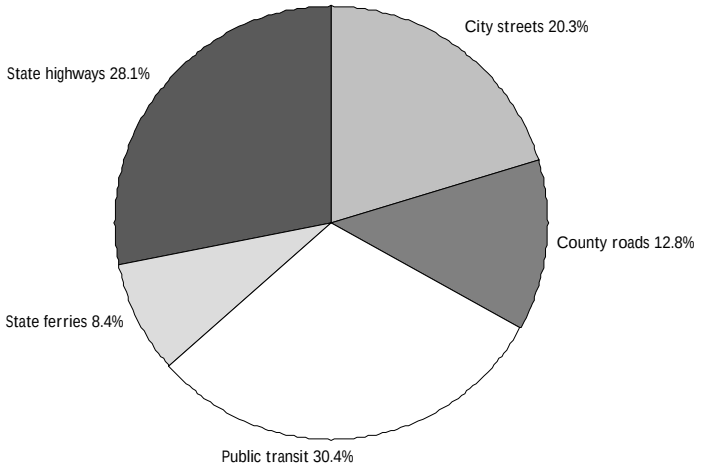
Source: Sound Transit 1999

FINANCING MTP IMPROVEMENTS

The 1995 MTP identified the costs for maintaining and improving the region's transportation system, and it compared these costs to available revenues. The financial element was updated in 1998 (PSRC 1998b) to reflect passage of the funding for the regional high-capacity system, new economic forecasts, and new information on needs. Although it is based on current law revenues, it does not include the effect of Initiative 695 enacted in November 1999 which drastically cut the state motor vehicle excess tax that funds highway programs, state ferries, and transit services.

Figure 6-5 shows the percentage share of total expenditures for each of the five principal transportation programs averaged over the period 1989-1996. All expenditures, including operating and capital costs, are included. A total of $1.7 billion (in nominal dollars) was spent in 1996. A significant shortfall in revenue, $16 billion or 24%, needed to improve the principal parts of the regional system--city streets, county roads, public transit, state ferries, and state highways--is predicted (Table 6-17). The 2001 MTP is expected to contain a financial analysis of the cost to meet travel demand by increasing capacity or managing demand (PSRC 1999).

Figure 6-5 Transportation Expenditures by Program Area, 1989-1996



Source: PSRC 1998c

Table 6-17 Regional Financial Capacity to Fund the MTP (Billions of 1998 dollars)

Program area	MTP Current Commitments	MTP Full Needs	Current-Law Revenues	Revenue Shortfall
City streets	12.5	12.5	9.4	3.1
County roads	6.9	8.1	6.6	1.5
Public transit	27.8	27.8	22.9	4.9
State ferries	5.1	5.1	3.9	1.2
State highways	7.8	12.4	7.3	5.1
Total	60.1	65.9	50.1	15.8

Source: PSRC 1998c

CHAPTER SEVEN

LAND USE/TOD PLANNING

INTRODUCTION

The central Puget Sound region has embarked on an effort to manage growth and reduce its impacts. Efforts were actually underway in King County before the state legislature required all rapidly growing counties in the state to plan for growth and to link land use and transportation planning. This chapter reviews the state requirements, the regional growth and transportation strategy, and local growth planning focusing on the City of Seattle's comprehensive plan.

REQUIREMENTS OF THE STATE GROWTH MANAGEMENT ACT

The Washington State Growth Management Act (GMA), adopted in 1990 and subsequently amended several times, directs counties and cities in the fast growth areas of the state to write comprehensive plans to manage growth using a 20-year planning horizon. Plans must contain several elements and meet criteria specified in state law. Major aspects of the law are indicated in Table 7-1. A separate but related provision allows local jurisdictions to charge impact fees to cover the public costs of new development, including the costs of roadways and transit service.

REGIONAL TRANSPORTATION PLANNING

Another state law specifically addressing transportation planning in the central Puget Sound region was adopted concomitantly with the GMA. The statute requires coordinated transportation planning and is linked to elements of the GMA. It's major provisions are shown in Table 7-2. The Metropolitan Transportation Plan (MTP) was described in Chapter Six.

REGIONAL GROWTH STRATEGY

Efforts to apply new urbanism principles by creating compact and transit-oriented and mixed-use development involve the designation of urban centers and their linkage by a high quality regional transportation system.

Urban Centers

The regional growth and transportation strategy, VISION 2020, calls for a range of types and sizes of "urban centers", described as "places with a dense mix of business, commercial, residential, and cultural activity within a compact area of up to 1.5 square miles" (PSRC 1990a, 1990b, & 1995b). The 21

designated urban centers include the Seattle central business district, 4 other centers in Seattle, and, 16 centers outside Seattle (Figure 7-1). Planners expect these 21 centers to accommodate 16 percent of the growth in regional population and 30 percent of the regional growth in employment to the year 2020.

Table 7-1 Key Provisions of the Washington State Growth Management Act (GMA)

Element	Description
Planning schedule	Twenty-year horizon; 5-year updates beginning in 2002.
Sensitive areas protection	County must designate and protect (zone/regulate development on) agricultural lands, forest lands, mineral resource lands, and critical areas including wetlands.
Urban growth areas	County must draw boundary outside of which only non urban development is permitted. Each city in county must also have a UGB. Growth areas must be no larger than needed to accommodate 20 years of predicted growth at higher densities assumed under the plan.
Density	Plans must specify the distribution and density of future development, including housing to meet different needs and incomes.
Rural development	Development is allowed outside of the UGA in several special circumstances: clustered residential development; several low-density zoning categories; and planned communities (see below).
Coordination	Plans must be coordinated and consistent across county boundaries or in any case of shared interest regarding a regional issue. Local plans for capital facilities must be coordinated and consistent with expected development.
Concurrency	Local government regulations must prohibit transportation development below LOS standards unless roadway improvements and/or TDM strategies are in place or initiated concurrently with the start of development. TDM includes transit, ride-sharing, and TSM.
Transportation and land use linkage	Land use assumptions must be used in forecasting travel, and forecasts must assist location and timing decisions for added roadway and transit capacity.
New fully-contained communities	County may authorize development outside UGA if previsions are made for transit-oriented site planning, TDM, and mix of uses.

Source: Revised Code of Washington (RCW 36.70A)

Table 7-2 Major Provisions of the Regional Transportation Planning Act

Provision	Description
Planning authority	The regional transportation planning organization (RTP) is the same as the metropolitan planning organization (MPO) designated for federal planning purposes.
Strategy	RTP prepares and periodically updates a transportation strategy for region, including preferred policies.
Plan / consistency	Prepared by the RTP, a 6-year plan must be consistent with county and city policies and plans, and with state transportation plan. It must be based on a least-cost planning methodology that identifies the most cost-effective strategies, and it must make the most efficient use of existing facilities to relieve congestion.
Coordination	All local transportation projects and TDM programs that have regional impact must be consistent with the regional plan and with the adopted growth and transportation strategy.
Guidelines for local comprehensive plans	Local plans must address relationship of transportation system to a number of factors including residential density and urban design that supports high-capacity transit.

