PUGET SOUND PARK & RIDE SYSTEM UPDATE

FINAL REPORT

Prepared for:
Washington State
Department of Transportation
Office of Urban Mobility

Prepared by:
Parsons Brinckerhoff

February 2001





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Study Purpose & Acknowledgements

The purpose of this study was to identify regional long-range park-and-ride lot needs in King, Kitsap, Pierce and Snohomish Counties. Long-range park-and-ride lot needs had been identified for the central Puget Sound region in the 1970s, leading to substantial investment by the Washington State Department of Transportation (WSDOT) and local transit agencies in the system of park-and-ride lots that exists today. But new and emerging park-and-ride lot needs have not been updated since that time – so few new park-and-ride lot projects have been funded more recently. The goal of this study was to develop corridor-level park-and-ride demand estimates for the year 2020, and to identify potential current and future park-and-ride lot investment needs within the four-county region that can be prioritized through the regional and state priority programming processes and through transit agency budget processes.

The study's demand estimates, forecasts, and list of recommendations was developed through a collaborative effort that included representatives from Community Transit, Everett Transit, King County Metro, Kitsap Transit, Pierce Transit, Sound Transit, Puget Sound Regional Council (PSRC), Washington State Ferries, WSDOT Northwest and Olympic Regions, and the study's sponsor WSDOT Office of Urban Mobility (WSDOT OUM). Recommendations consist of generalized locations and cost estimates for park-and-ride lots by major commuter and transit "corridors" for each county. The recommendations are divided into three planning horizons: Short-Term (2000-2006), Mid-Range (2007-2015), and Long-Range (2016-2030).

The first step towards agreement on future regional park-and-ride lot needs was accomplished in October 2000 when WSDOT OUM, with the concurrence of the participating agencies, submitted the recommendations list to PSRC as "candidate" park-and-ride facilities in the Metropolitan Transportation Plan (MTP) Update. The recommendations list has also been submitted to the WSDOT's Washington Transportation Plan (WTP) and State Highway System Plan (SHSP) update processes. It is intended that the collaborative effort of this study will continue in later programming efforts to implement the study's recommendations and during future updates of this study.

We appreciate the time and effort the participating agency representatives committed to identifying the long-term needs for a regional park-and-ride system. Our thanks go to following and other agency staff who contributed to the study:

Community Transit: Tim Brakke, John Layzer, Kim Morley, Joy Munkers
Everett Transit: Dennis Bloom, John Peterson
King County Metro: Mike Bergman, Kate Donley, David Hull
Kitsap Transit: Wendy Clark, John Clauson, Doug Johnson
Pierce County Transit: Kevin Desmond, Nathaniel Jones, Tina Lee
Sound Transit: Vicki Cannard, Nick Marquardt, Brian O'Sullivan, Matt Taunton
Puget Sound Regional Council: Becca Aue, Ned Conroy, King Cushman
Washington State Ferries: Celine Gihring
WSDOT Northwest & Olympic Regions: Bob Caldwell, T.J. Nedrow
WSDOT OUM: Rob Fellows, Jean Mabry (OUM Project Manager), Helena Kennedy Smith

We also extend our thanks to Rob Spillar and Leah Bolotin, Parsons Brinckerhoff's (PB) project manager and senior planner for this study, and their team for their excellent work on this study: Anji Bhagat, Bill Carter, Daniel Haufschild, Sandi Miller, Carly Nelson, Steve Rolle, Cathy Strombom, and Monica Welle. Also to Gary Edler and Felix Kwakwa of K2 & Associates.

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I. EXECUTIVE SUMMARY

INTRODUCTION

The purpose of the Puget Sound Park-and-Ride Study is to develop a comprehensive update to the regional park-and-ride system plan for King, Kitsap, Pierce, and Snohomish Counties. Planning for park-and-ride lots has not been done for the Puget Sound area on a regional basis for 25 years.

This project is sponsored by the Washington Department of Transportation's Office of Urban Mobility (WSDOT OUM). The primary goal of the project is to develop corridor-level park-and-ride demand estimates for existing and future conditions, and to develop short-, mid-, and long-range recommendations for potential park-and-ride investments within the four-county region. The identified investment opportunities may be added to the Washington Transportation Plan (WTP) and will be provided to the Puget Sound Regional Council (PSRC) for use as a guide for recommending facilities in the Metropolitan Transportation Plan (MTP) update. Inclusion in the MTP allows WSDOT to seek partnering opportunities with local transit agencies to jointly site and develop park-and-ride facilities throughout the region. Inclusion of future investment needs in the WTP allows WSDOT to program potential park-and-ride site selection projects as part of their roadway and corridor planning process.

The results of this study provide project recommendations for generalized areas rather than specific sites. It provides an understanding of park-and-ride demand for major corridors in the Puget Sound region and identifies current and future facility needs. The demand forecasts developed in this report can serve as a tool for agencies to use in the allocation of park-and-ride capacity. Unconstrained estimates of current demand as well as 2010 and 2020 demand forecasts are provided.

STUDY AREA DESCRIPTION

The identified focus area for this study includes the four counties of King, Kitsap, Pierce and Snohomish. WSDOT and the transit agencies in each county were requested to identify primary commuting and transit corridors within their jurisdictions for which park-and-ride facility investments would be appropriate either now or in the future. Analysis was focused on these transit corridors.

METHODOLOGY OVERVIEW

A three-part demand estimation methodology was utilized to calculate existing year 2000 demand estimates, as well as year 2010 and 2020 forecasts. The three-part process involved:

- Estimation of existing "unconstrained" park-and-ride facility demand using a regression-based Park-and-Ride Demand (PRD) Model developed for the Puget Sound region.

- Forecasting future demand based on existing "unconstrained" estimates, future service assumptions, and **population** growth rates taken from the PSRC EMME2 travel forecasting model.
- Forecasting future demand based on existing "unconstrained" estimates, future service assumptions, and **transit** ridership growth rates taken from the Sound Transit EMME2 travel forecasting model, or from the PSRC model where appropriate.

The two separate forecasts developed by the population-based and transit-based growth rates were used to provide a range of possible future forecasts. Both demand estimates and forecasts were adjusted according to input from local transit agencies, based on their experience within individual corridors.

DEMAND ESTIMATES

The focus of the demand estimation approach was to develop demand estimates at a corridor level for the major transit corridors in the four counties. These estimates should not be viewed as site-specific implementation recommendations or forecasts. They are based on optimistic assumptions regarding lot placement, size, and transit service in order to develop a corridor-level "unconstrained" demand estimate. Detailed analyses based on factors such as committed transit services, known service area characteristics, competing services, and planned facility locations should be considered as part of site selection and design criteria for actual implementation of park-and-ride projects.

Existing park-and-ride capacity and observed demand, as well as unconstrained demand estimates and forecasts for 2000, 2010 and 2020 are summarized in Table 1.1.

