2 TRAVEL DEMAND AND TRANSIT MARKET ANALYSIS

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2 TRAVEL DEMAND AND TRANSIT MARKET ANALYSIS

Introduction

Assessing the market for public transportation between Seattle neighborhoods and between Seattle and other regional destinations is a foundational element of the Seattle Transit Master Plan (TMP). Work on the market analysis will continue as the TMP is developed; this section summarizes the initial phase of work.

Two foundational elements of the market analysis are summarized in this section:

- *A point-to-point analysis of all travel within Seattle and between Seattle and the region*. This data is derived from the Seattle travel demand model.
- *A point-to-point and corridor level analysis of transit demand and use patterns in Seattle*. This analysis uses several sources including the Seattle travel demand model and boarding data collected by King County Metro and Sound Transit.

The information presented in this section is the first stage of a multi-stage analysis process. The market analysis will answer several important questions. This first stage will answer:

1. What are the major travel patterns within Seattle and connecting to the region?
2. How effective is the current transit network in serving those travel markets?
3. Where is the transit system being used most heavily? How does this correlate with overall travel demand? What factors are attributable to the differences?
4. What are the conditions for transit users walking or bicycling to bus stops and stations?

Subsequent stages of the market analysis will answer:

1. How will travel demand patterns change in the next 20 years?
2. How effectively does the planned and funded transit network meet projected future travel needs?
3. How directly does the arterial street network connect the highest volume travel patterns?
4. How effectively does the arterial street network provide accessibility to the largest potential transit markets?
5. What corridors should be prioritized for improvements to transit service levels; for capital investments to improve speed, reliability, and capacity; or for both?

Factors Affecting Transit Demand

There are a number of factors that planners can use to evaluate and predict future transit demand. Those proven to be most predictive include: *density, size, regional location, community design, street design, and price (both of transit travel and competing modes).*

- **Density**, for the purpose of this study, is described by the combination of population and employment per acre. In *Transit Metropolis*, Robert Cervero states, "It is widely agreed that higher urban densities will do more than any single change to our cityscapes in attracting people to trains and buses."
  - Every 10% increase in population and employment densities yields a 5-8% increase in transit ridership, controlling for other factors (such as lower incomes, restricted parking, and better transit services generally associated with more compact settings). Note that this is an aggregate of studies of many densities, and is refined by other studies listed below.
  - In a 1984 study in New York City, results showed that neighborhoods with densities of 8,000 people/square mile (five dwelling units/acre) averaged 0.2 daily transit trips per resident, while otherwise comparable neighborhoods (in income) with 24,000 people/square mile (15 dwelling units/acre) averaged 0.7 daily transit trips per capita.[1]
  - A study by Spillar and Rutherford (1998) states, "Transit use per person grows with increasing density up to a ceiling at somewhere between 20 and 30 people per acre (about 19,000 people per square mile or 12 dwelling units/acre). In terms of income, in higher income neighborhoods (those with less than 18% low-income families) density has less of an effect on transit use than in low-income areas, but this could be due to the relatively small number of samples available." [2]

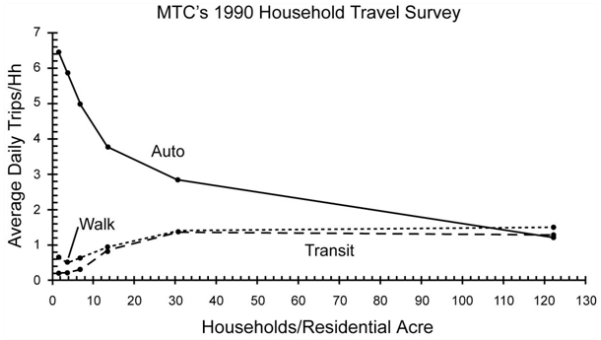
1 Cervero, Robert. 1998. Transit Metropolis, Island Press, 1998. p. 72-74

2 Spillar, Robert J., and G. Scott Rutherford. 1998. "The Effects of Population Density and Income on Per Capita Transit Ridership in Western American Cities." Institute of Transportation Engineers' Compendium of Technical Papers: 60th Annual Meeting. August 5-8, 1998. Pp. 327-331.

- Similarly, the San Francisco Bay Area's Metropolitan Transportation Commission surveyed over 10,000 households throughout the metropolitan region in its 1990 Household Travel Survey, and showed that transit trip ridership per household flattens out at a density of about 30 households per acre, or roughly 48,000 people per square mile (see Figure 2-1). The study also shows that a base of at least five households per acre (8,000 people/square mile) is needed before transit ridership will grow, increasing noticeably at about 10 households per acre (16,000 people per square mile) and up.

- **Size** must be considered together with density to determine the overall market that has been organized in a transit-oriented way, which in turn will determine the level of service that can be supported. An isolated, 50-unit apartment building surrounded by surface parking and/or open space could have a very high density rating if analyzed within a fine enough zone, but this alone would not mean it deserves the same level of service as a larger neighborhood with an average density of 25 units per acre, because it is a much smaller market. A particular level of service will require a *minimum density over a minimum area.*
- **Regional location** also affects travel demand as well as transit efficiency. Travel demand between two points tends to be inversely related to the distance between those points. If there are other transit-oriented places close by, it is more likely that transit will be attractive as a mode. In addition, regional location determines whether a proposed line will have strong anchors to sustain ridership at the ends of the line. Regional location is addressed by ensuring that future transit corridors have major activity centers—often referred to as anchors—at their endpoints.
- **Community design** is another crucial, but often unnoticed, element of transit demand. Community design is especially important as it relates to pedestrian access and safety. Even at high densities, people will not use transit if it is difficult or dangerous to access a bus stop. Many of today's auto-oriented suburban apartment complexes, while very dense, have extremely poor access to major arterials or viable transit carrying streets. It is possible to configure density so that it is impossible to serve with transit.
- **Street design** is also an important component of transit access and operational viability. Neighborhoods where all roads are designed to connect to arterials or collector streets allow transit customers to reach bus stops without walking out of direction. They also provide more efficient routing options that can support high frequency service.