Source: Revised Code of Washington RCW 47.80

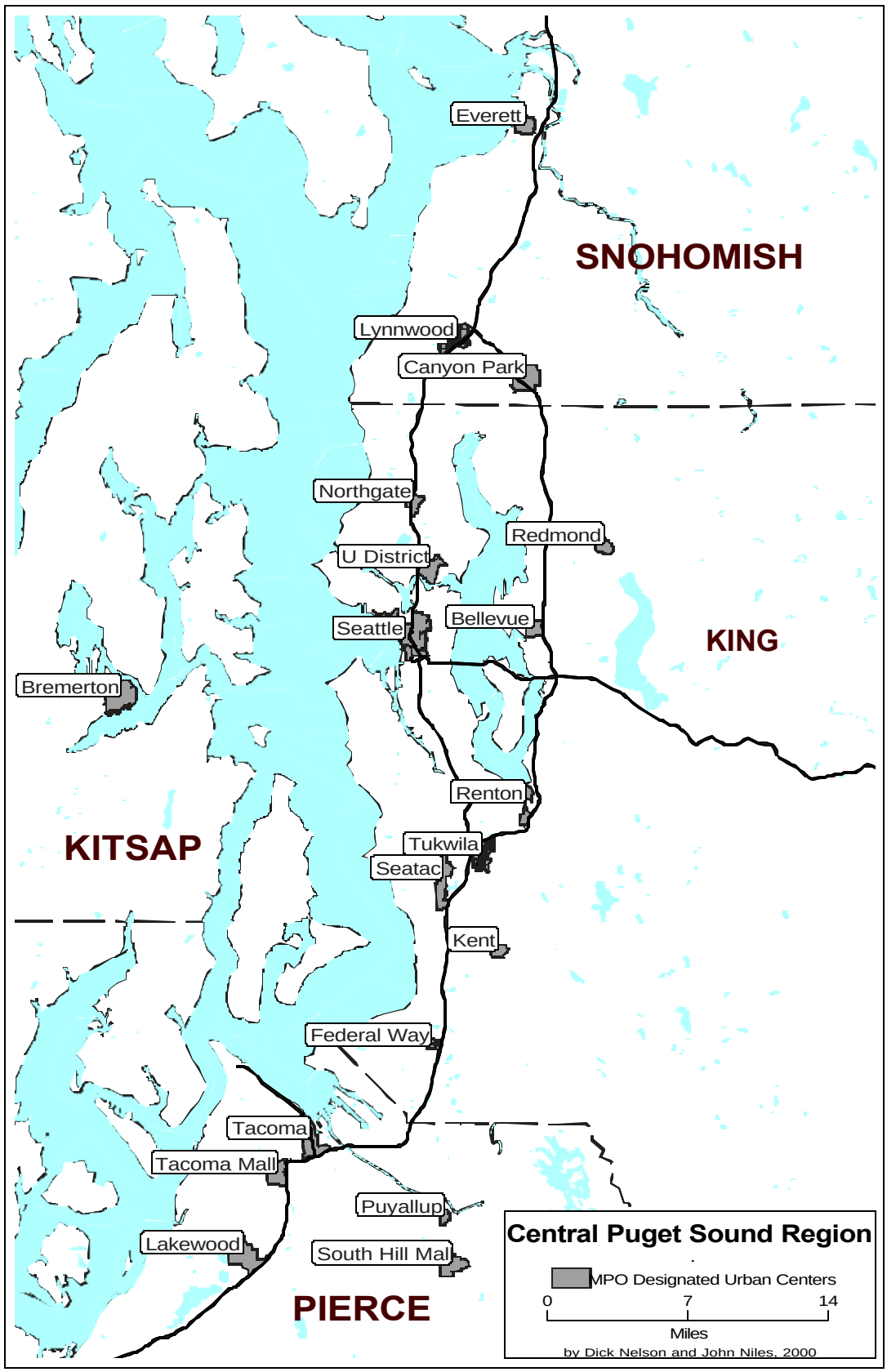


Figure 7-1 Designated Urban Centers
Source: PSRC 1996

Linkage of Centers/TOD

Under the regional plan, the 21 mixed-use centers, designated "urban centers", are to be connected by a new regional rapid transit system now being developed (PSRC 1995b). Highway improvements, principally completion of the regional HOV lane network, would be made. Local jurisdictions are encouraged to identify smaller "town centers" for pedestrian and transit-oriented development and redevelopment (PSRC 1995b).

The specific TOD policies of King County and the City of Seattle are shown in Table 7-3. The City of Seattle's transportation plan includes a strategy that would support development of "full service" neighborhood business districts in "urban villages" (Seattle 1998). Under the proposed plan, the city government would assist business associations to identify gaps in the provision of basic goods and services in neighborhood business districts. The idea is to promote shopping within neighborhoods by offering "a full range of products and services to meet people's day-to-day needs." Seattle's designated urban villages are shown in Figure 7-2.

Table 7-3 Regional TOD Planning Requirements and Seattle's Implementation Strategy

Puget Sound Regional Council VISION 2020 Update - May 1995
Urban Centers. The VISION 2020 strategy is to reinforce and diversify our existing urban centers...to build an environment that will attract residents and businesses to the advantages it offers. These advantages include excellent access to frequent and fast transit that connects to other centers and to surrounding neighborhoods, a selection of attractive and well-designed residences, and proximity to a diverse collection of services, shopping, recreation and jobs.
City of Seattle Transportation Strategic Plan - October 1998
Support Development of "Full Service" Neighborhood Business Districts. This strategy promotes shopping within neighborhoods by helping Seattle's urban villages to offer a full range of products and services to meet people's day-to-day needs.

Urban Center Land Use Predictions

Planning for the urban centers involved subjective judgments as to the amount of new growth that the centers will accommodate to the planning horizon. Table 7-4 shows these estimates for jobs, including retail jobs, population, and households. It can be seen that the assumptions are in effect conservative, in other words planners believe that the centers will not serve as magnets to concentrate population and employment.

Figure 7-2 Seattle's Urban Villages
Source: City of Seattle

Table 7-4 Estimated Land Use in Designated Urban Centers

In the Urban Centers:	1990 Baseline	2020 Baseline	Vision 2020 w/TOD
Fraction of jobs	34.5%	34.5%	34.7%
Fraction of retail jobs	33.4%	33.4%	32.3%
Fraction of population	11.3%	11.3%	13.4%
Fraction of households	12.6%	12.6%	15.6%

Source: Estimated by authors from PSRC data

CHAPTER EIGHT

CURRENT PLANNING TOOLS

INTRODUCTION

The current central Puget Sound regional planning process encompasses a number of tools and reporting mechanisms that collectively provide a picture of how and where government planners are trying to influence growth and transportation.

In summary of Chapters 6 and 7, the main focus of regional planning is on influencing the locations of new residential housing and of new job sites to be within urban growth areas, and on causing as much of the new housing and job growth as possible in 21 designated places called urban centers that are the main hubs of the metropolitan transportation system. The transportation focus is on serving the journey to work.

An inspection of reports published in the second half of the 1990s by the regional planning agency and local governments provide a picture of how the implementation of regional transportation plans is progressing. The most important of these are:

- 1998 Metropolitan Transportation Plan (MTP) Progress Report.
- An overview of progress in managing regional growth.
- Preliminary plans to update the MTP in 2001.
- The regional Congestion Management System.
- Several local government monitoring efforts.
- Several additional planning processes initiated by concerned citizens.

We next review each of these in turn, highlighting particular sections that seem to bear most directly on the issues of change and uncertainty, and how they have and have not been addressed by the planning process. We also emphasize some apparent inconsistencies in transportation system performance estimates produced for the MTP.

METROPOLITAN TRANSPORTATION PLAN 1998 PROGRESS REPORT

The 1998 Progress Report for the MTP (PSRC, 1998a) provides an "assessment of the region's progress toward implementing the policies, programs, and projects identified in the 1995 MTP." It includes updated socioeconomic, travel demand, and air quality forecast data.

This report is full of significant, revealing observations, and suggests that a significant revision in the substance of the 1995 MTP is warranted, as well as showing a need for revisions in the process and tools for creating a plan.

PSRC Model and Forecasts Changed

As described in an Chapter 6, the PSRC's transportation model has produced dramatically different results in 1995 and 1998 for the forecast market share of transit in the year 2020. A 48% growth in transit market share for 2020, from 4.0 to 5.9, was revised significantly downward to a growth of just 13%.

The Progress Report also points to revised model outputs showing a sharp rise in off-peak Vehicle Miles Traveled (VMT) in the revised 2020 forecast, from 49 million VMT per day, to 61 million. The daily hours per day in the off peak rise enormously from 81 thousand hours per day to 288 thousand. This is a result of a shift in the model's simulation of the present day. The 1998 version of the model shifts some of the baseline congestion from PM peak to the AM peak and the off-peak.

These shifts are partially explained by the following statement on page 8 of the Progress Report:

Forecasting is a discipline that continually changes based on new technology, new methodologies, and new data pertaining to any of the numerous variables use in the models. The 1998 updated travel forecasts were driven both by new data and by methodology changes that help maintain the Regional Council's state-of-the-art modeling capabilities.

Despite the enormous differences between the transit market share forecasts in 1995 and 1998, the Regional Council affirms the soundness of the 1995 MTP in a summary statement in the Progress Report (page 9), as follows:

The differences between the two forecasts clearly indicate that the overall programs and strategies identified in the MTP do not need to be changed.

On page 9 of the Progress Report, the 2020 transit forecasts made in the 1995 MTP and revised in 1998 are described as comparable in terms of a positive direction, for example, "on average, increased use of carpools and transit." But there is no reference made to the amount of change in the respective forecasts from a baseline starting point, for example a statement like, "while we formerly calculated that transit market share would move from 4.0 to 5.9, we now forecast that the change will be from 4.0 to 4.5, which like before, is a positive change for the better."

Furthermore, as the future evolves year-by-year into the reality of the present, there is another issue: no monitoring of transit performance is in place. The Progress Report on page 30 states:

Transit will play an enormous role in achieving long term regional objectives. However, there is currently no formal method to monitor transit's regionwide contribution toward regional objectives and goals.

And the 1998 revisions of the mode share forecasts reveal still another issue: A comparison of the revised person trip mode shares in the 1998 MTP Progress Report with the original mode shares reported in the 1995 MTP suggests that the 1995 calculations are internally inconsistent. The PSRC transportation model puts person trips into one of three modes (transit, carpool, and SOV) and classifies all trips as either work or nonwork. The relationship between the all trips mode share (A), the work trips mode share (W), the nonwork trips mode share (N), and the fraction of nonwork trips (f) must be A=fN+-(1-f)W; in other words, the all trips share of any mode is the weighted average of the two components, the corresponding mode share for work trips and for nonwork trips (Table 8-1).