PROGRAMMING & COST ESTIMATES

The primary goal of the study was to provide planning-level capital project recommendations for inclusion in the MTP. Inclusion in the MTP is intended to initiate project programming and create project placeholders for future funding. Programming recommendations were developed to address the existing (year 2000), year 2010, and year 2020 corridor demand estimates.

Programming recommendations for capital projects were developed for three planning periods: short-range (2000-2006), mid-range (2007-2015), and long-range (2016-2030). Short-range projects consist of those projects already programmed by participating agencies. Assuming that the programming of facilities typically lags behind demand, the project list for future time periods responds to the previous period's demand estimate, as follows:

Period	Program Period	Demand Year
Short-Term	2000-2006	2000
Mid-Range	2007-2015	2000 unmet demand
Long-Range	2016-2020	2010
Long-Range	2030 MTP horizon	2020

Project recommendations were reviewed with WSDOT and the participating transit agencies to assure consistency with current agency planning efforts. These agencies provided input based on their local knowledge of the corridor conditions, services, and park-and-ride facilities. Based

on their input, project recommendations were added, deleted, and adjusted in terms of programming time period to better meet the agency's objectives.

Table 1.1

Demand Summaries by County and Transit Corridor

Transit Corridor	Existing Capacity	Existing Demand		Future Demand	
		Observed	Unconstr. Estimate	2010	2020
King County					
I-5 (North)	2121	1984	2980	2400 to 2700	2540 to 3230
I-5 (South)	4299	3345	4920	5720 to 6190	6410 to 7670
I-405	5117	3571	4230	4270 to 4720	5270 to 6460
I-90	1952	1950	3210	4130 to 4440	4780 to 5350
SR 167	1866	1301	2430	2740 to 2840	3340 to 3820
King County Totals	**15,355**	**12,150**	**17,770**	**19,260 to 20,890**	**22,340 to 26,530**
Kitsap County					
South Kitsap	369	357	490	730	1010 to 1410
Central Kitsap	290	218	1370	1840 to 1960	2440 to 3400
SR 305	541	439	670	900 to 1070	1260 to 1750
SR 104	391	191	350	580 to 690	660 to 920
Kitsap County Totals	**1591**	**1205**	**2880**	**4050 to 4450**	**5370 to 7480**
Pierce County					
Peninsula	441	286	420	460	460
I-5 Central	2451	2145	4770	5420	5420 to 6240
Valley	78	19	1170	1380	1380 to 1640
Pierce County Totals	**2970**	**2450**	**6360**	**7260**	**7260 to 8340**
Snohomish County					
Southwest Snohomish	4187	3419	5210	7420 to 8120	9030 to 10840
North Snohomish	359	210	1103	1340	1620
Southeast Snohomish	609	390	1270	1710 to 1810	2060 to 2320
Snohomish County Totals	**5155**	**4019**	**7583**	**10,470 to 11,690**	**12,710 to 16,180**
Four-County Totals	**25,071**	**19,824**	**34,593**	**41,040 to 44,290**	**47,680 to 58,530**

Source: Parsons Brinckerhoff

A summary list of project recommendations and cost estimates is presented in Table 1.2.

Table 1.2

Project Recommendations and Cost Estimates

County	Transit Corridor	Existing Stalls	Short-Term (2000-2006) New Stalls	Short-Term (2000-2006) Cost Estimate	Mid-Range (2007-2015) New Stalls	Mid-Range (2007-2015) Cost Estimate	Long-Range (2016-2020) New Stalls	Long-Range (2016-2020) Cost Estimate	MTP Horizon (2021-2030) New Stalls	MTP Horizon (2021-2030) Cost Estimate	TOTALS New Stalls	TOTALS Cost Estimate
King	I-405	5,117	0	$0	600	$9,000,000	300	$10,680,000	1,650	$53,670,000	2,550	$73,350,000
	I-5 South	4,299	3,400	$54,200,000	0	$0	0	$0	900	$19,350,000	4,300	$73,550,000
	SR 167	1,866	2,190	$57,333,000	0	$0	0	$0	700	$15,050,000	2,890	$72,383,000
	I-5 North	2,121	1,000	$19,500,000	0	$0	0	$0	550	$17,875,000	1,550	$37,375,000
	I-90	1,952	1,500	$37,328,000	650	$16,600,000	1,300	$36,140,000	950	$27,960,000	4,400	$118,028,000
	ITS/Surveillance			$4,940,200		$2,385,600						$7,325,800
	Total	**15,355**	**8,090**	**$173,301,200**	**1,250**	**$27,985,600**	**1,600**	**$46,820,000**	**4,750**	**$133,905,000**	**15,690**	**$382,011,800**
Kitsap	South Kitsap	369	350	$757,200	0	$0	200	$1,500,000	600	$4,500,000	1,150	$6,757,200
	SR 104	391	220	$500,000	0	$0	250	$1,875,000	200	$1,500,000	670	$3,875,000
	Central Kitsap	290	0	$0	1,350	$10,125,000	250	$1,875,000	1,600	$31,600,000	3,200	$43,600,000
	SR 305	541	0	$0	0	$0	0	$0	1,500	$48,000,000	1,500	$48,000,000
	ITS					$746,000						$746,000
	Total	**1,591**	**570**	**$1,257,200**	**1,350**	**$10,871,000**	**700**	**$5,250,000**	**3,900**	**$85,600,000**	**6,520**	**$102,978,200**
Pierce	I-5 Central	1,796	1,450	$34,590,500	1,000	$30,750,000	300	$9,450,000	200	$6,150,000	2,950	$80,940,500
	Valley	78	1,200	$28,286,000	1,000	$31,500,000	250	$7,875,000	100	$1,700,000	2,550	$69,361,000
	Peninsula	441	650	$16,665,000	750	$23,062,500	0	$0	0	$0	1,400	$39,727,500
	Lakewood/Dupont	493	750	$12,673,000	750	$23,062,500	300	$9,450,000	200	$6,150,000	2,000	$51,335,500
	Spanaway/Parkland	162	0	$0	300	$9,450,000	250	$7,875,000	0	$0	550	$17,325,000
	ITS/Surveillance					$1,271,000						$1,271,000
	Total	**2,970**	**4,050**	**$92,214,500**	**3,800**	**$119,096,000**	**1,100**	**$34,650,000**	**500**	**$14,000,000**	**9,450**	**$259,960,500**
Snohomish	SW Snohomish	4,187	4,166	$72,514,400	0	$0	2,250	$50,750,000	2,600	$59,800,000	9,016	$183,064,400
	North Snohomish	359	350	$5,100,000	250	$4,250,000	300	$5,100,000	350	$7,350,000	1,250	$21,800,000
	SE Snohomish	609	600	$8,400,000	650	$7,800,000	0	$0	500	$9,250,000	1,750	$25,450,000
	ITS/Surveillance					$1,632,600						$1,632,600
	Total	**5,155**	**5,116**	**$86,014,400**	**900**	**$13,682,600**	**2,550**	**$55,850,000**	**3,450**	**$76,400,000**	**12,016**	**$231,947,000**
Four County Total		**25,071**	**17,826**	**$352,787,300**	**7,300**	**$171,635,200**	**5,950**	**$142,570,000**	**12,600**	**$309,905,000**	**43,676**	**$976,897,500**

Notes:

1. Program plans are organized by county. The lead agency for a project will be determined at the time of implementation.
2. This program plan identifies the general location, time period, and type of park-and-ride facilities needed. Exact size, location, timing, and type of facility to be determined by local agencies and public process at the time of implementation.
3. Forecasts represent unconstrained transit corridor demand.
4. Cost estimates are in year 2000 dollars.
5. All costs are preliminary planning level capital estimates intended to serve as placeholders. They do not include operations or maintenance costs.
6. Funds have been programmed for lots in the short-term category only. No commitment has been made or is implied regarding funding or the ability to fund further projects.