FIGURE 2-1 AVERAGE DAILY TRIPS PER HOUSEHOLD VS. DENSITY



Source: John Holtzclaw

Although the City of Seattle does not directly control how service is allocated, it does control many of the elements that make transit successful. *In other words, while the City does not control how limited transit operating dollars are allocated, it does have some control over the development patterns that will drive future transit demand and service allocation.* More than anything, markets drive transit service allocation; better transit will require dense, mixed-use corridors with excellent access to transit stations.

A model developed by Fehr and Peers to model transit ridership using community land use, urban form, and service characteristics shows the following relationships with ridership. As shown in Figure 2-2, two factors with the most influence on increasing transit ridership relate to frequency and thus reduced wait times.

FIGURE 2-2 FACTORS INFLUENCING TRANSIT RIDERSHIP (RAIL)

Given a 100% Increase In	Expect Ridership Increase
Number of peak period trains	48%
Peak-period feeder buses	29%
Population and employment within ½ mile of transit station	23%
Parking spaces	4%
Population within station catchment	2%

*Adapted from Fehr & Peers direct ridership model (2004).

Price (Fare Levels and Other Travel Costs)

As with any service, transit fare costs and the comparative costs of alternative services, such as driving and parking, play a major role in traveler decisions about when, where and how to travel.

- Non-commute trips tend to be more price sensitive than commute trips. Elasticities for off-peak transit travel are typically 1.5-2 times higher than peak period elasticities, because peak period travel largely consists of commute trips.
- Transit-dependent riders[3] are less price sensitive than choice or discretionary riders. Certain demographic groups, including people with low incomes, non-drivers, people with disabilities, high school and college students, and elderly people tend to rely on transit more than other groups (see Figure 2-11). Transit-dependent riders typically constitute a higher percentage of overall transit ridership than the group represents as a percent of total population. Discretionary riders or potential riders are a much larger group, but are much more sensitive to price and other service quality factors.
- According to the Transit Master Plan web survey (including over 10,000 responses) cost of service was not among the top reasons why non-users chose other travel options; 11% of infrequent riders or non riders identified "costs too much" as a reason they do not use transit more often.
- Figure 2-3 shows the effect of fare levels on transit users by rider type.[4] While these results can vary depending on other factors, they help illustrate how fare changes impact ridership.

3 Transit-dependent individuals rely on transit because they do not have access to a private vehicle or cannot drive due to a physical or mental impairment. This group includes people who are unable to afford a vehicle and people who choose not to own a car.

4 David Gillen, "Peak Pricing Strategies in Transportation, Utilities, and Telecommunications: Lessons for Road Pricing." Curbing Gridlock. TRB (www.trb.org), 1994, pp. 115-151.

FIGURE 2-3 EFFECTS OF TRANSIT FARES ON DEMAND, BY DEMOGRAPHIC GROUP AND TYPE OF TRIP

Factor	Percent Change in Transit Demand for a 10% Increase in Fares
Overall transit fares	-3.3% to -2.2%
Riders under 16 years old	-3.2%
Riders aged 17-64	-2.2%
Riders over 64 years old	-1.4%
Car owners	-4.1%
People without a car	-1.0%
Work trips	-1.0% to -1.9%
Shopping trips	-3.2% to -4.9%
Off-peak trips	-1.1% to -8.4%
Peak trips	-0.4% to -3.2%
Trips < 1 mile	-5.5%
Trips > 3 miles	-2.9%

The table above is based on the concept of elasticity—a measure of responsiveness or how much one factor changes another. The table illustrates the effects of an incremental 10% increase in transit price on transit ridership among different demographic groups and for different types of trips. Overall, the effect is a 2.2%-3.3% decrease in ridership (an elasticity of -0.22 to -0.33). Transit-dependent riders and commuters have a less elastic response to changes in the price of transit or, in other words, their travel behavior is less affected by price increases. For example, ridership among people without a car only decreases by 1% in response to a 10% fare increase (an elasticity of -0.1).

Other policies or price structures that impact or have the potential to impact transit ridership include:

- **Free Fare Area.** In Seattle, the free fare area impacts demand for transit. Many customers that might otherwise walk or not travel at all use transit in this zone. Additionally, some travelers walk to stops just inside the Free Fare Area to board, rather than boarding at a closer stop.
- **Parking Price.** For decades, researchers have confirmed the direct relationship between trip-end parking price and transit use. In Seattle, high transit mode share for travel to the Center City can be attributed in part to the relatively high cost of parking in Downtown and adjacent neighborhoods. A review of parking prices in central business districts (CBD) and citywide mode share for peer cities, described in Chapter 5: Peer Review, shows strong correlations. Seattle's median downtown parking rates are the highest among these cities, tied with San Francisco (see page 5-25). Research studies have reported that a $1.00 per trip parking charge causes the same reduction in vehicle travel as a fuel price increase of $1.50 to $2.00 per trip. Commuter parking fees are closely interrelated with a number of other trip cost and time cost factors, such as the cost for alternative mode travel (i.e., transit fares), the cost of time related to change in travel time, and more intangible benefits such as travel flexibility. Hensher and King (2001) modeled the price elasticity of CBD parking, and predicted how an increase in parking prices in one location will affect a shift to transit and cause drivers to seek parking opportunities further afield. They found a 10% increase in prices at preferred CBD parking locations to cause a 5.41% reduction in parking demand overall. A 2.91% reduction was attributed to people shifting to transit. [5]
- **Roadway Pricing.** Tolling has been introduced in the Puget Sound and is considered to be a critical mechanism for raising revenue and managing congestion. Tolling has been implemented on

5 David A. Hensher and Jenny King, "Parking Demand and Responsiveness to Supply, Price and Location in Sydney Central Business District," Transportation Research A, Vol. 35, No. 3 (www.elsevier.com/locate/tra), March 2001, pp. 177-196.

SR 167 and is approved for implementation on the SR 520 Evergreen Floating Bridge. It is being considered for SR 99 in Seattle, on I-90 high occupancy vehicle lanes, and on SR 509. It is difficult to quantify the impacts of tolling on transit mode share, since there are a number of other factors at play in travel decision making, including: presence and quality of transit service in the tolled corridor and the travel time difference between transit and driving. That said, tolling typically increases the overall cost of driving and provides a greater cost advantage to transit.