Table 8-1 Calculation of Nonwork Trip Fraction From Person Trip Mode Shares as Forecast by PSRC

	1995 Forecast MTP 2020	1998 Forecast MTP 2020
Transit		
• Work Trips	11.6	10.9
• Nonwork Trips	3.6	2.8
• All Trips	5.9	4.5
✓ ***First calculation of nonwork trip fraction***	***0.71***	***0.79***
Single Occupant Vehicle		
• Work Trips	71.1	65.3
• Nonwork Trips	47.3	56.9
• All Trips	57.9	58.7
✓ ***Second calculation of nonwork trip fraction***	***0.55***	***0.79***
Carpool		
• Work Trips	17.3	23.8
• Nonwork Trips	49.1	40.3
• All Trips	36.2	36.8
✓ ***Third calculation of nonwork trip fraction***	***0.59***	***0.79***

Source: PSRC 1998a, Exhibit 3

As shown in the second column of the table above, this relationship holds in the revised 1998 MTP 2020 forecast displayed in the MTP Progress Report, Exhibit 3, with f=0.79 the same across all three modes, as it should be.

However, as seen in column 1 of the table above, when using the mode share numbers in the 1995 forecast of MTP 2020 in the same published exhibit, a calculation using the formula above to solve for the nonwork trip fraction f reveals an inconsistency in the value of f between the different modes. Calculations of the weighted average formula using the transit mode shares imply f=0.71, the SOV mode shares imply f=0.55, and the carpool mode shares imply that f=0.59. The value of f should not be different when calculated for the different modes across a single strategy or forecast.

A return to the 1995 MTP document from PSRC (PSRC 1995) and an examination of all of the mode shares for the models of Current Conditions, the 2020 Trend, and the 2020 Optimum Performance Strategy reveals this same problem of internal inconsistency in what should be a stable relationship to a single value of the nonwork person trip fraction f. In the numbers that are published in Table 5 of the 1995 MTP, the nonwork trip fraction we calculate varies from 0.23 to 0.75 depending on which system performance result and which mode.

This earlier internal inconsistency in the person trip mode shares revealed in the 1998 Progress Report suggests a need for future modeling results to be closely examined in all respects.

The Concept of "Balance"

On page 4, the 1988 Progress Report explains:

The perceived and real costs of driving and parking a private vehicle are viewed as reasonable in relation to the convenience, time savings, and comfort afforded. As a result, even though people know they will have to contend with congestion, they still choose to drive alone, adding to the throngs that already strain the region's roadways beyond their serviceable capacity for several hours each day.

Whatever the causes, the one undeniable fact is that the region has, for some time, been unable to balance supply and demand for transportation services. The key to making things better will lie in the region's ability to provide this balance in a manner that also gives people and businesses adequate mobility, access and choices.

So here, balance has dual meaning:

- lack of capacity for vehicles on the road, as in balance of supply and demand.
- need to provide alternatives to the SOV, as in balanced multi-modal system.

These uses of "balance" are subject to alternative interpretation. In the first case, some traffic analysts would contend that congestion is how supply and demand is balanced in the road network. For example, when too many vehicles crowd onto a bridge, some drivers have to wait for road space to open up. PSRC takes this point of view on page 31 of the Progress Report document when unmet state ferry demand is described as "meaning more delays."

In the second case -- balance as providing choices -- there is an arguable misuse of "balance" in the government constructing expensive new modal alternatives yielding ridership performance that is not "in balance" with the cost.

Still another issue of "balance" is between the four components of the MTP, stated on page 21 of the Progress Report to be: System Management; Demand Management; Capacity Expansion; and Growth Management. Is the spending "balanced" among these four approaches, as judged by the resource input to each, and the performance output that one might reasonably expect from each? In fact, the Progress Report does not provide an analysis of spending across these four categories, but we would understand from the words in the report that effort and spending are not reasonably divided among the four.

For example, Intelligent Transportation System (ITS) initiatives are included in Transportation System Management component. Spending on the Smart Trek Model Deployment Initiative for ITS is mentioned -- $13.7 million. Earlier, 1998-2020 spending for local roads is listed at $21 billion; public transit, $28 billion; ferries and state highways, $17 billion. Is ITS spending in "balance" with other spending?

Actually, the traffic management and transit enhancement parts of ITS could be considered to be a part of Capacity Expansion. Looking at the millions of dollars spent on ITS for capacity expansion versus the billions of dollars on roads, transit, and ferries for capacity expansion heightens the issue of balance vis a vis ITS spending even further.

Another example: Turning explicitly to Demand Management, the Progress Report candidly states on page 29,

The funding for demand management programs is vastly inadequate compared to the results expected from it. Some plans assume a vehicle-travel reduction of 20(+) percent as a result of transportation demand management.

A final issue of "balance" pertinent to our focus on nonwork travel improvement is mentioned on page 29:

The overwhelming majority of the region's Transportation Demand Management strategies address only the work trip. ... The nonwork trip is much more difficult to serve with TDM strategies, but it will be essential to develop the programs to do so.

Dispersion of Retail Locations

The issue of market-driven dispersion of shopping and consumer service locations is clearly alluded to, but not addressed in detail. On page 6, the Progress Report notes:

...the region's existing urban form predates growth management planning and will be with us for a long time. These preexisting patterns will continue to dominate as new development techniques and strategies are employed. The emphasis on redevelopment and infill development that is prevalent in so many local growth management plans is among the most challenging type of development to accomplish. Moreover, the preexisting urban form, with its assumption of automobile access, frustrates efforts to develop new travel options. A "catch-22" situation exists since the lack of travel alternatives ultimately reinforces the use of automobiles. Development in our region is also increasingly affected by national and even global economics. Trends toward "big-box" retail shopping and "just-in-time" freight movement are two examples of economic influences from outside the region that affect local land use.

GROWTH MANAGEMENT REVIEW

The 1998 Regional Review (PSRC, 1998e) is subtitled, "Monitoring Change in the Central Puget Sound Region." This is the second version of what is to be a series, and this is the most recent as of January, 2000. The report is designed to track "patterns and progress" in meeting the objectives of the statewide Growth Management Act and the regional Vision 2020. The report covers population, jobs, housing, transportation measures, and income, and also indicators of how well policy is working, such as the location of building permits and the status of boundary changes as municipalities are formed or expand their borders. It summarizes data through 1997.

The report provides a series of maps produced with the Regional Council's regional geographic information system (GIS). This is a computer program that maintains databases (files) of geographic characteristics for the four-county region, and allows additional descriptive data associated with these characteristics to be maintained in an organized fashion. For example, the boundaries of the various local government jurisdictions are maintained in this system, and attributes such as population, employment, and number of new housing permits can be associated with each jurisdiction or census tract. Most importantly, the regional GIS permits detailed maps to be made and presented as part of planning documents like the Regional Review.

Land Use Patterns

One important set of attributes in the GIS is the adopted land uses in the comprehensive plans for all jurisdictions in the region. These adopted land uses amount to official plans for the kinds of development that will be allowed or encouraged within the Region over the next 20 years. The commercial and mixed use zoning in the region, shown in Figure 3-3, and the 1998 housing permits, shown in Figure 4-3, are maps we prepared with data from the Regional Council's GIS.

The picture provided in the Regional Review is one of continuing dispersion of residential growth. The summary notes:

While King County has managed to limit [residential] building permits outside of the UGA to 8 percent in 1996 and 1997, both Kitsap and Pierce counties show more permits outside of the UGA in 1997 than 1996, and these permits total between one third and one half of all permits issued.

Preliminary analysis of a sample of 1998 housing permit data collected by PSRC and provided to us indicates that 20 percent of housing units permitted in 1998 were outside the UGA, which would maintain the same rate seen in the Regional Review. The number of units in the four county region represented by this 20 percent is 5,648, which is close to the number reported graphically in the Regional Review for 1997 (PSRC 1997b).

The report does not cover the location of retail or other commercial development.

The report's general conclusion is that the "for the most part, the data are inconclusive" about whether GMA and Vision 2020 are successful in managing growth.

Transportation Trends

Pages 17-20 of the report cover transportation. The specific points made are these:

- Licensed vehicles and licensed drivers are growing faster than population.
- The proportion of work-related trips, now 18.5%, is shrinking over time.
- The highest proportion of all vehicle trips are on the urban portions of the interstate freeways like I-5, I-90, and I-405.
- The VMT growth rate has slowed and is now tracking with population/employment growth instead of growing faster. This essentially means that there is one car for every driver in the region.
- Per capita transit use grew from 1980-1997, but relationship to the number of trips is not explained, and the market share of transit is not covered.
- Cross-Sound ferry usage is growing dramatically.
- Congestion is increasing in the morning and afternoon peak periods, and the peak periods are lengthening in duration.

This document should be studied by members of the NWTIP Planning Team, especially for its many informative maps.