Source: Parsons Brinckerhoff

INTELLIGENT TRANSPORTATION SYSTEMS

While the focus of the study was to estimate park-and-ride demand and to identify programming recommendations, the study also included some preliminary intelligent transportation system (ITS) concepts for future evaluation. ITS applications could support park-and-ride usage and fit into a comprehensive region-wide park-and-ride plan. Preliminary planning-level cost estimates are presented in Table 1.2, and described in more detail in Section IV.

NEXT STEPS

As population continues to grow in the Puget Sound region, congestion and air quality will remain top concerns. Programs which make it easier or more convenient for people to choose transit over single occupancy vehicles will play an important part in this region's ability to comply with state and federal standards and retain its high quality of living. At the same time, existing land use patterns and commuting preferences must be recognized. Techniques to improve regional mobility and encourage modal shifts are an integral part of the long-range transportation planning process.

This study is intended to support and dovetail with local and regional land use and mobility planning decisions enacted over the next 30 years. Since all demand estimates were produced under an unconstrained methodology, its recommendations can be seen as "maximum" or optimistic scenarios. Maximum flexibility has been incorporated into the programming, with a range of forecasts, time periods, and facility size recommendations. Suggested projects should be considered as order-of-magnitude recommendations within a transit corridor.

In October 2000, the programming recommendations and cost estimates presented in this report were submitted by WSDOT, with the concurrence of local and regional transit agencies within the study area, to the PSRC for inclusion into the MTP. Once this system-wide program of park-and-ride expansion is adopted into both the MTP and WTP, the next step toward implementation will be for local agencies to identify funding for individual projects. This region has been subject to a widely varying political and legislative climate vis-à-vis support of, and funding for, transportation projects. Funding for the recommended facility investments is not guaranteed. As these investment recommendations are further evaluated, funding commitments from appropriate local and regional agencies will be required before implementation.

Most of the short-term projects have already been programmed by local transit agencies. Implementation of projects beyond those currently programmed will require careful analysis of ridership trends, transit service, funding climate, and political feasibility. Meeting local park-and-ride demand may include surface or structured expansion of existing sites, surface or structured new construction, or phased construction. Optimal placement within a transit corridor will involve a site-level study process including alternatives identification, preliminary design/environmental review, public involvement, and funding support.

II. STUDY INTRODUCTION

BACKGROUND

The purpose of the Puget Sound Park-and-Ride Study is to develop a comprehensive update to the regional park-and-ride system plan for King, Kitsap, Pierce, and Snohomish Counties. The project is sponsored by WSDOT. The primary goal of the project is to develop corridor-level park-and-ride demand estimates for existing and future conditions, and to develop short-, mid-, and long-range recommendations for potential investment opportunities. The identified investment opportunities may be added to the WTP and will be provided to the PSRC for consideration for inclusion in the MTP. Inclusion in the MTP allows WSDOT to seek partnering opportunities to jointly develop park-and-ride facilities throughout the region, and inclusion in the WTP allows WSDOT to program potential site selection as a part of State roadway projects.

Northgate Transit Center

WSDOT views park-and-ride facilities as necessary auxiliary facilities to the freeway and regional high occupancy vehicle (HOV) system. Park-and-ride facilities can be used to accommodate future growth in travel demand by increasing accessibility to transit services in urban, suburban, and rural locations. Providing adequate park-and-ride capacity where it is needed will help to maximize the use and benefit of both the transit and HOV systems. Placement of new and expanded park-and-ride facilities in the regional MTP and the WTP will initiate their formal programming as transportation system components.

This is not the first instance of WSDOT interest in park-and-ride facilities within the central Puget Sound Region. In the early to mid 1970s, WSDOT took a proactive role in developing 15 joint park-and-ride facilities within the Central Puget Sound Region that are still in active service today. WSDOT's role in these projects ranged from securing state and federal funding, to securing the right-of-way for construction on behalf of the respective transit agency, to the construction of facilities themselves as lead agency. A comprehensive region-wide park-and-ride system update has not been undertaken since the Park-Ride Program Evaluation conducted in 1976.

As the only transportation provider with jurisdiction over all four counties, the WSDOT's OUM is taking the lead as sponsor of this system plan update. OUM, together with WSDOT's Northwest and Olympic Regions, is working in coordination with local and regional transit agencies including:

- Community Transit
- Everett Transit
- King County Metro

- Kitsap Transit
- Pierce Transit
- Sound Transit
- Washington State Ferries

These agencies, along with PSRC, are jointly serving as the steering and advisory committee for this project. It is WSDOT's desire that this joint coordination will continue through the development and implementation of the Study's recommendations.

Please note that the programming and cost estimate aspects of this study address capital projects only. Analysis and cost estimates for operations, maintenance, public education, and enforcement were beyond the scope of this study.

STUDY AREA

The identified focus area for this study includes the four counties of King, Kitsap, Pierce and Snohomish. The report study area and its major transportation facilities is presented in Figure 2.1.

WSDOT and the transit agencies in each county were requested to identify primary roadway networks within their jurisdictions for which park-and-ride facility investments are appropriate now or in the future. This study does not include all state routes in the four-county area, but focuses instead on primary commuting and transit corridors. The corridors identified are:

King County

- I-5/SR 99
- I-90
- SR 167/Commuter Rail Corridor
- I-405
- SR 520
- SR 522

Kitsap County

- SR 3
- SR 16
- SR 104
- SR 160
- SR 166
- SR 303
- SR 304
- SR 305

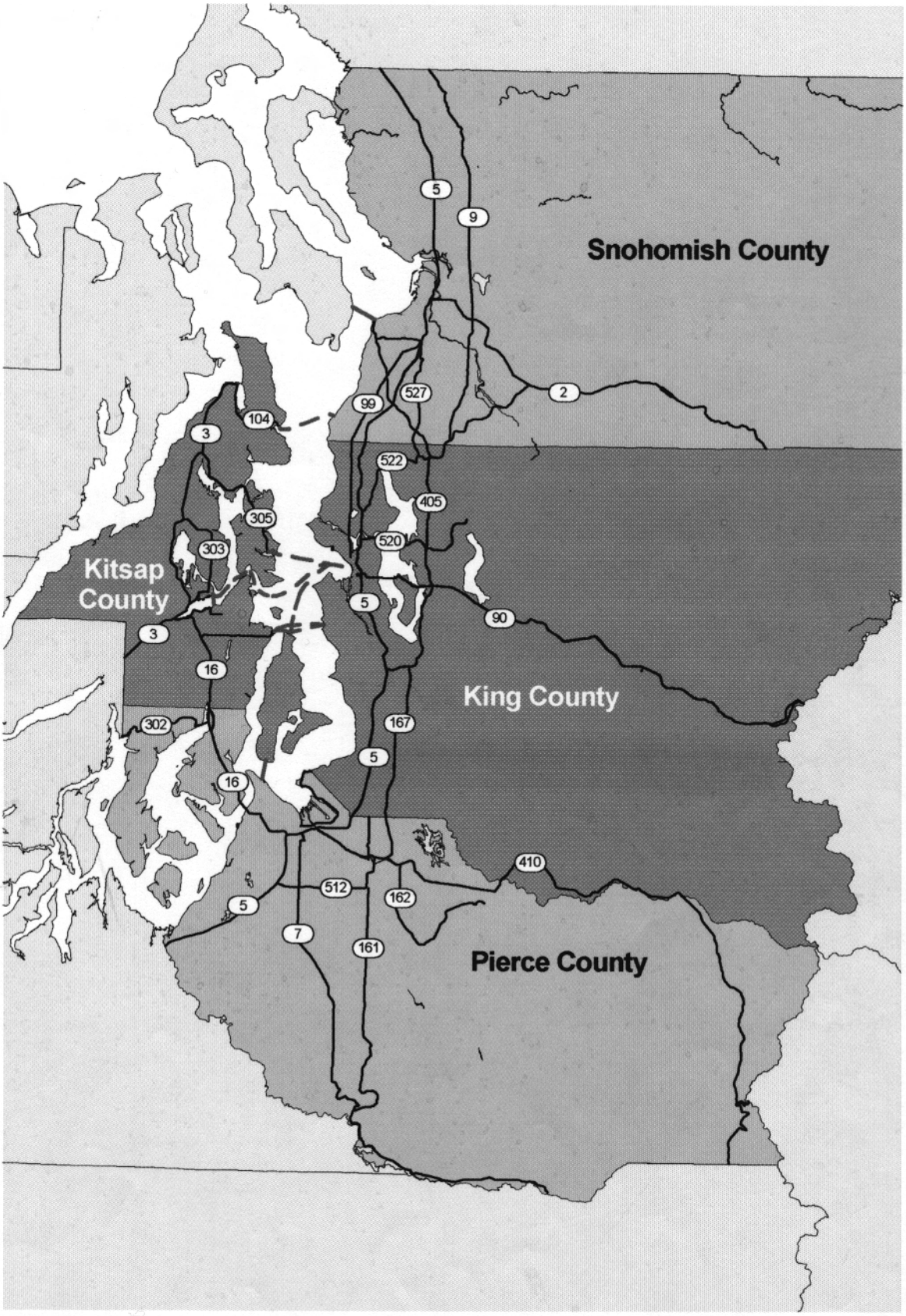
Pierce County

- I-5
- SR 7
- SR 16
- SR 161
- SR 162
- SR 167
  (existing & proposed extension)
- SR 302
- SR 410
- SR 509
- SR 512

Snohomish County

- US 2
- I-5/SR 99
- SR 9
- SR 522
- SR 525/526
- SR 527

task3-four county pr/technical/gis data/4county.apr



Report Study Area

Puget Sound Park-and-Ride System Update

FIGURE 2.1

III. METHODOLOGY

PARK-AND-RIDE DEMAND ESTIMATION

Overview

A primary goal of this project was to develop corridor-level demand estimates. A list of primary transit commuting corridors, and in some cases sub-areas, was developed with input from WSDOT and local transit agencies. These transit corridors were broadly defined and can include multiple freeways, state routes, arterials, and transit routes. Permanent park-and-ride lots were grouped into logical corridors reflecting major network, geographic, and service features. Demand for park-and-ride lots was analyzed for these corridors or sub-areas. Analysis at the corridor level allows for more accurate demand forecasting overall, and for more flexibility in the interpretation of the results and in implementation of the proposed programming.

Corridor-level analysis allows the study process to capture both local park-and-ride demand and demand that may be shifting between facilities within the corridor. In some corridors, especially those where demand for park-and-ride has exceeded capacity, lot substitution has been observed. Lot substitution, the phenomenon of patrons passing by the lot closest to their origin in preference for a down-stream facility, can be driven by a number of factors including differences in service, demand to capacity ratios, cost of transit service in different fare zones, facility amenities, and other factors.

In order to quantify corridor-level park-and-ride demand, estimates and forecasts were developed for the years 2000 (existing), 2010, and 2020. A three-part estimation methodology was utilized to calculate demand for these three time periods. The three-part process involved:

- Estimation of existing "unconstrained" park-and-ride facility demand using a regression-based PRD Model developed for the Puget Sound region.
- Forecasting future demand based on existing "unconstrained" estimates, future service assumptions, and **population** growth rates taken from the PSRC EMME2 travel forecasting model.
- Forecasting future demand based on existing "unconstrained" estimates, future service assumptions, and **transit** ridership growth rates taken from the Sound Transit EMME2 travel forecasting model, or from the PSRC model where appropriate.

The two separate estimates developed by the population-based and transit-based growth rates were used to provide a range of possible future forecasts.

The term "unconstrained" is used in this study to denote ideal conditions for capture of park-and-ride market demand. In some cases, the unconstrained year 2000 demand is estimated as higher than existing facility demand. This is because existing utilization may be constrained by factors other than lot size (e.g., facility location and accessibility, type of transit service provided, or a perceived safety concern or lack of other patron amenities). The analysis undertaken in this study was designed to estimate and forecast potential demand, unconstrained by less-than ideal facility attributes and service characteristics.

The region's park-and-ride system also serves as a staging platform for the vanpool programs of six local transit agencies. In the year 2000, some 1,250 formally organized carpools were

Rose Keir, 20-year vanpool participant

registered by the agencies. Organized car- and vanpools are entitled to priority loading on some of the most popular and congested ferry routes. Similarly, all car- and vanpools, formal or informal, are entitled to use existing park-and-ride facilities. While not all use park-and-ride facilities as a meeting or staging location, regional data suggest that up to 20 percent of vehicles parked at any individual facility may be a car- or vanpool. Demand estimates for existing and future park-and-ride facilities are inclusive of car- and vanpool utilization of the facility.