- **Employer subsidies** for transportation can have a significant impact on transit demand. Subsidies typically come in a few primary forms:
  - **Parking subsidy.** Employers that provide free parking to employers are subsidizing driving by covering the cost of vehicle storage at the trip end. Employers that provide free employee parking typically have high rates of driving.
  - **Transit pass subsidy.** Many Puget Sound employers subsidize employee transit pass purchases, fully or in part. Statistical evidence shows that employers who provide transit pass subsidies achieve much higher rates of transit use than those that do not.
  - **Privately provided transportation.** Existing transit services do not meet employee transportation needs for all employers in Seattle and the Puget Sound. Some employers provide private shuttle or commuter bus service to employees to fill in gaps in the public transit network and/or to provide an increased level of convenience or privacy. These types of services are typically free and are a form of transportation subsidy. Microsoft runs peak-hour commuter bus service from several Seattle neighborhoods to their campus in Redmond. Within Seattle, a number of medical institutions run private shuttles connecting their facilities to major transportation hubs.

Transit Market Analysis

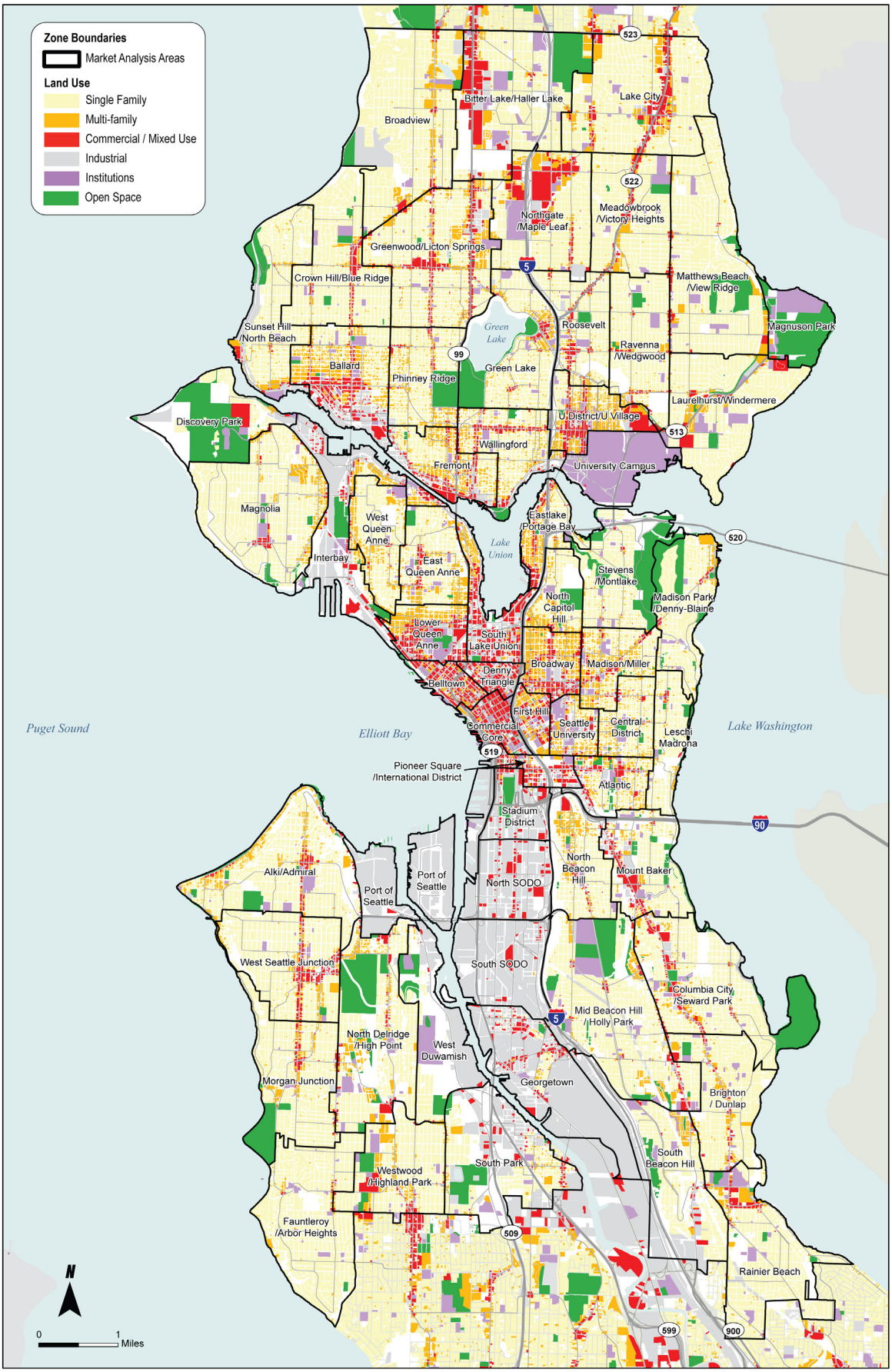
A range of factors combine to affect demand for transit. Some are quantifiable; others are more subtle. Extensive industry research shows that the built environment—including land use density and mix of uses, neighborhood form, connectivity in the transportation network, and urban design—significantly impacts travel behavior. Compact development is also linked to positive externalities such as reduced greenhouse gas emissions, active community environments, and increased livability (urban open spaces, affordable housing, and transportation options). These relationships are described in more detail in Chapter 3: Land Use.

This section evaluates factors known to impact transit demand and describes current system use. It also describes briefly how creating a disincentive to driving, such as parking price and roadway tolls, affects transit demand.