2001 MTP UPDATE

Beginning mid-1999, the PSRC has been underway on preparing an updated, revised version of the Metropolitan Transportation Plan to be published in 2001. The 2001 MTP will have updated data and

a time horizon that extends out to the year 2030, ten years beyond the 2020 horizon of MTP 1995. The following information on the MTP update is from two publications, "Where Will We Want to Go Tomorrow?" an undated information piece from PSRC distributed in late 1999 (PSRC 1999c), and the January, 2000 PSRC newsletter (PSRC 2000).

The 2001 MTP is driven by forecasts of continuing growth in population, from 3.2 million in 2000, to 4.7 million in 2030. Another driver of reconsideration in the plan is said to be an updated official forecast that carbon monoxide levels from automobile emissions will increase starting in 2010, and exceed existing federal standards some time after the year 2020

The PSRC Transportation and Growth Management policy boards are reported by the PSRC as providing the following guidance on the preparation of the new MTP:

- *The updated MTP should be clearer than the 1995 plan regarding specifics, how the various components of the plan would be implemented over time, and what different funding and phasing scenarios buy in terms of congestion relief, air quality and other measures.*

- *The environmental review must consider increased road capacity within the Urban Growth Area. The analysis should include capacity needs, costs and performance measures.*

- *The alternatives considered must examine total travel demand and analyze how that demand may be met by increasing capacity and/or managing demand.*

- *The long-range vision of the MTP must be broad and clear. The vision should not be narrowly focused on fiscally constrained plan. The MTP must also clearly identify a shorter-term strategy and priorities.*

- *Least cost planning and total cost analysis will be applied to the alternatives to evaluate cost and benefits.*

- *The MTP needs to communicate solutions that people can understand, want to see accomplished, and will support politically and financially.*

New Strategies for Analysis

The Puget Sound Regional Council plans to analyze several different strategies for implementing the 2001 MTP (PSRC 1999d & 2000b). The different strategies are based upon different planning assumptions:

Current revenues and programs: This strategy assumes only executing those projects and programs from the 1995 MTP for which there is funding committed or demonstrated, including recent cutbacks in state revenues adopted by citizen initiative. The implementation of current local government comprehensive

plans is assumed to continue. This would include the Sound Transit "starter" system now planned for implementation between now and 2010.

Reaffirm Adopted MTP: This strategy includes all of the actions contemplated in MTP 1995 including unfunded ones and updates since then. The 1995 MTP includes 1200 new lane miles of state, county, and city roadway, plus extension of the presently funded Sound Transit system in encompass a light rail network that links Tacoma, Seattle, Everett, Bellevue, Redmond, and Issaquah. Extensions of the present HOV lane network are also in the 1995 MTP. PSRC notes that "HOV corridors deliver more congestion relief than any other investment and are important to the success of Sound Transit and other regional transit services."

Extend MTP to 2030: The version will implement additional capacity for roads and transit to meet increased travel demand through the year 2030.

Modify MTP by influencing the built environment: This implementation will postulate achieving different land use that fosters greater pedestrian movement and transit usage. Forecasts of future population and employment distributions will be modified to reflect people living and working in a different pattern than the one to which present trends are leading. This amounts to an extension of the Vision 2020 strategy of focusing growth in urban centers and other areas near rail stations and bus transit centers.

Modify MTP by influencing travel: This final strategy will postulate increases in the price of road travel and of parking. This strategy will generate additional revenues for transportation improvement and shape travel behavior by making travel more expensive in peak periods and parking more expensive in urban centers.

Congestion will Grow

Previews of the planning process prepared by PSRC are hinting that traffic congestion is going to continue to increase despite new strategies and the investments made by the plan:

Even with all the additional billions of dollars and tremendous human capital about to be invested in roads and transit, the anticipated results -- more traffic and its consequences -- are enormously dispiriting for a place that prides itself on a uniquely superior quality of life. As the plan is updated, the region's tolerance for the status quo will have an opportunity to collide with its ambitions for what could be or should be.

CONGESTION MANAGEMENT SYSTEM

A congestion management system is required in larger U.S. metropolitan regions under federal law. A CMS is "a systematic process for managing congestion that provides information on transportation system performance and on alternative strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet state and local needs." The law provides that the Puget Sound

Regional Council has the responsibility for developing the CMS, in cooperation with the Washington State Department of Transportation (WSDOT) and local jurisdictions and agencies.

In response, the PSRC has created a process for collecting measurements of the flow of traffic on a sample of segments of the region's major highways. Particular high volume segments have been the focus of measurement so far. The results of the CMS effort to date have been provided in two reports. Congestion Management System, Baseline System Performance Report, May 1998 (PSRC 1998d) provides an initial look at some of the region's most traveled corridors for average weekly conditions, fall 1995. Transportation conditions for 26 critical highway segments, and six cross-Sound ferry routes are shown. A second report, 1997 System Performance Report, came out in 1999 (PSRC 1999e) providing data for the fall of 1997. More segments were measured than earlier.

The number of areas monitored and the selection of performance measures is rising as the CMS is developed. Performance measures in the latest report include:

- vehicle volume-to-capacity ratio
- general-purpose lane occupancy
- transit travel time
- HOV and general-purpose lane speeds
- transit frequencies and ridership
- ferry boat frequencies
- major park-and-ride utilization
- commute trip reduction program effectiveness

Major Regional Conclusions

The general region-wide conclusion gleaned from the data by PSRC is that for many monitored segments, congestion occurred in both directions during both the morning and evening peak periods. Critical road segments showing the ratio of volume to capacity in 1997 are identified in the Figure 8-1. V/C ratios are called level of service (LOS) measures. In the traffic engineering profession, when V/C is between 0.9-1.0, the level of service (LOS) hits its lowest point, class E: "Operation at or near capacity and therefore volatile because there are virtually no useable gaps in the traffic stream; maneuverability is extremely limited; any disruption to the traffic stream, such as vehicles entering from ramps or changing lanes, can cause disruptions." LOS E is frequently seen on the map.

Interesting comparisons are possible between 1995 and 1997 on the few road segments where consistent data are available. For example, the volume to capacity ratio on three significant routes is reported in Table 8-2 on the SR-520 bridge across Lake Washington, I-5 at the King-Snohomish Line, and on the SR-167 Valley Freeway south of I-405.

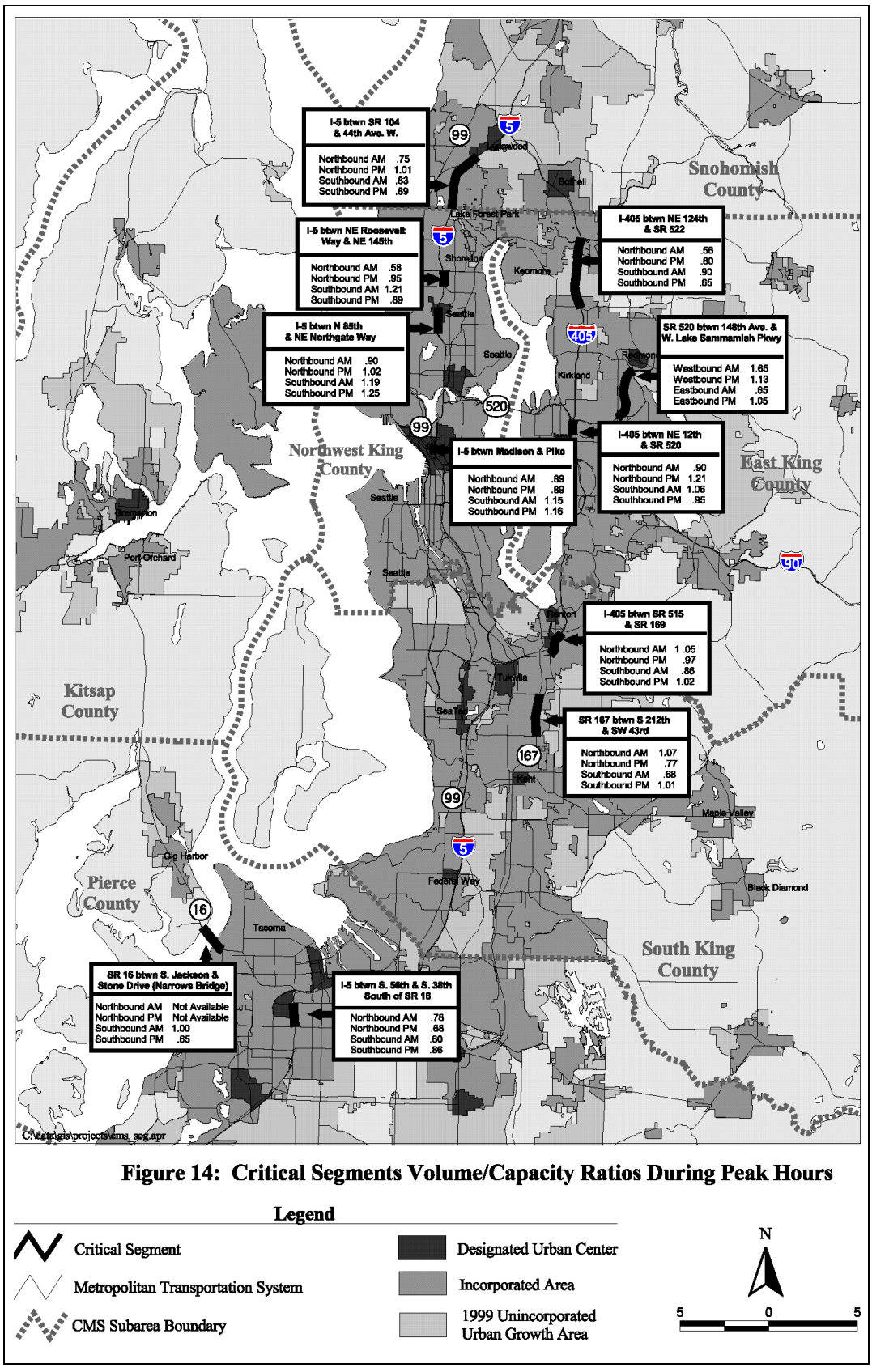


Figure 14: Critical Segments Volume/Capacity Ratios During Peak Hours

Legend

- Critical Segment
- Metropolitan Transportation System
- CMS Subarea Boundary
- Designated Urban Center
- Incorporated Area
- 1999 Unincorporated Urban Growth Area