After generation of future forecasts, facility demand was then aggregated to corridor-level estimates and forecasts. This demand was adjusted based on input from the local transit agencies. The estimates and forecasts were then divided into specific programming recommendations, which were reviewed and adjusted by individual transit agencies based on their knowledge of the study area. All programming suggestions are considered moveable within the transit corridor. The process for estimating existing and future demand is illustrated in Figure 3.1 and 3.2. A more detailed methodology is discussed in the following subsections.

As indicated above, the focus of the demand estimation and forecasting approach was to develop corridor-level demand estimates. Location-specific forecasts developed as part of the process should not be viewed as implementation plans. These forecasts are based on optimistic assumptions about service levels and transit facilities. At the corridor level, such demand estimates are appropriate for planning and programming purposes. For implementation, detailed analyses based on factors such as committed transit services, known service area characteristics, and competing facility locations will need to be considered for site selection and design criteria.

Existing Demand

Existing park-and-ride facility observed demand within the central Puget Sound region often exceeds current facility capacity. Excess demand in the form of illegally parked vehicles at individual facilities, vehicles parked along adjacent streets, and vehicles parked in adjacent properties can be readily identified through field observations (e.g., South Bellevue P&R in King County, Tacoma Dome P&R in Pierce County, Lynnwood Transit Center in Snohomish County, and Harper Evangelical Church in Kitsap County). When demand for individual facilities exceeds available capacity, an unobservable latent demand can develop. Demand observations at individual park-and-ride facilities may therefore substantially under-represent existing demand because of the capacity constraint generated by the full facility.

Similarly, existing park-and-ride investments within individual corridors may not optimally "cover" the demand within the corridor. For example, a theoretically ideal coverage area can be

Figure 3.1

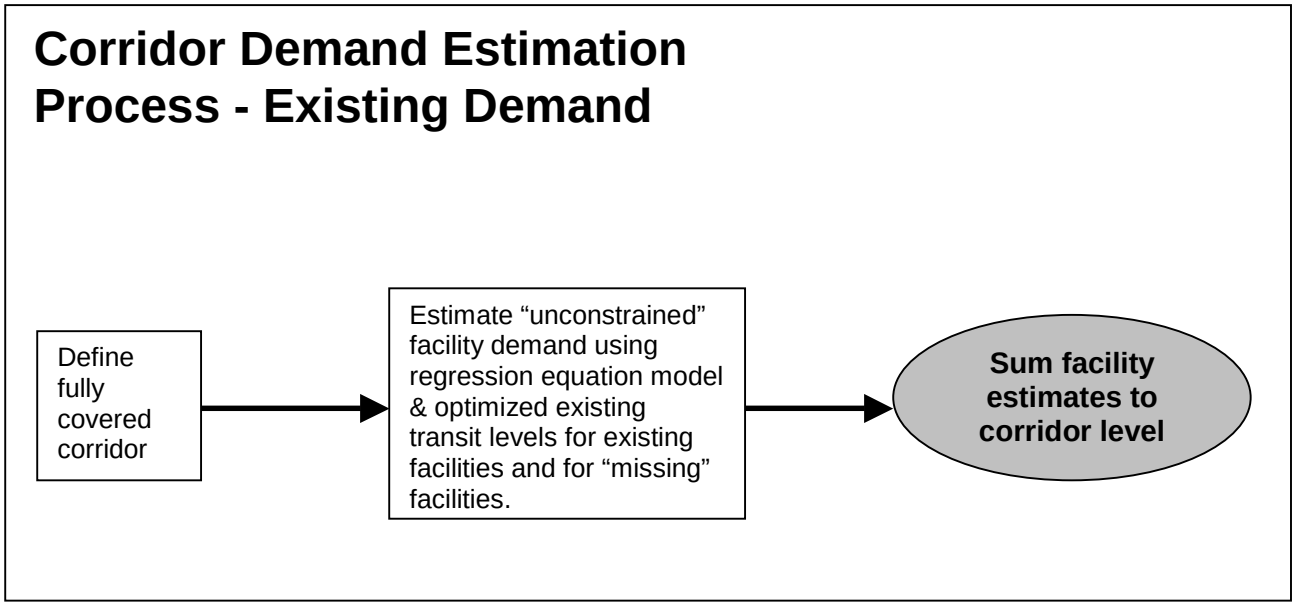
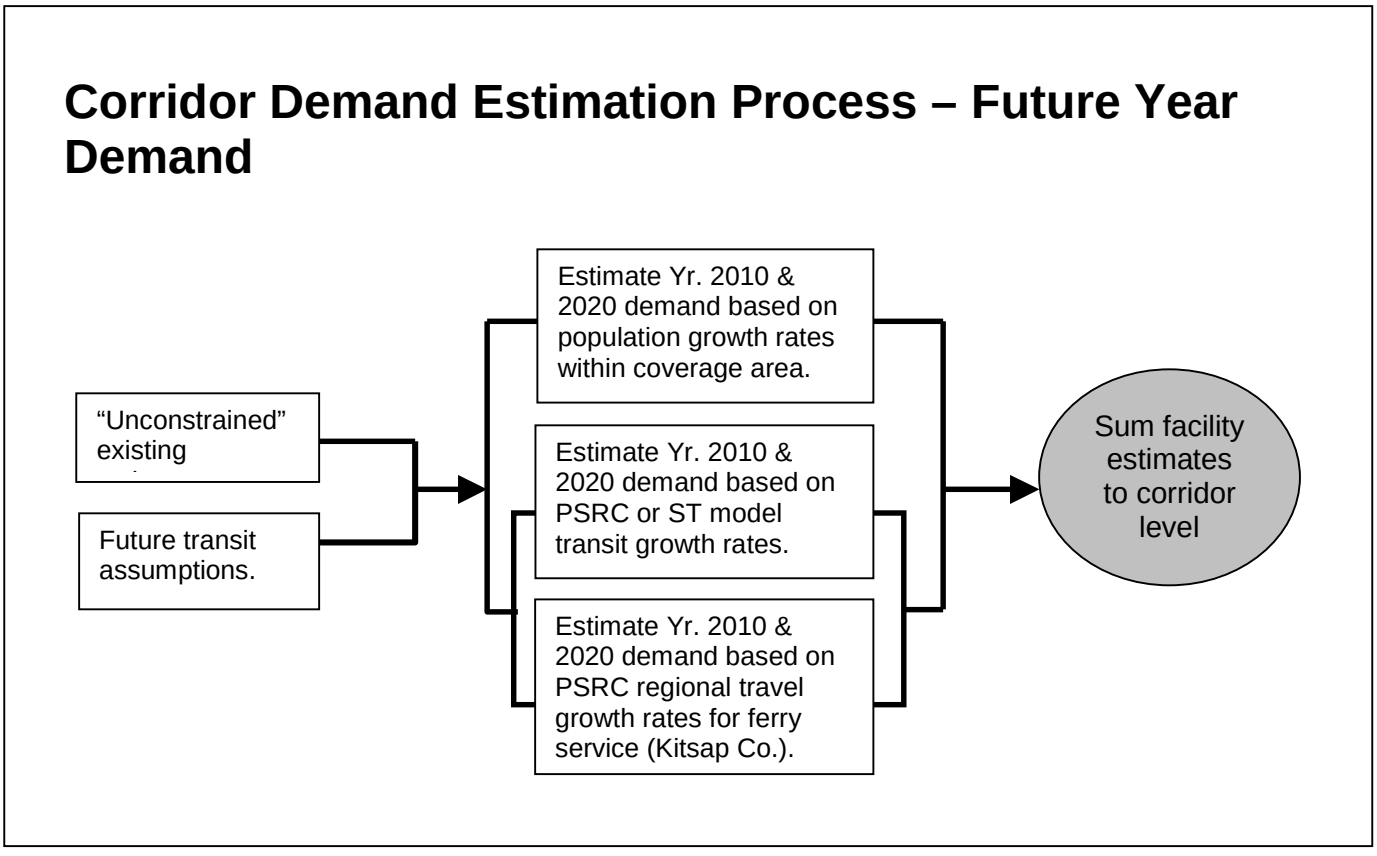