Existing Land Use Patterns

- Seattle has adopted an urban village strategy to focus future population and employment growth in designated areas. These areas are classified into four categories based on their degree of land use intensity: urban centers, manufacturing/industrial centers (MIC), hub urban villages, and residential urban villages. Chapter 3: Land Use describes these designations in detail (see page 3-1).
- Seattle has significant areas of single-family residential development. Concentrations of multifamily housing, retail, commercial, and office space are found largely in urban centers and urban villages and along major transportation corridors.
- In north Seattle, concentrations of retail, commercial, and office space are present in a higher number of centers and corridors than in west and south Seattle where retail activity is limited to select corridors (e.g., California Avenue and Rainier Avenue).
- Industrial, manufacturing, and warehousing activities are concentrated in two major areas, north of downtown along the Ship Canal and the Ballard locks, and south of downtown in the Port of Seattle Harbor, SODO, and along the Duwamish River.
- Seattle Center City and neighborhoods located between the Ship Canal and I-90, and Elliott Bay and Broadway have concentrated areas of multifamily housing; retail, commercial and office space; educational and health institutions; and mixed use developments. In particular, Lower Queen Anne, Belltown, South Lake Union, and Capitol Hill show significant variety and diversity of land uses.

FIGURE 2-4 CITY OF SEATTLE LAND USE PATTERNS



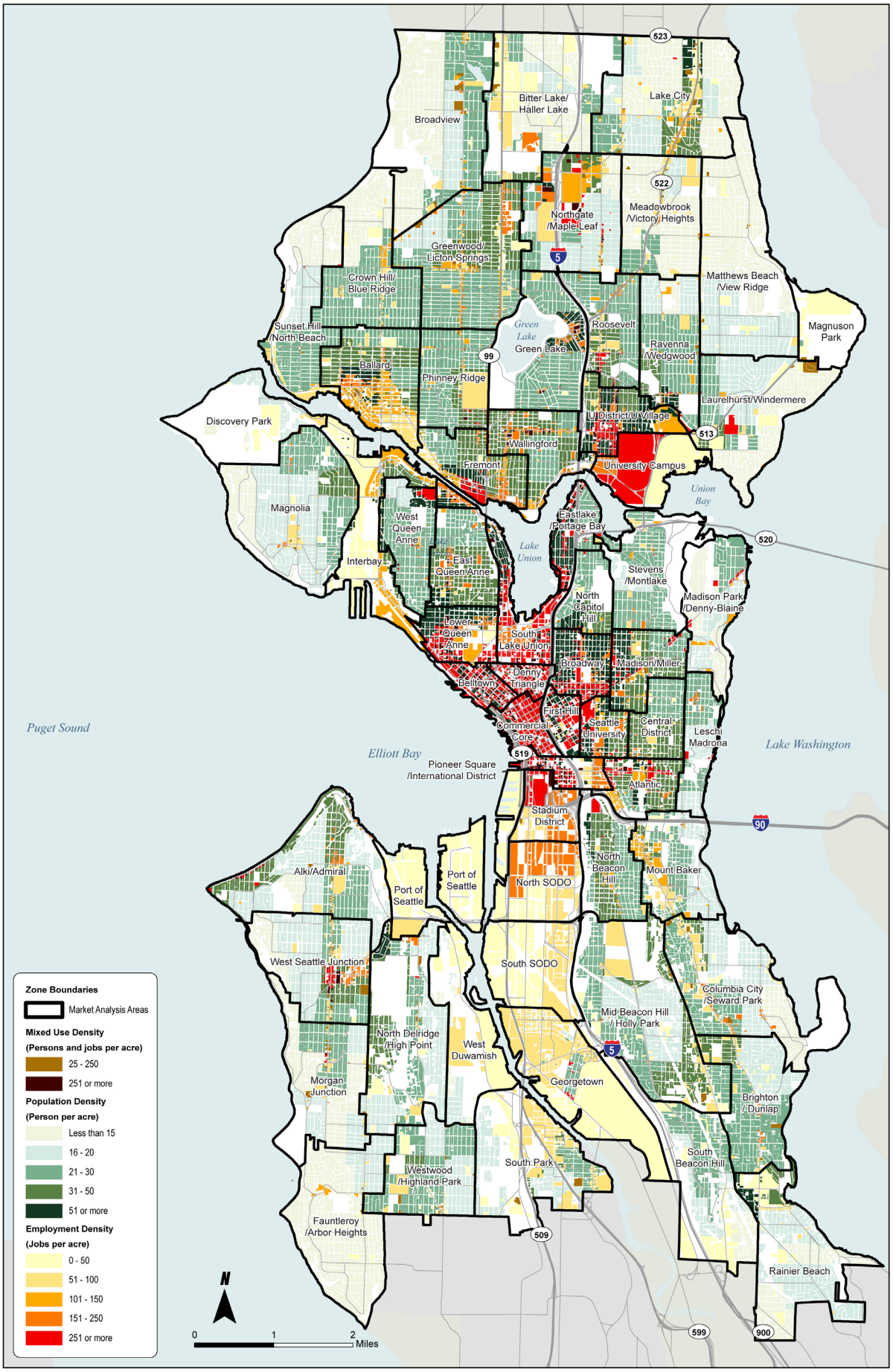
Nelson|Nygaard consulting associates

Source: City of Seattle

Existing Population and Employment Density

- Population and employment density have a significant influence on transit demand. The density of residential, retail, and commercial development determines the number of people and/or activities that are near transit services.
- As density of development increases, incentives to use transit (or disincentives to driving) such as traffic congestion, parking availability, and parking rates tend to increase.
- Other important indicators that affect transit use include proximity of a large university, employment center, or other activity center; where these land uses exist people tend to live and work in more concentrated environments.
- Areas of high employment density (more than 40 jobs per acre) are found in the Center City and adjacent neighborhoods, including downtown, First Hill, Capitol Hill, Denny Triangle, and South Lake Union, and in the University District and the University of Washington (UW) campus. These areas correlate with areas where transit use is highest.
- Major residential density areas (more than 20 persons per acre) are found in Ballard, Greenwood, Lake City, Fremont, Green Lake, the University District, Lower Queen Anne, South Lake Union, Capitol Hill, First Hill, and in portions of West Seattle and Columbia City.