N

5 0 5

Figure 8-1 Critical Segments on Regional Freeway System

Source: 1999e

Table 8-2 Volume to Capacity Ratios on Key Highway Segments

Peak flow direction	1995 volume/capacity	1997 volume/capacity	Change 1995-97	Congestion trend 1995-97
520 Bridge over Lake Washington				
Commute to Seattle				Overall, better
Westbound AM	1.00	0.97	-2.5%	better
Eastbound PM	0.89	0.87	-2.9%	better
Commute to Bellevue				Overall, worse
Eastbound AM	0.92	1.00	8.6%	worse
Westbound PM	0.97	0.97	0.0%	same
I-5 at Snohomish-King County Line				
Commute to Seattle				Overall, a little worse
Southbound AM	0.93	0.88	-4.8%	better
Northbound PM	0.71	0.77	7.7%	worse
Commute to Snohomish County				Overall, much worse
Northbound AM	0.45	0.51	12.2%	much worse
Southbound PM	0.71	0.81	14.6%	much worse
Valley Freeway south of I-405				
Commute to Seattle/Bellevue				Overall, better
Northbound AM	1.06	1.06	0.0%	same
Southbound PM	1.17	1.01	-13.7%	much better
Commute to Kent				Overall, worse
Southbound AM	1.06	1.07	0.9%	worse
Northbound PM	1.22	1.25	2.5%	worse

Source: PSRC 1999c; Congestion Trend judged by authors.

In each case, the data show that in a comparison of 1995 and 1997, the ratio of volume to capacity was improving or deteriorating less quickly on the commute toward the urban center of Seattle in comparison to the daily commute away from Seattle, which in most cases was showing increasing congestion. These data are consistent with the general observation that job and shopping opportunities are emerging at a faster rate in the suburbs than in the core city of Seattle.

Table 8-3 summarizes the geographic direction of the worst congestion on the three critical segments in 1995 and 1997. Again, the trend across these two years is in the direction of a shift toward a net outbound flow away from the urban center in the morning, and an inbound flow toward the urban center in the evening. The inbound flow in the evening may bear some relationship to attendance at evening sports, entertainment, and cultural events in center city Seattle.

Table 8-3 Direction of Worst Congestion, Key Highway Segments, AM and PM

Morning Peak	**1995**	**1997**
SR-520 Bridge	Toward Seattle	Toward Bellevue
I-5 at King-Snohomish Line	Toward Seattle	Toward Seattle
Valley Freeway	Same both directions	Toward Kent
Afternoon Peak		
SR-520 Bridge	Toward Seattle	Toward Seattle
I-5 at King-Snohomish Line	Same both directions	Toward Seattle
Valley Freeway	Toward Seattle/Bellevue	Toward Seattle/Bellevue

Source: Table 8-2, this document

The congestion management system bears watching as a source of traffic measurement in the years ahead. What is missing to date is a sense of more precise causes of congestion besides generally high volumes with respect to road capacity. More pointed causes of congestion would include accidents and breakdowns; road maintenance, upgrades, and expansions; utility, transit, and private construction that impacts vehicle passage; bottlenecks such as freeway exits that routinely back up (like U.S. Route 2 off of I-5 northbound in Everett), freeway entrances that are not properly ramp metered, and surges of vehicle traffic caused by events at destination and origin sites such as professional baseball games and Boeing shift changes. Accidents and breakdowns are reported by the SmartTrek ITS Program to cause about 60% of highway congestion (Pacific Rim Resources, 1998).

Another interesting finding is shown in Figure 8-2 which is from the latest congestion management report (PSRC 1999e). We have annotated the information boxes on transit ridership with numbers in the lower right hand corners that reveal passengers per bus on a number of selected routes around the region. The average ridership per bus ranges between 7 and 31, which amounts to 13 to 58 percent of the typical 53 seat capacity of a bus. These figures do not illustrate bus loading during the peak versus the non-peak, which is important in grasping the full picture.

LOCAL GOVERNMENT MONITORING EFFORTS

Several of the local government jurisdictions carry out some monitoring of land use and transportation. The counties of King, Snohomish, and Pierce have monitoring efforts. Kitsap County does not. The only municipality that publishes a monitoring report visible to us is the City of Seattle. King County does the most comprehensive job of monitoring land development and transportation performance of the four counties in the region.

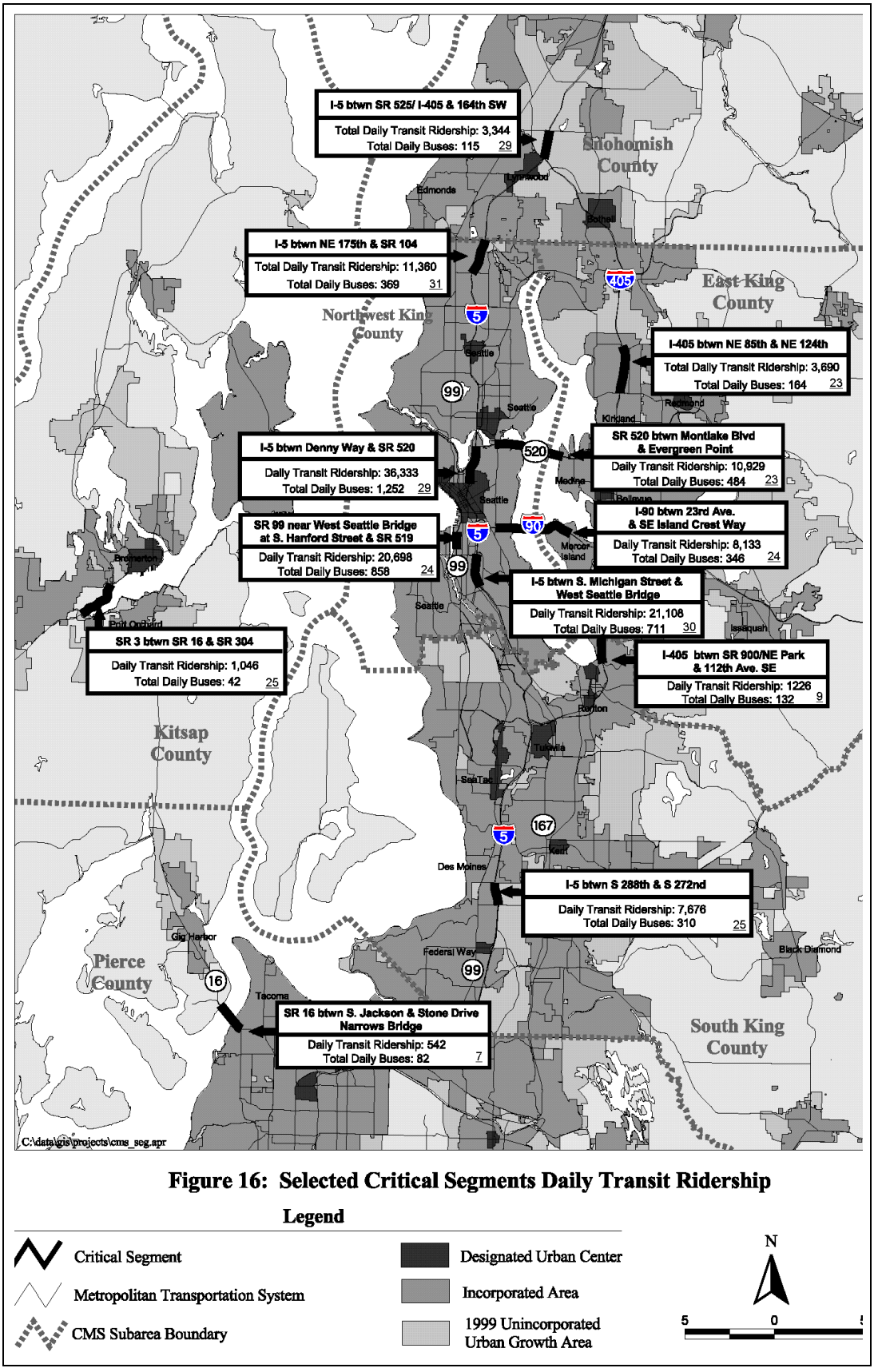


Figure 16: Selected Critical Segments Daily Transit Ridership

Figure 8-2 Daily Transit Ridership on Selected Segments (Avg. Riders per Bus Underlined)
Source: PSRC 1999e

1998 King County Benchmark Report

The King County Benchmark Report (King County 1998) provides quantitative indicators that enable decision makers to determine whether or not King County Planning Policies are achieving their intended outcomes. These policies were developed by a committee of 15 elected officials from local government, adopted by the King County Council, and ratified by the cities in 1994. Areas of comprehensive planning policy include economic development, environment, affordable housing, land use, and transportation. The 45 indicators in the report are intended to let policy-makers know whether different actions to implement the policies are needed, or whether revisions to the policies are required.