Figure 3.2



identified for each existing park-and-ride facility based on regional statistics.[1] Corridor segments with sufficient adjacent population that do not fall within an ideal coverage area of a park-and-ride facility are underserved. Demand within underserved areas may not be fully realized at existing park-and-ride facilities, thus resulting in latent unmet demand within the system.

To overcome these two limitations, a process to estimate existing demand based on facility characteristics and full corridor coverage was utilized. The process is based on the assumption that to obtain unconstrained corridor estimates, the corridor must be spatially served by sufficient facilities to approximate a fully covered corridor. Furthermore, it is assumed that an unconstrained estimate of park-and-ride demand at individual facilities can be approximated using a regression-based approach.[2]

THE PRD MODEL

The PRD model was used to estimate existing unconstrained facility demand. This model is a spreadsheet model based on a series of regression formulae developed for King County in 1995. The model was based on an analysis of the demand characteristics of thirty-one active lots in the King County system. Input variables include service area population, auto and transit costs, distances to major employment centers, the number of express buses during the AM peak period, best time to central business districts, proximity to the freeway system, number of adjacent park-and-ride facilities, and the availability of midday service. Details regarding the development and use of this model were published in *Park-and-Ride Planning and Design Guidelines*, Parsons Brinckerhoff Monograph #11, October 1997.[3]

The PRD model generates a range of demand estimates for individual facilities based on six regression formulae. Each formula emphasizes one or several of the inputs described above. Depending upon the location of the lot, service characteristics, or other considerations, either an average of all six equations, or the results of subsets of the equations, was chosen for each lot. For example, demand for lots in outlaying areas with low population and very low density land use is more accurately predicted by the formula emphasizing population. Hence, for such lots, only the most population-sensitive equation was used as the predictor of demand. The model parameters and underlying equations are presented in Figure 3.3.

The PRD model is not constrained by the existing capacity provided at current facilities, and therefore can predict latent demand. Facilities used in the derivation of the model ranged in size from approximately 150 spaces to 1000 spaces. Hence, the model is most accurate when used to estimate facilities within this range. However, it is sufficiently flexible and accurate when planning at the regional level to extend this range of applicability down to facilities as small as 100 spaces and for facilities up to 1500 spaces without introducing unreasonable results. As an example of its validation, the PRD model was used to verify the appropriate design characteristics for the newly opened Ash Way Park-and-ride facility in Snohomish County. Demand counts within the first few months of operation and after a normal demand stabilization period were within 30 vehicles of the demand estimates generated by the model.

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[1] Spillar, Robert J., *Park-and-Ride Planning and Design Guidelines,* 1995 William Barclay Parsons Fellowship Monograph #11, Parsons Brinckerhoff, New York NY, 1997.

[2] Ibid.

[3] Ibid.

Figure 3.3

DEFINITION OF MODEL VARIABLES

ATRANCOST	Ratio of Auto Operational Cost to Transit Cost. Auto Operational Costs includes parking costs.
AMBUS	Number of Express Bus Trips to Seattle CBD from the Park and Ride lot during the AM Peak period
AMBUSROOT	Square root of **AMBUS**
CBDSQ	Square of the distance in miles from the subject Park and Ride lot to Seattle CBD
FREEWAY	Boolean variable to capture proximity to Freeway. This variable takes the value 1 or 0
TRANSPD	Speed of Transit in mph expressed as a ratio of distance from the subject Park and Ride lot to the Seattle CBD to the best scheduled time to reach CBD from the Park and Ride lot
LOG_SPD	Natural logarithm (ln) of **TRANSPD**
ADJSPACE	Number of spaces in the adjacent park and ride lots within a 2.5 mile radius from the subject park and ride lot
UWTIME	Transit travel time from the subject park and ride lot to University of Washington District
MIDDAY	Boolean variable to capture presence of midday transit service from and to the subject park and ride lot
NUMLOTS	Number of adjacent park and ride lots within a 2.5 mile radius from the subject park and ride lot

MODEL 1 **ADJ R^2 = 0.447** **N=31** **STD. DEV = 128**

DEMAND = -45.664 + 52.687 * AMBUSROOT + 0.600 * CBDSQ + 129.904 * FREEWAY

MODEL 2 **ADJ R^2 = 0.645** **N=22** **STD. DEV = 84**

DEMAND = -1109.418 + 71.205 * AMBUSROOT + 126.2 * FREEWAY + 332.516 * LOG_SPD
+ 0.054 * ADJSPACE

MODEL 3 **ADJ R^2 = 0.415** **N=31** **STD. DEV = 131**

DEMAND = -815.390 + 42.069 * AMBUSROOT + 125.451 * FREEWAY + 291.503 * LOG_SPD

MODEL 4 **ADJ R^2 = 0.403** **N=31** **STD. DEV = 133**

DEMAND = -128.492 + 118.469 * ATRANCOST + 37.965 * AMBUSROOT + 152.677 * FREEWAY

MODEL 5 **ADJ R^2 = 0.620** **N=22** **STD. DEV = 84**

DEMAND = -359.661 + 73.236 * AMBUSROOT + 145.392 * FREEWAY + 13.219 * TRANSPD

MODEL 6 **ADJ R^2 = 0.694** **N=22** **STD. DEV = 92**

DEMAND = (-21.459 + 20.558 * FREEWAY + 35.169 * MIDDAY + 12.590 * NUMLOTS
+ 0.673 * UWTIME) * TOTPOP / 10,000

Note: Major local destinations can be substituted for the Seattle CBD. See individual county methodologies.