FIGURE 2-5 CITY OF SEATTLE POPULATION AND EMPLOYMENT DENSITY



Source: City of Seattle

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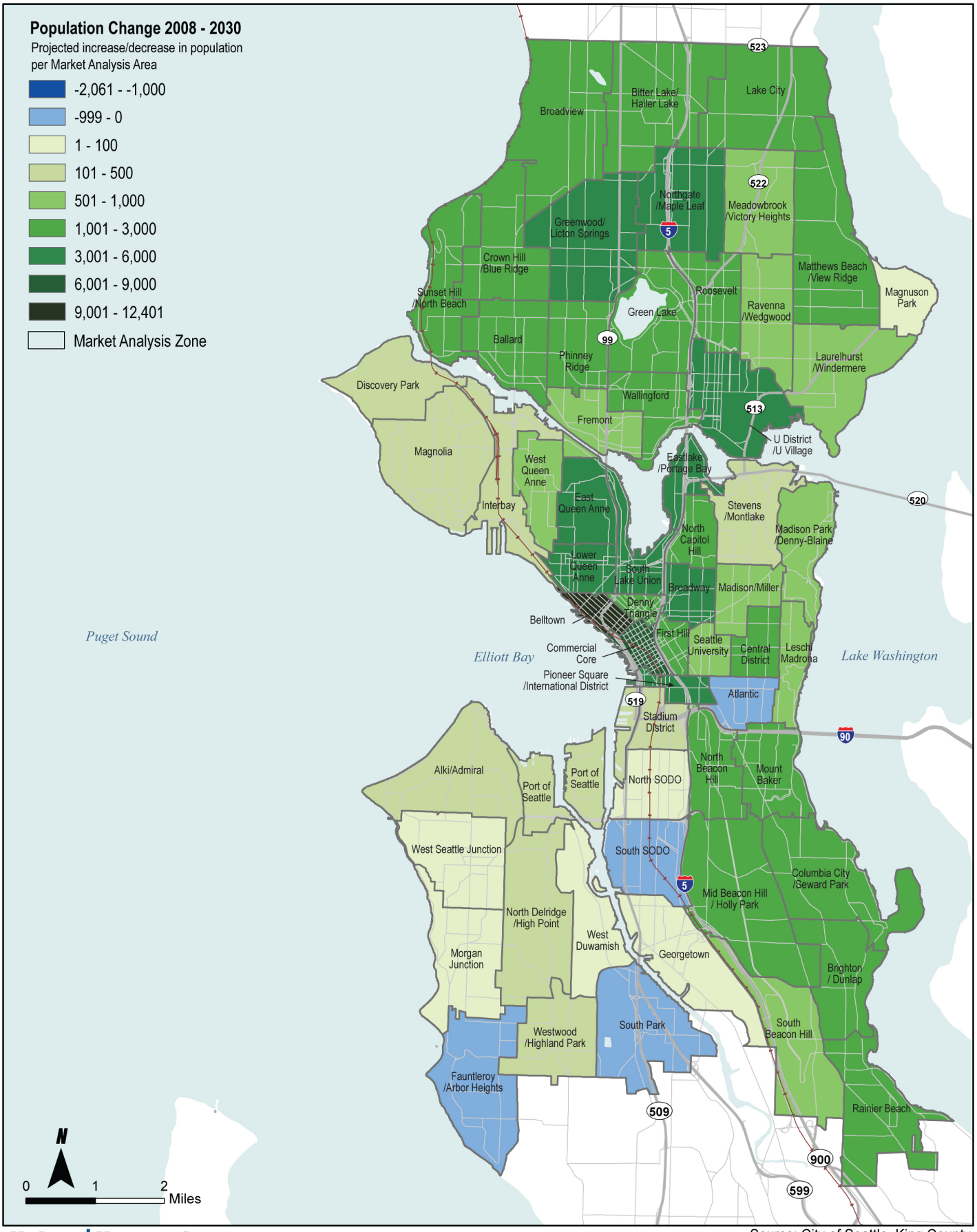
Population Change (2008-2030)

- This map shows the distribution of projected population growth in Seattle. The Puget Sound Regional Council (PSRC) forecasts a net increase in population of about 100,000 new residents by 2030, from nearly 575,000 residents in 2008. Recent real estate market trends suggest that urban living may be more favored in the coming decades than it has been in the past; if these trends continue Seattle could take on a larger share of regional population growth than projected by PSRC.
- Most growth is projected to happen in urban centers and residential urban villages where density exists today. Outside the Center City, where most growth is anticipated, growth in Northgate has the potential to be most transformative.
- Areas throughout south Seattle are expected to experience moderate population growth. West Seattle is expected to remain relatively stable, adding to the residential population in Alki/Admiral and along 35th Avenue SW.
- According to PSRC land use projections, the UW Campus area is projected to lose population (about 2,000 people) by 2030. This may be in part due to a redistribution of student residences to the University District, but could also represent a shortcoming in the data. For this reason, it is more appropriate to look at the University District and UW Campus together; a significant increase in population (about 3,000 people) is projected for the area, which has nearly 16,000 people as of 2008 (see figure 2-6).

FIGURE 2-6 CITY OF SEATTLE POPULATION CHANGE (2008-2030)