In this report, these are some of the indicators and policies pertinent to transportation planning:

- Vehicle miles traveled (VMT) per year. King County policy is to improve air quality and protect water quality. Motor vehicles are a leading source of air pollution and, also, water pollution through rain water runoff washing brake lining particles and oil droppings into storm drains and streams. VMT per capita is declining, and further constraining growth in driving is a policy objective.

- New housing units in Urban Areas and Rural/Resource Areas, and in Urban Centers. Intended outcomes of County policy are to direct the majority of growth into designated urban areas and urban centers, and to limit growth outside of the boundaries of these areas in what are called rural and resource areas. "The number of residential units built in Rural Areas has been declining since 1992. Nonetheless, development has been occurring at nearly three times the rate anticipated in the King County Comprehensive Plan. In fact, 46% of the number of units targeted [for 20 years into the future] have already been built [in the first five years]."

- Ratio of land consumption to population growth. County policy calls for an "efficient use of urban land" in order to minimize further development on what is now rural land. A widely reported analysis by the PSRC that between 1980 and 1990 King County saw a 19% increase in population and a 37% increase in developed land is inconsistent with data published by the U.S. Census Bureau.

- Employment in Urban and Rural/Resource Areas, Urban and Manufacturing/Industrial Centers.

- Ratio of achieved density to allowed density of residential development.

- Percent of residents who commute one way within 30 minutes. County policy is to enhance transportation and land use linkages, which means taking steps that cause people and their jobs to be close to one another. About 79% of Puget Sound commuters travel less than thirty minutes to or from work. (1998-p117)

- Transit trips per person. County policy aims to increase the availability of modes other than single occupant vehicles. Transit ridership is generally keeping pace with population (1998-p.117).

- Percent of residents who use alternatives to the single occupant vehicle.

- Ability of goods and services to move efficiently and cost effectively through the region.

- Number of lane miles of city, county, and state roads in need of repair and preservation.

King County 1999 Annual Growth Report

King County also publishes an Annual Growth Report (King County 1999) covering land development and demographic information for this county, its cities and unincorporated areas. The latest version is dated September 1999. Conclusions of interest include:

- King County's population is growing slowly as job numbers stabilize. Job growth is higher than population growth, so more commuting from neighboring counties is required.

- The rate of residential construction continues to increase. Residential growth focuses in cities and three unincorporated communities. Although King County as a whole is growing slowly, many of its cities are growing rapidly. The suburban cities are acquiring the majority of the county's growth, both through annexation and through new construction within their boundaries. By 2012, the entire urban area, with 90% of the King County population, is planned to be within city limits.

- Growth in rural areas and unincorporated urban areas is exceeding targets set under growth management regulations. In the four years 1995-98, new housing construction is 43% of the way to the 20 year target of 8,200 units in rural areas. The unincorporated areas that are not planned to be shifted into city boundaries are now approaching their 20 year targets.

- Retail trade has increased 17 percent since 1990 on the strength of the construction of new retail centers in Redmond, Bellevue, Woodinville, downtown Seattle, and elsewhere.

- Traffic congestion is worsening while transit ridership grows slowly. Transit use has increased in the last two years, but it comprises at best a stable share of vehicle miles traveled. Certain roads in unincorporated King County are reaching capacity sooner than expected.

Snohomish County Monitoring

Snohomish County Tomorrow 1997 Growth Monitoring Report (Snohomish County 1997) fulfills Snohomish County planning policy that requires a series of data indicators be compiled and published annually in a growth monitoring report to be reviewed by a steering committee. The 1997 report is divided into four main sections:

- population and employment growth

- annexations and incorporations

- residential development

- housing market trends

This report is a data compilation with no analysis or summary presented. The data are consistent with data presented in the PSRC Regional Review.

Pierce County Monitoring

The Pierce County Quality of Life Benchmarks Annual Report (Pierce County 1997) contains sections titled "Proper Distribution of Land" and "Effective Regional Transportation." Most of the quantitative indicators are quotients, for example, "miles of road in Tacoma per vehicle mile traveled" and "average transit-trips per hour per bus," with an occasional raw number thrown in like "containers transported through Port of Tacoma." Single composite indicators are calculated by averaging the growth rates for a small but arbitrary number of these specialized indicators.

The Executive Summary for transportation indicators notes that they "have shown relatively little change since 1990. The largest gains have been made in the efficiency of public transit and activity at the Port of Tacoma, while the largest declines have involved traffic congestion (p. 9)." In another place (p.24), a summary notes that "while the transit system is operating more efficiently, it is also carrying fewer riders, and making fewer trips. Also, while we own fewer cars per person, we are driving more."

The Executive Summary for land use remarks, "Indicators of land use have been unstable, and no discernible trends can be seen, although the share of new housing units being built in incorporated parts of the county appears to be declining (p. 9)."

These sections and the rest of the report do not provide any additional insights on transportation and land use beyond those available in PSRC reports. The methodology used to calculate a composite indicator -- straight, unweighted averaging of the various quotient indicators -- is arbitrary and questionable. As of January 2000 there were no updates of this report available.

City of Seattle Monitoring

The Seattle monitoring effort is titled Seattle's Comprehensive Plan -- Monitoring Our Progress (Seattle, 1998). The report covers the four "core values" of the Comprehensive Plan: Community, Environmental Stewardship, Economic Opportunity, and Social Equity. The indicators are quantitative measures of selected conditions that bear on the goals of the Comprehensive Plan. Transportation indicators are under Environmental Stewardship and cover commuting to work, transit ridership, and alternative transportation facilities. The main conclusions on these three areas are as follows:

- Commuting to work: More people were driving alone to work in 1990 than in 1980.

- Transit ridership: Approximately one out of every three trips made by Seattle residents in 1996 used the public transit system (Note: this probably applies to commute trips rather than all trips.).

- Alternative transportation facilities: In 1998, the City had 35.75 miles of HOV lanes, 10 miles of transit-only lanes, 15.86 miles of streets with bicycle lanes, and 28.35 miles of dedicated multipurpose (including bicycle) trails.

Overall, the transportation focus of the report is on alternatives to SOV driving as a mode, especially for getting to work. The report does not add any new data or insights to those provided in the PSRC and King County monitoring efforts.

OTHER PLANNING PROCESSES

There are four other transportation planning processes that are apparent in the region and generating data potentially of use to the Nonwork Travel Improvement Planning Process. The State Government has initiated and is coordinating broad studies of the travel demand across and around Lake Washington in King County, and of the north-south I-405 corridor in King and Snohomish County. A preliminary set of recommendations regarding cross-Lake Washington improvements have been submitted by a citizen task force to the state (WSDOT 1999).

In Seattle, the Elevated Transportation Company (ETC) was formed as a result of a citizen initiative to plan for a Seattle-wide elevated transportation system, likely some kind of monorail developed under a public-private partnership (City of Seattle 1997). The ETC has asked the private sector for proposals (ETC 2000). As a result of a neighborhood planning process, numerous inter-community proposals have been made to improve the City of Seattle's transportation environment (City of Seattle 2000). Also in Seattle, the Mayor has initiated a study of "intermediate capacity" transit service in a number of corridors, perhaps in the form of electric streetcars/trams (City of Seattle 1999). And finally, Bellevue-based shopping center developer Kemper Freeman has privately initiated and supported a study of road capacity in the region (Kemper Development Company 1999).

CHAPTER NINE

FORCES POTENTIALLY SHAPING ACTIVITIES, LAND USE, AND TRAVEL

INTRODUCTION

In addition to all of the forces described so far in this document, there are still other forces that may drive change in the structure of the economy and society in the central Puget Sound region, and consequently reshape activity and movement. Some of the emerging forces are undoubtedly not clearly visible at present, nor are their consequences predictable in the same way that women joining the work force to become daily commuters, and decreasing household size were missed by travel forecasts three and four decades ago (Table 9-1 & 9-2). Thus, they have not been factored into regional planning.