Source: Parsons Brinckerhoff

Coverage Areas

An initial step in the corridor estimation process involves the definition of ideal coverage areas for individual park-and-ride facilities within each corridor. Major park-and-ride facilities within each transit corridor were identified, and a typical service area then applied to each lot. Based on research in the Puget Sound region described in *Park-and-Ride Planning and Design Guidelines*, a circular 2.5-mile radius area centered on each park-and-ride facility was used as the assumed ideal coverage service area. Holes or underserved areas were then identified from the spatial distributions observed for existing park-and-ride facilities. Where underserved areas were identified, hypothetical placeholder or "proxy" facilities were located. On the other hand, where several permanent facilities were located closely together, or an adjacent facility was determined to be "minor," one or more existing park-and-ride lots may have been combined together. This allowed for an analysis of existing demand unconstrained by less-than-ideal facilities or facility placements.

Identified coverage areas for park-and-ride facilities within each county's transit corridors are shown by county in the following chapters. Proxy lots and combined existing lots were located for analysis purposes, and do not suggest finalized recommendations. Identified coverage areas should also not be mistaken for full draw areas. Based on research in the *Guidelines,* approximately 50 percent of a typical park-and-ride lot will normally draw from within the circular 2.5 mile radius area. The PRD model equations are developed to estimate full (100 percent) facility demand based on this reduced service area definition (i.e., 2.5 mile radial area).

Transit Assumptions

The PRD model also requires the input of transit assumptions. In order to estimate "unconstrained" park-and-ride demand, reasonably aggressive existing and future transit service levels were assumed. These assumptions were developed in close concert with individual transit agencies and are identified by county in the following chapters.

Future Demand

An unconstrained year 2000 demand was estimated based on the PRD methodology, and used as the base level for existing demand. This demand was then grown at both the rate of population growth as extracted from the PSRC EMME2-based model, and the rate of ridership growth as extracted from the Sound Transit EMME2-based travel model, Locally Preferred Alternative (LPA).

The Sound Transit model is an incremental model that pivots off of existing demand and service levels. This is in contrast to the PSRC model that is a fully synthetic model inclusive of the full four-step modeling process, based on Vision 2020 land use assumptions. Kitsap County and other outlying areas of the region are outside Sound Transit's LPA forecast area. For these areas, the PSRC model output was used to determine ridership growth rates.

The two separate scenarios represented by the population-based and transit-based growth rates were used in order to provide a range of possible future forecasts. These two approaches are discussed in more detail below.

POPULATION-BASED GROWTH FACTORS

The population-based projection method assumes as an underlying basis that park-and-ride demand can be directly linked to population in the coverage areas of each transit corridor.

Although there are certainly more factors that affect park-and-ride demand (freeway congestion, transit service levels, parking costs at employment centers, etc.), population growth can be a key indicator for anticipated growth in usage. Growth rates were calculated by corridor and applied to estimated existing demand at each facility, both existing and proxy, that comprise a corridor. Population-based forecasts generally provided the low end of the forecasting range for future demand because they imply that existing demand as a percent of the commuting market is stable and that future demand can be predicted by a straight-line forecast approach based solely on population growth. Using this method, no allowances are made for future modal shift resulting from system-wide transit improvements and/or increasing arterial and freeway congestion.

TRANSIT-BASED GROWTH FACTORS

The transit-based projection method assumes that park-and-ride demand grows at a similar rate to the forecasted background growth in transit demand in the coverage area of each transit corridor. Growth rates were calculated by corridor and applied to estimated existing demand at each facility, both existing and proxy, that comprise a corridor. The transit-based forecasts were generally higher than the population-based forecasts because transit modal share is generally expected to increase as transit improvements are realized, urban and suburban areas of the region continue to densify, and non-transit travel networks become increasingly congested.

Corridor-Specific Adjustments

A uniform methodology was applied throughout the study area in order to assure consistency of findings. The three-pronged approach outlined above allowed for minor modifications to be made for each county to reflect unique characteristics within corridors. Because the PRD model was primarily developed in King County, adjustments were required to validate the model for use in Kitsap, Pierce, and Snohomish Counties. These adjustments were made on a primarily trial-and-error basis in order to obtain reasonable existing condition estimates. Once validated for the existing conditions, these modifications were maintained into the forecasting of future demand levels.

For example, in Kitsap County the travel time between the subject park-and-ride facility and the nearest ferry terminal offering service to Seattle was found to be a better indicator variable than the full travel time to the Seattle CBD. This variable substitution was therefore made for all Kitsap County estimates. In all cases, forecasts resulting from variable substitution were reviewed and approved by local transit agencies.

Details of corridor-specific methodological adjustments are presented by county in the following chapters.

PROGRAMMING

This study provides an estimate of demand through 2020 and a list of potential capital projects phased through the PSRC 2030 planning horizon. These projects represent a financially unconstrained view and are not prioritized beyond their phasing. Capital projects were programmed over three planning periods: short-range (2000-2006), mid-range (2007-2015), and long-range (2016-2030). Short-range projects consist of those projects already programmed by participating agencies. Assuming that the programming of facilities typically

lags behind demand, the project list for future time periods responds to the previous period's demand estimate, as follows:

Period	Demand Year	Program Period
Short-Term	2000 pipeline projects	2000-2006
Mid-Range	2000 unmet demand	2007-2015
Long-Range	2010	2016-2020
Long-Range	2020	2030 MTP horizon

Project recommendations were reviewed with WSDOT and the participating transit agencies to assure consistency with current agency planning efforts, and for completeness and reasonableness. Projects were added, deleted, and moved forward or backward in time to better meet an agency's objectives. Project location, size, and type of facility were also determined through this iterative process. It must be emphasized that this program is not financially constrained and that fulfillment of total park-and-ride demand may be neither feasible nor desirable. This issue must be addressed at the corridor policy level and at facility implementation.

During the identification of corridor projects for each county, two important assumptions were utilized:

- A 20 percent reserve capacity was added to parking demand in order to account for growth in carpool and vanpool operations, for midday usage of the facility, and for short-term use of spaces. It should be noted that carpool and vanpool lot use is already included in the model estimation, so this reserve capacity would be for growth in current rates only. It is also assumed that agencies will begin to define park-and-ride facilities as being "full" once they near the 80 percent utilization level. (Note: carpool, vanpool, and rideshare demand, as well as the criterion that trigger facility expansion are influenced by policy. Future updates to the park-and-ride system plan and individual site design efforts should explicitly review current policy on these issues to assure consistency with current standards and needs.).
- In instances where existing capacity exceeds demand, it was assumed that 50% of excess capacity may eventually be put into use through improved bus service, improved user information, and expanded marketing, or other means of attracting users.

An eight-step process was used to identify corridor programming needs based on the projected demand estimates. These identified programming needs take into account existing and future capacity shortfalls, transit agency policies, and system-wide demand. This eight-step process is described in detail below, and represented in Figure 3.4.

STEP ONE: Existing capacity is discounted by 20 percent to allow for operational reserve.