Source: City of Seattle, King County

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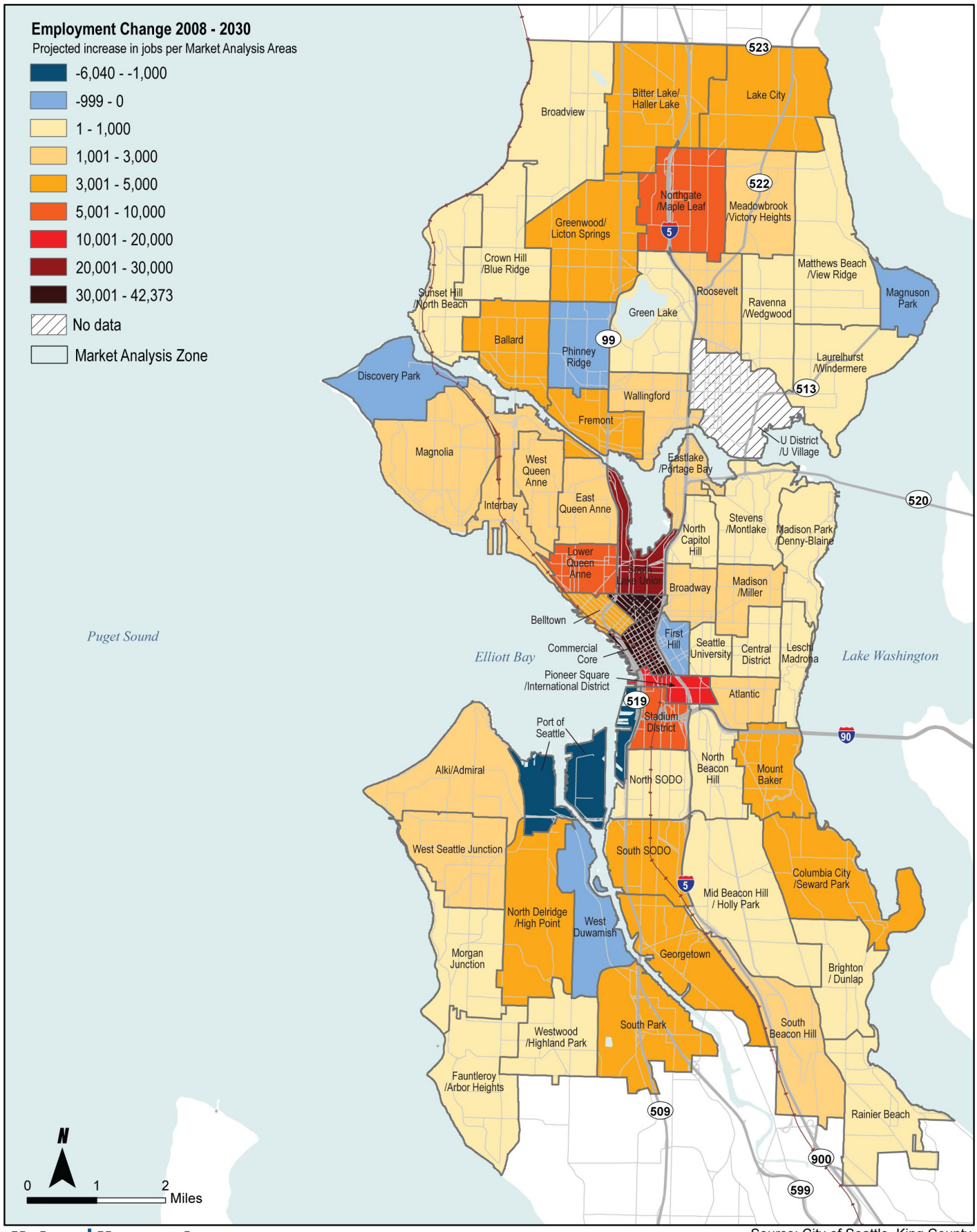
Employment Change (2008-2030)

- According to PSRC projections, a net increase of about 200,000 jobs is expected in the city of Seattle by 2030, from about 500,000 jobs in 2008.
- The largest employment growth is expected in downtown Seattle and adjacent Center City areas, including Lower Queen Anne, South Lake Union, Denny Triangle, Pioneer Square/ International District, and the Stadium District north of SODO.
- Northgate is expected to receive high growth in employment (an increase of 5,000-10,000 jobs from over 9,000 in 2008), while adjacent areas in North Seattle—such as Lake City, Bitter Lake/Haller Lake, Greenwood, and Ballard—are projected to receive moderate job growth.
- West Seattle and south Seattle show moderate employment growth in Alki/Admiral, the West Seattle Junction, High Point/North Delridge, Mount Baker, and Columbia City.
- Significant employment growth is also expected in industrial areas along the Duwamish River, in SODO, Georgetown, and South Park.
- Employment projections for the University of Washington Campus are not included in Figure 2-7 due to an error in the PSRC land use projection for this zone.

FIGURE 2-7 CITY OF SEATTLE EMPLOYMENT CHANGE (2008-2030)



Source: City of Seattle, King County

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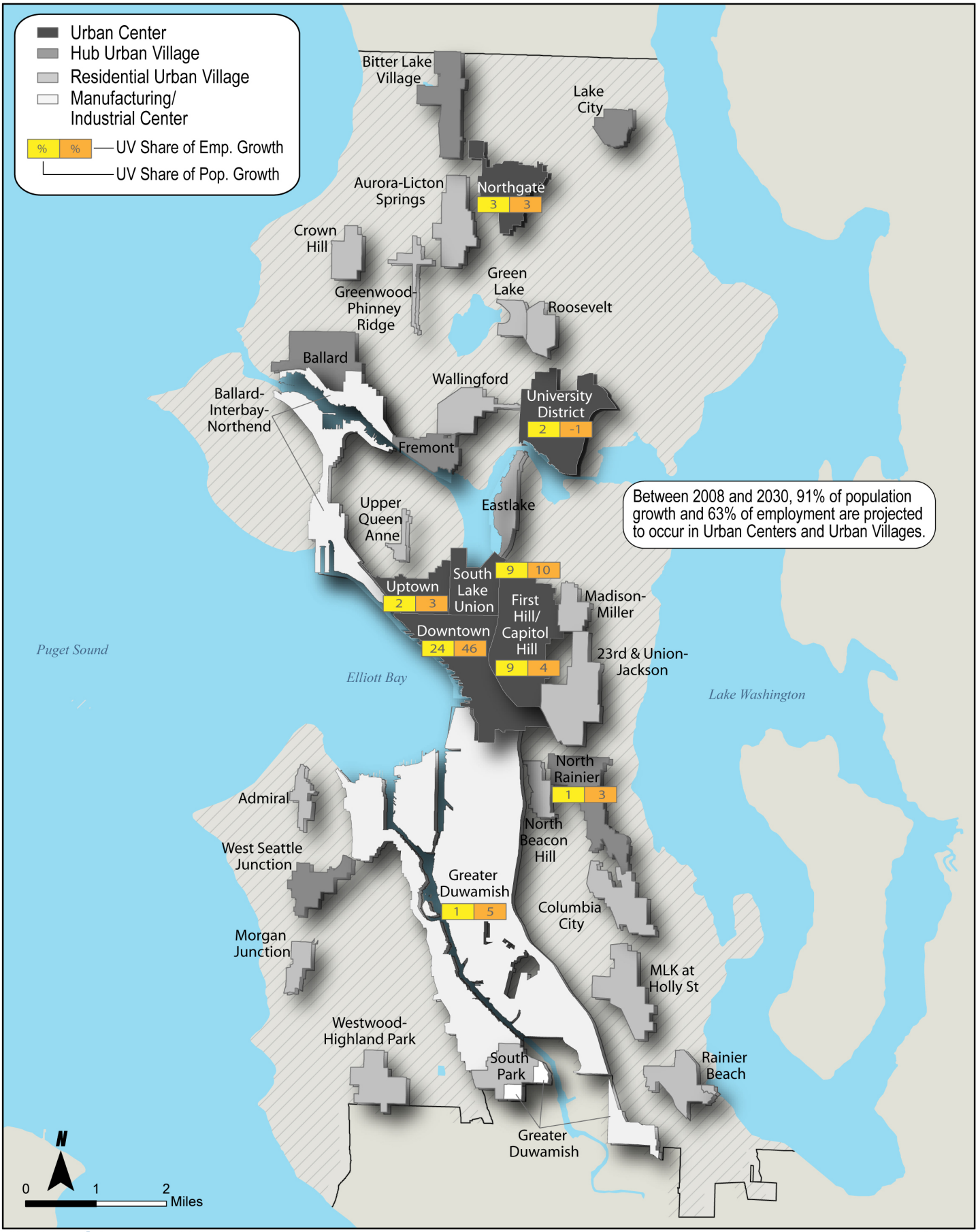
Urban Village and Center Growth Allocation (2008-2030)