Table 9-1 Demographic and Vehicle Ownership Forecast of 1967 Puget Sound Transportation Study

	1990 Forecasted	1990 Actual	Difference
Population	2,750,000	2,749,000	--
Households	820,000	1,071,000	31%
Employment	992,000	1,445,000	46%
Passenger vehicles	1,176,000	1,727,000	47%
Commercial vehicles	153,000	516,000	237%

Source: Puget Sound Governmental Conference (PSGC) 1967

Table 9-2 Actual 1990 Performance of Highway Element Compared to Estimated 1990 No-action Alternative; 1990 Transportation System Plan for Central Puget Sound Region as Modeled in 1974

	1972 Existing System	**1990 No-action**	**1990 Actual**
Daily VMT per Capita	12.5	13.8	23.1
Average System Speed - mph	30.1	28.6	26.2
Freeways	53.6	38.2	n.a.
Arterials	23.2	22.2	n.a.

Source: PSGC 1974

We have used the ongoing environmental scanning systems of Global Telematics to develop a cursory list of additional forces affecting the future of urban activity and movement beyond those that we have already discussed. These forces fall into three broad categories: technology applications, environmental changes, and lifestyle shifts. We note where these forces seem to have been acknowledged by the regional planning process.

TECHNOLOGY APPLICATIONS

The application of advanced technology is likely to be a significant driver of change over the next 30 years. The most consequential categories for transportation planning are information technology (IT), which includes both computers and telecommunications (called telematics in combination), and transportation technology, in which applications of new materials and energy technology count heavily. Other technology categories potentially affecting land use and travel patterns include medical/biology, entertainment, and molecular nanotechnology.

Information Technology

Computers and telecommunications are advancing rapidly. It is conventional wisdom that over the next 30 years ordinary computer microchips will have processing power that exceeds that of the human brain, and that widely available communications channels will have the theoretical physical capacity to carry simultaneously all of the digital communications streams generated on the planet. Some of the advances widely foreseen are these:

Computers Smaller, More Powerful, and Everywhere

Smaller, faster, more powerful processing, larger storage capacity, less expensive, and ubiquitous computing is a standard forecast from all observers for the decades ahead. Inventor and futurist Ray Kurzweil predicts "that by 2019, a $1,000 computing device will equal the computational ability of the human brain, and by 2029, that same price tag will supply a computer with the computing capacity of 1,000 human brains" (Barrett 2000).

Small hand-held computers called Personal Digital Assistants (PDAs) are rapidly acquiring more functionality. International Data Corporation, a market research firm covering the computer industry, expects the sales for PDAs to exceed the sales of personal computers by 2005. Miniature, limited-function computers are likely to be widely deployed in the decades ahead. Some of these will simply monitor machinery like elevators and soft drink machines.

Modern automobiles already contain dozens of small computers, and some of them may maintain communication with maintenance facilities. Because of the Internet and Global Positioning Systems (GPS), location-aware information utilities will be possible, for example, a capability in PDAs to provide written or verbal directions from anywhere to anywhere else. Instant foreign language translation is becoming increasingly feasible, to be built in to every telephone.

Voice Communications Everywhere

Wireless telephony is on a path to affordable ubiquity. Hands-free, voice-controlled versions will be available for use on the street and in automobiles. The number of wireless voice providers serving the Puget Sound region has risen from two to seven as a result of Federal deregulation and private sector response to surging market demand (Point.com).

Internet Everywhere

A cheap, always-on internet device that can be held in one hand is probably coming soon. Display devices that simulate paper, or that work through virtual displays based on small attachments to eyeglasses seem possible. Their use by drivers of cars may be limited, but clearly passengers could be allowed full functionality. Drivers of cars will be offered hands-free, voice-enabled internet access built into their new cars, according to recent product development announcements from both GM and Ford (Welch 2000).

Countless options for streaming video will be available at homes, offices, and other fixed locations where large screens are available. In the Puget Sound region, this means that the congestion warnings on the traffic information web site of the Washington State Highway Department, the City of Bellevue, and at a few private sector employment centers could become more accessible to people everywhere.

Electronic Commerce Everywhere

A wide and growing variety of consumer and business transactions will take place through the Internet and Internet-like private networks. Online sales volume is doubling annually as of the beginning of year 2000, according to electronic commerce industry analysts at Forrester Research (Weber 2000). This includes ordering goods and services for delivery later, and the instant availability of an array of services that earlier required travel to a service-delivery facility such as city hall, a clinic, or a school.

Seattle is the headquarters of the largest retail web site, Amazon.com, which bring high awareness of web shopping to the region. As noted in the Seattle Times, the Seattle area is poised to become one of the first sites for a full-scale online grocery war. In addition to HomeGrocer.com, Albertson's last month launched its first online-grocer site, Albertsons.com, in Bellevue. And California-based Webvan Group, recently signed a lease to rent a 350,000 square-foot distribution center in Kent, with plans to open up a Seattle site by late 2000 (Soto 1999).

Cameras and Sensors Everywhere

Security from personal assault and property crimes in transit vehicles and cars, at bus stops and park-and-ride lots, and other public spaces are likely to come from video cameras that transmit to public safety services and in many cases to the Internet for general viewing. General visibility through

video of the inside of any public transit vehicle is feasible as a way of portraying the status of seating capacity to potential riders.

Teleconferencing and Virtual Reality

While face-to-face meetings and other examples of physical presence will always have unique, attractive characteristics, there will be a wide array of technologies supporting remote interaction between people and machines. Boeing Company has a professional effort underway to exploit video teleconferencing as a substitute for some daytime in-firm, business meetings.

Mobile Workers and Virtual Workplaces

The ability to do office and other kinds of work in many different and varied locations is growing steadily, supported by expanding technology characteristics. The degree to which remote work has limitations trades off directly with the time and expense of travel. A phone call or video conference between Tokyo and California trades off against flying to meetings in either place or an intermediate place.

TRANSPORT-RELATED TECHNOLOGY

Transportation is a more mature technology than IT, but there are many developments possible in the decades ahead that would certainly improve vehicle functionality and safety.

Public Transit Service Innovations

Modified regulations, computer-aided dispatching and navigation, and new guideway and vehicle configurations could potentially lead to the offering of new public transportation services. Subscription rental cars at transit stations, which are variations on airport shuttle vans and jitneys, route-deviation buses, subsidized carpooling, and various fixed-guideway schemes are conceivable (Schneider 2000).

Intelligent Transportation Systems (ITS) Applications

ITS is the application of computers and telecommunications to motor vehicle transportation. ITS supports all of the following improvements in transportation, most of which have already been demonstrated in early versions:

- Faster door-to-door travel times by traffic signal coordination and ramp metering, advice on most direct routes that avoid near-term congestion, and directions to best parking spaces. The Seattle freeway system is a world leader in ramp metering, with WSDOT having conducted a six-year research study showing a 50 percent drop in travel time over a 7 mile stretch of freeway served by 22 ramps, despite volume increases in excess of sixty percent (Black 1998).

- Automatic braking and lane holding systems in intelligent vehicles that permit higher safe speeds, closer spacing of cars on the road, and a reduced number of accidents, thus increasing the capacity of road segments.

- Smart cards for easy fare payment, rider information systems, more coordinated scheduling for transfers, and other systems to increase the appeal of public transit. Bus systems in the Puget Sound region are introducing a coordinated fare payment system momentarily.

- Older and disabled people more able to drive by themselves, or to use public transit with a higher sense of security and confidence.

- Faster response to accidents and other situations by emergency services.

- Better warnings and other responses to weather conditions.

- Use of automatic road toll collection systems that support value pricing of travel on road segments with reduced congestion.

- Instant ridematching, security systems, driver compensation systems, and other opportunities to support ridesharing/carpooling. Bellevue has pioneered instant ridesharing and continues to improve the program.

The Seattle region is a national leader in ITS implementation, having been designated as a national demonstration city and conducting a $13.7 million project called Smart Trek to expand, integrate, and coordinate the region's traveler information systems, according to the (PSRC 1998). As described in a public relations booklet (Pacific Rim Resources 1998), the components of this SmartTrek project are:

- WSDOT FLOW Map: An internet-based map of traffic speeds and incidents on the freeways in King County, southern Snohomish, and the Tacoma area.

- TrafficView: Real time video pictures of area freeways

- Busview: An internet-based map of where King County Metro buses are in real time.

- Ferry Traveler Information: Ferry locations and waiting lines are monitored and information disseminated via variable message signs and highway advisory radio.

- Cable TV Traffic Updates: Pictures and maps of freeway traffic conditions broadcast over cable TV.

- Dynamic Ridematch: Carpooling arranged on short notice in the Redmond area through email and the internet.