Adjusted Existing Capacity = Existing Capacity minus 20%

STEP TWO:

Available Capacity = Adjusted Existing Capacity minus Observed 2000 Usage

STEP THREE: In some instances, existing capacity may be underused. For the purposes of this study, it is assumed that 50 percent of unused capacity will count towards existing estimated demand, therefore:

If Available Capacity > 0 (unused capacity) then Adjusted Available Capacity = ½ Available Capacity

STEP FOUR :

Unmet 2000 Demand = 2000 Estimated Demand minus Observed 2000 Usage

STEP FIVE:

2000 Need = (Unmet 2000 Demand minus Adjusted Available Capacity) plus 20% Reserve

Short-Term Projects

Short-range projects consist of those projects already programmed by participating agencies (Six-Year Programs)

STEP SIX:

Mid-Range 2007-2015 Need

Unmet 2000 Need = 2000 Need minus Six-Year Program

STEP SEVEN:

Long-Range 2016-2020 Need

2010 Need = [(2010 Demand minus 2000 Estimated Demand) minus 2000 Unused Capacity] plus 20% Reserve

2000 Unused Capacity = 2000 Need < 0

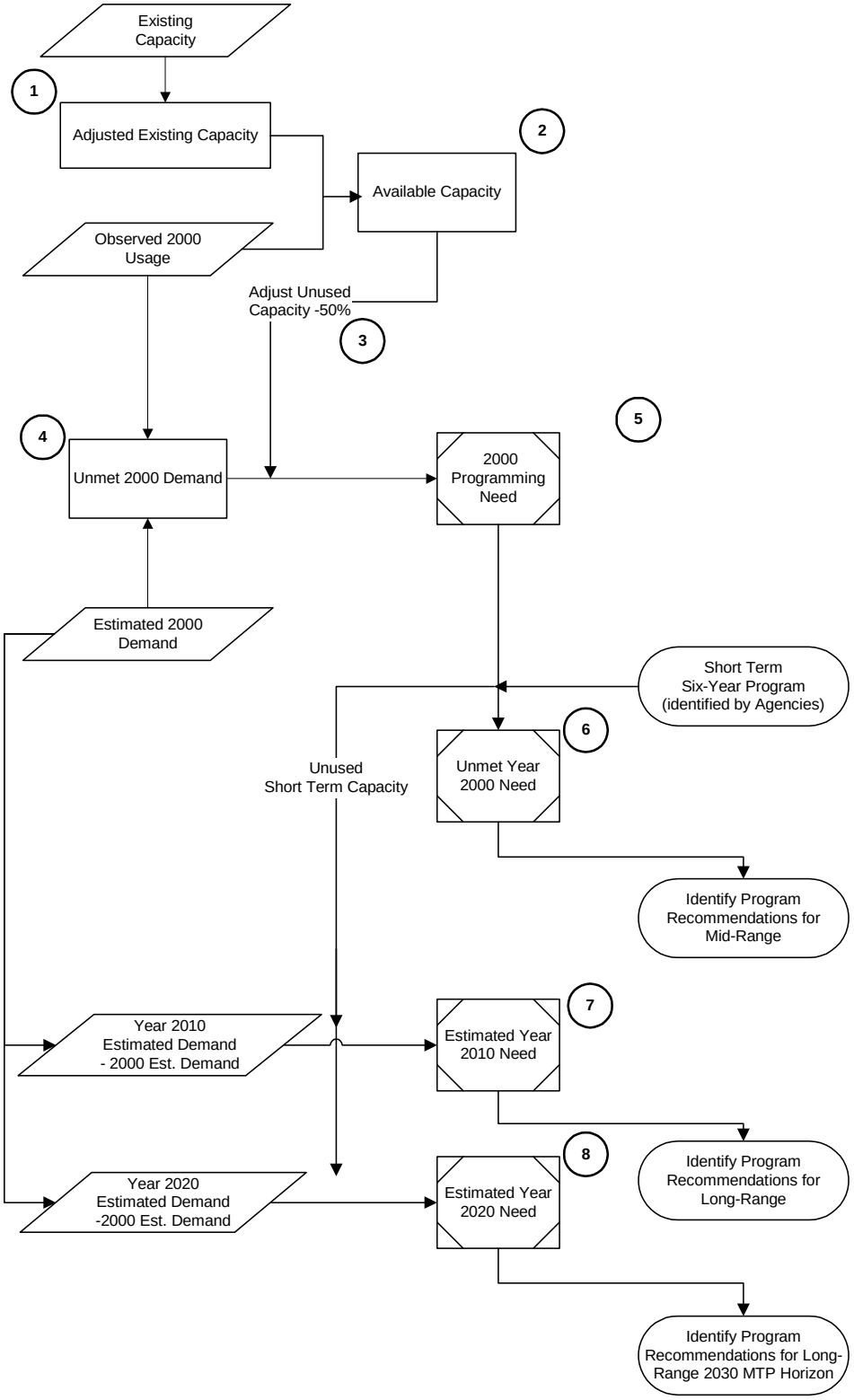
STEP EIGHT:

Long-Range MTP Horizon Need

2020 Need = [(2020 Demand minus 2010 Demand) minus 2010 Unused Capacity] plus 20% Reserve

Figure 3.4

Eight-Step Programming Process



COST ESTIMATING

In order to help develop programming level cost estimates for facilities, unit costs were derived for each county. These costs were based on current and completed projects and then adjusted as needed to reflect each agency's individual implementation experiences. While these cost assumptions tend to be conservative, they are given as order of magnitude estimates. More detailed costs estimates will need to be developed at the time of implementation. All cost estimates are stated in constant 2000 dollars.

Unit costs for construction were developed for both surface parking and parking structures by county. For surface parking, stalls were assumed at a size of 800 square feet to allow for landscaping and circulation. Structured parking was assumed to require 400 square feet per stall for right-of-way (footprint) calculations. Because of the tremendous range in land values witnessed in the region, right of way cost assumptions were developed for each county and sub area to more accurately reflect variations. Each county used a slightly different approach for determining land value. Kitsap, for example, used "high cost" and "average cost" assumptions as appropriate for individual project locations, whereas King County used the generalized geographic areas of "North", "South", and "East".

Table 3.1 summarizes the cost assumptions used for programming cost estimates. Detailed cost information is presented by County in the following sections.

Table 3.1

Cost Assumptions by County

County	Type of Facility	Construction Cost/Stall	ROW Cost Per Stall by Area		
			North	**South**	**East**
King	Structure	$15,000	$17,500	$6,500	$12,800
	Surface	$10,000	$35,000	$13,000	$25,600
			High Cost	**Average Cost**	
Kitsap	Structure	$20,000	$12,000	$1,250	
	Surface	$5,000	$24,000	$2,500	
			SW Urban	**N & E Urban**	**Rural**
Snohomish	Structure	$15,000	$8,000	$6,000	$3,500
	Surface	$5,000	$16,000	$12,000	$7,000
			Urban	**Rural**	
Pierce	Structure	$20,000	$10,750	$3,500	
	Surface	$10,000	$21,500	$7,000	

Source: Parsons Brinckerhoff