- 44% of population growth between 2008 and 2030 is expected to occur in the Center City and adjacent neighborhoods including Uptown, First Hill/Capitol Hill, and South Lake Union. The yellow boxes in Figure 2-8 illustrate each urban village's share of overall projected population growth.
- 63% of job growth between 2008 and 2030 is expected to occur in the Center City and adjacent neighborhoods including Uptown, First Hill/Capitol Hill, and South Lake Union. The orange boxes in Figure 2-8 illustrate each urban village's share of overall projected employment growth.
- Outside of the Center City, the Northgate urban center is expected to see the greatest growth.
- Although not in a designated urban village, Seattle Children's Hospital's Major Institution Master Plan will be completed by 2030 and an increase of about 5,000 jobs is predicted for the hospital.

FIGURE 2-8 SEATTLE URBAN URBAN VILLAGE AND CENTER GROWTH ALLOCATION (2008 – 2030)



Source: City of Seattle

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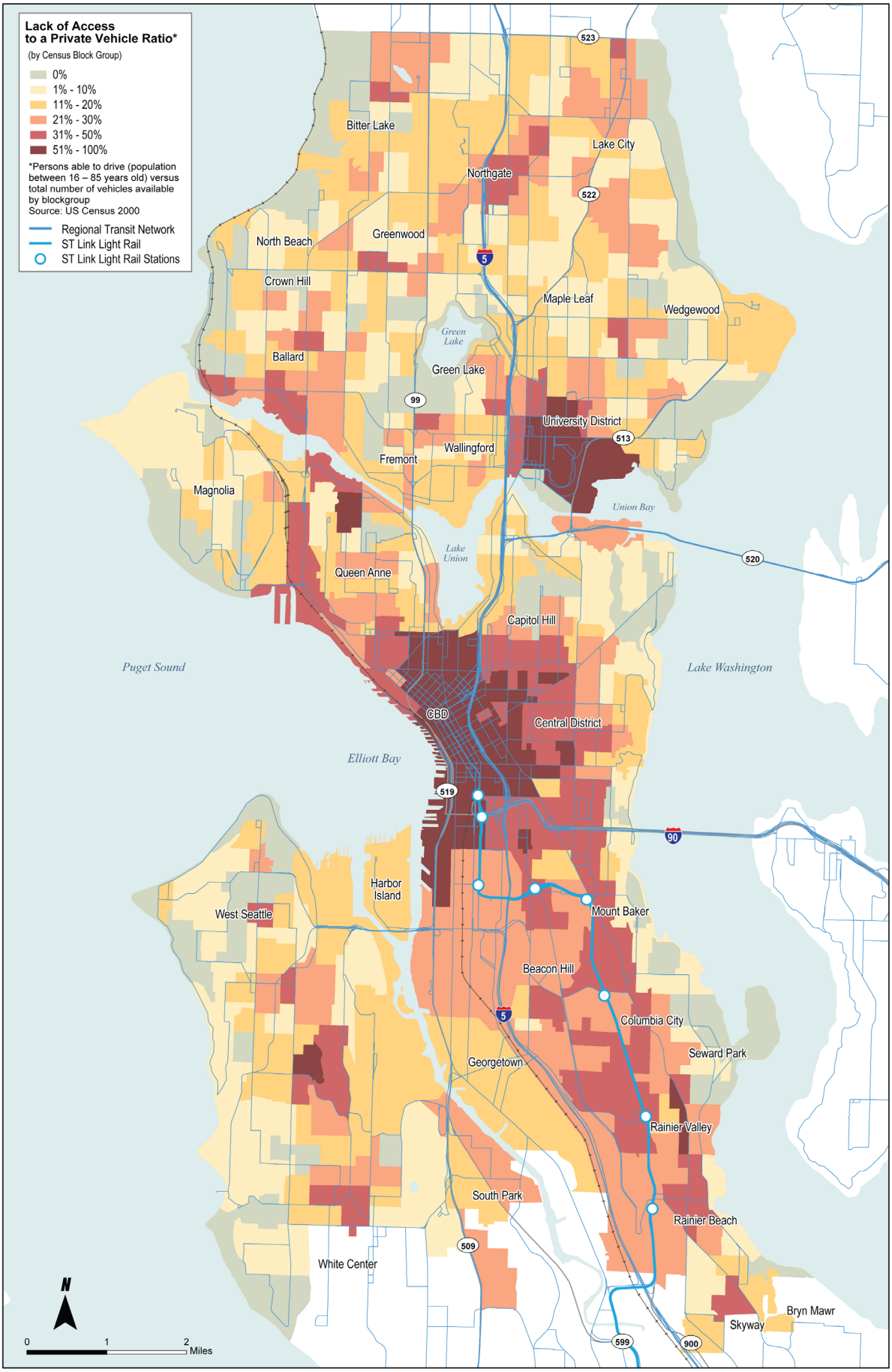
Lack of Access to a Private Vehicle