- Customized Traffic Reports: Traffic reports covering only the roads selected by the customer.
- Seattle Center Parking Information: Using electronic signs to let people know where to park during events.
- Sea-Tac Airport Traffic Information. Uses short range radio and variable message signs.
- Fastline Travel Software: Real time traffic and transit information broadcast to hand held computers.
- Transit Watch: Electronic displays of bus departure times at selected transit malls.
- Advanced Traffic Management Systems: Better coordination of traffic information among 19 local government jurisdictions in the Seattle area.
- Bellevue Traffic Control Center: Covers Bellevue arterials.
- Enhanced Incident Information: Automated transmittal of State Patrol accident reports to radio stations and the public.

Improvements in Private Vehicles

New materials, advanced propulsion systems, and in-vehicle electronics to manage maintenance requirements could lead to dramatic improvements in cars. Lower energy consumption and emissions, smaller size, higher safety levels, and lower operating costs are the target of manufacturers worldwide. Ballard Systems in the Vancouver, BC region, nearby to Puget Sound, is a world leading company developing fuel cell technology. Pacific Northwest National Laboratory in Richland, Washington operated by Battelle for the U.S. Department of Energy is also working on fuel cells for a new generation of automobiles. Pacific Northwest writes in their public relations magazine, "In the next 10 years, environmentally friendly fuel cells may begin replacing conventional combustion engines in consumer automobiles" (PNNL 1999). Western Washington University in Bellingham is a research center for electric vehicle technology.

New Options for the One Hour Travel Range

As the 21st century progresses, there may develop some radically new options for transportation that increase the options for short trips of say, one hour or less, the time range at which people are willing to commute daily or attend an evening entertainment event. One can imagine the possibility of very fast express trains or short takeoff and landing aircraft that serve center city locations. Moving people from their homes and offices to the stations where such systems provide boarding is a challenge of course. Cars that fly --a more ubiquitous form of personal aviation -- is another possibility that is being explored and developed by the National Aeronautics and Space Administration (NASA 2000).

INTERACTION OF INFORMATION TECHNOLOGY AND TRANSPORT

International communications and transportation are likely to facilitate a continuing increase in the level of interaction between people across political boundaries as the 21st century progresses. Tourism, business travel, immigration and emigration, importing and exporting of goods, adoption of overseas fashions and customs, and other unforeseen activity and movement effects are likely as result of globalism facilitated by distance spanning technologies.

MEDICAL/BIOLOGY RELATED TECHNOLOGY

The people in the Puget Sound region are considered healthier than most. The Center for Studying Health System Change reports that as of 1997, "Health status is generally better in Seattle than in the rest of the nation. The Seattle area has lower mortality rates among infants and the general population than the rest of the nation. Age-adjusted mortality is 20 percent lower than the national average....Seattle has 20 percent fewer hospital admissions and 38 percent fewer days of care per 1,000 population than the respective national averages. Despite the fact that Seattle is a regional center for medical care, it has almost 40 percent fewer short-term hospital beds per 1,000 population than the national average" (Fountain 1997). In the future, people may stay healthier and live longer as a result of medical and biological technology.

Health Enhancements

Keeping aging people in better health and mobile for a longer portion of their lives is a goal of much research, and healthiness could certainly see breakthroughs or, less probably, reversals. Enhancements could also occur for disabled people who might be provided with more mobility or other health-related incentives to spending more time out in public.

Lifespan Changes

Increasing human lifespan is a long-term trend that may see a sharp acceleration, or, much less likely, a deceleration or reversal. Acceleration of the trend would result from progress in the conquest of leading killers like heart disease and cancer. A deceleration could result from the emergence of a new disease or condition that cannot be thwarted by the medical community, or from another unexpected development.

NEW ENTERTAINMENT AND RECREATION OPTIONS

High-end multimedia electronics and lighting offers exciting new options for place-based entertainment and culture, such as light shows, concerts, environmental simulators, and games. Materials technology and creativity opens up new sporting and recreation opportunities; snow boarding, roller blading, and

mountain biking are three examples from the 20th century, very much practiced by residents of the region.

MOLECULAR NANOTECHNOLOGY

In the 21st century there is some informed speculation that thorough, inexpensive manipulation of the structure of matter could be based on molecule-by-molecule control of products and byproducts. Things made of metal and plastic can perhaps be made in a way analogous to how trees make wood. Some scientists believe that computer chips and small electronic devices like miniature cellular phones could be manufactured in any location from small quantities of raw materials using directions transmitted over the Internet. This technology would have important long-run implications for the transportation of raw materials and finished goods, and for the location of manufacturing activity (Drexler 1992).

ENVIRONMENTAL POLICY DRIVERS

This category includes the potential "big picture" changes that affect the lives of everybody in a society.

The Economy

In the present era of economic strength for the central Puget Sound region, it is important to realize that this aspect of the environment could change. One likely possibility is a downturn or two in the U.S. economy over the next few decades. Another possibility is a local recession caused by a problem with one of the areas major employers. A simultaneous collapse in the business performance of Microsoft and Boeing because of competition and other significant events (a difficult problem discovered in key products, for example) is certainly unlikely, but imaginable.

Global Climate Change

The effects of energy use and emissions generation on the Earth's climate -- so called global warming -- may lead to significant, policy-driven changes in activity and movement over the course of future decades.

Energy Supply

Energy shortages from reducing petroleum supplies, for example, or a new energy abundance, from exploitation of abundant hydrogen as a fuel, may develop in the decades ahead.

Crime and Terrorism

Personal security at home, at work, or in public places may become either more, or less of a problem in the years ahead. Reality and the perception of reality about crime and terrorism will affect what people do and where they go.

LIFE STYLE SHIFTS

In the category of life style shifts we include changes in how ordinary people live their lives, in particular, how they use time and how they use geographic space. These may be triggered by combinations of technological shifts, the development of new products, services, and other consumer opportunities, or big picture changes of the type described in the previous section. Potential life style shifts are another way of looking at the effects of technology and other aspects of the environment.

Personal Time Allocation Changes

Over the course of decades, the possibility is open for significant structural shifts across a wide segment of the regional population in the annual shares of work time versus leisure time, indoor versus outdoor time, home-based versus away-from-home time, and nearby versus very-distant activity time. This is because technology, global awareness, and economic circumstances provide new opportunities and perhaps new limits.

The movement and activities of people around December 31, 1999 in response to the year 2000 celebration (non-celebration) is an example of the possibilities in microcosm. Awareness of potential terrorism and potential infrastructure failures associated with Y2K computer problems served to dampen the enthusiasm, movement, and activities of many people in the central Puget Sound region. This is not an example, of course, of a long-term structural shift, but is an example of how perceptions of technology and potential societal dangers -- coupled with official government actions in the case of Seattle -- can alter human behavior in ways unforeseen even 60 days earlier.

Spatial Use Changes

In the same way that time allocations can change, people may change their space consumption and movement habits by living in bigger or smaller homes that are closer or farther from workplaces on average, becoming part of family or friend groupings that are more widely or less widely geographically dispersed, or choosing locations for fulfilling their consumer activity preferences that consequently yield more or less travel to get there. The market will likely continue to offer many choices in all ranges of price. Fashions and fads (unforeseeable now, since they are based on future human creations as yet uncreated) will be influential, no doubt. Also, the emerging preferences may be considerably influenced by vehicle traffic congestion, which is predicted by today's transportation planners to grow substantially in the next few decades.

As shown earlier, the availability of new destinations for new purposes, such as the Gorge Outdoor Amphitheater entertainment venue near George, Washington midway between Spokane and Seattle, or the SuperMall in Auburn, or a new sports stadium in downtown Seattle, also creates new patterns of spatial use and movement.

But beyond new destinations, there are other forces. As a mind experiment, consider the effect on weekend and evening vehicle travel for entertainment, recreation, culture, and shopping if ever household in the region were suddenly to own a brand new luxury car. Driving and vehicle miles traveled would jump upward. A structural rise in the price of gasoline would move driving in the other direction.

Organizational Rescheduling

Society's institutions are beginning to change their traditional schedules, and this trend could accelerate. More public schools are now operating year round to more fully utilize school classrooms, and there are attempts to make sure that the periods of certain vacations are staggered to avoid overloading travel facilities used by families taking holidays. More use of the full seven-day week and the full 24-hour day for scheduling work is also a trend, which among other effects serves to spread out the traffic load moving people and goods. The Boeing Company proposed a 24x7 work week during labor negotiations in 1999. Although rejected by the union, the company plans to offer it as a voluntary work option. Interaction with other geographic regions in the global economy clearly is a driver of this trend as well.

DISCUSSION AND CONCLUSION

Judgments about how to structure urban transportation in light of the wide array of future possibilities need to be made in the planning process for the region. We feel that there is a great deal of uncertainty about the future beyond five years because of forces like those just described, and other forces that cannot even be imagined. Many of these forces do not appear to have been acknowledged by regional planners.

Our recommendation is to follow the advice of forecaster Yehezkel Dror who thinks "we are increasingly facing the inconceivable" as all the deep drivers of history are undergoing radical transformation. Dror advises: "Presuming to foresee the longer-term future should be avoided, open-ended contingent outlooks should be the rule..." (Linstone 1999).

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