- This map shows the ratio of the overall population to private vehicles, providing an indicator of auto ownership. It reflects people who are unable to own a vehicle, those who choose to be car free, and households with multiple driving age adults that choose to own just one car.
- People generally have less access to private vehicles in neighborhoods where density is higher. This is an expected trend since the costs of storing a car are typically higher and more daily needs are accessible on foot.
- Neighborhoods with the best transit service also tend to have the highest ratios of people without access to an automobile. People who live (and/or choose to live) in these neighborhoods are less likely to require access to a car for their transportation needs.

FIGURE 2-9 LACK OF ACCESS TO A PRIVATE VEHICLE RATIO (2000)



Source: King County, ESRI, US Census 2000

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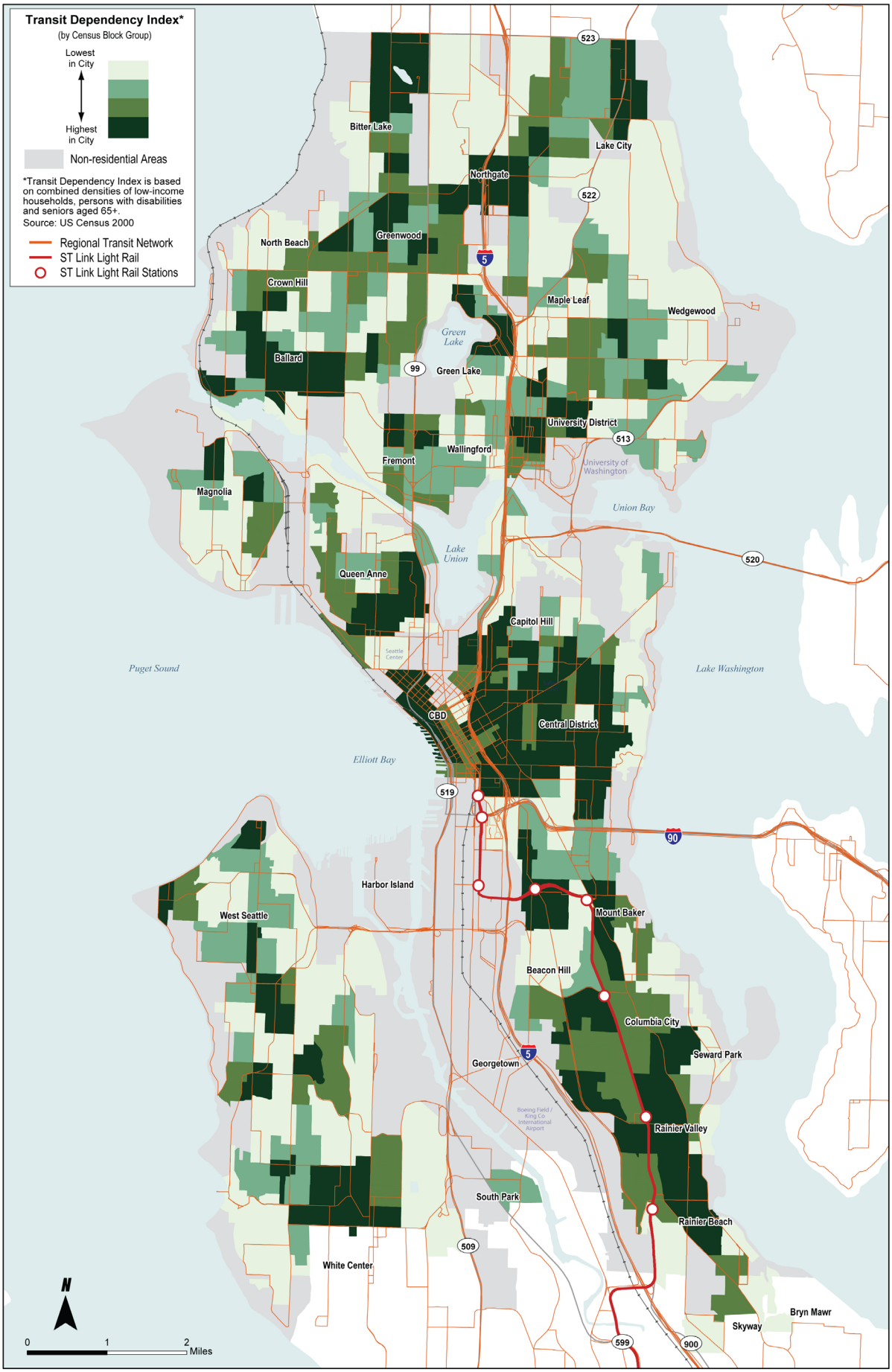
Transit Dependency Index

- Rates of transit dependency[1] align with density in residential areas; high transit dependency is seen in neighborhoods such as the Central Area, the east side of Queen Anne Hill, Ballard, the University District and others.
- Lower density areas that have high transit dependency rates include areas in the Rainier Valley, Delridge, Greenwood, Bitter Lake and Lake City.
- Areas of high transit dependency are mostly located within a quarter mile of a transit line.

1 Transit dependency refers to those individuals that rely on transit because they do not have access to a private vehicle or cannot drive due to a physical or mental impairment. It includes those who are unable to afford a vehicle and those who choose not to own a car.

FIGURE 2-10 TRANSIT DEPENDENCY INDEX (2000)



Source: King County, ESRI, US Census 2000

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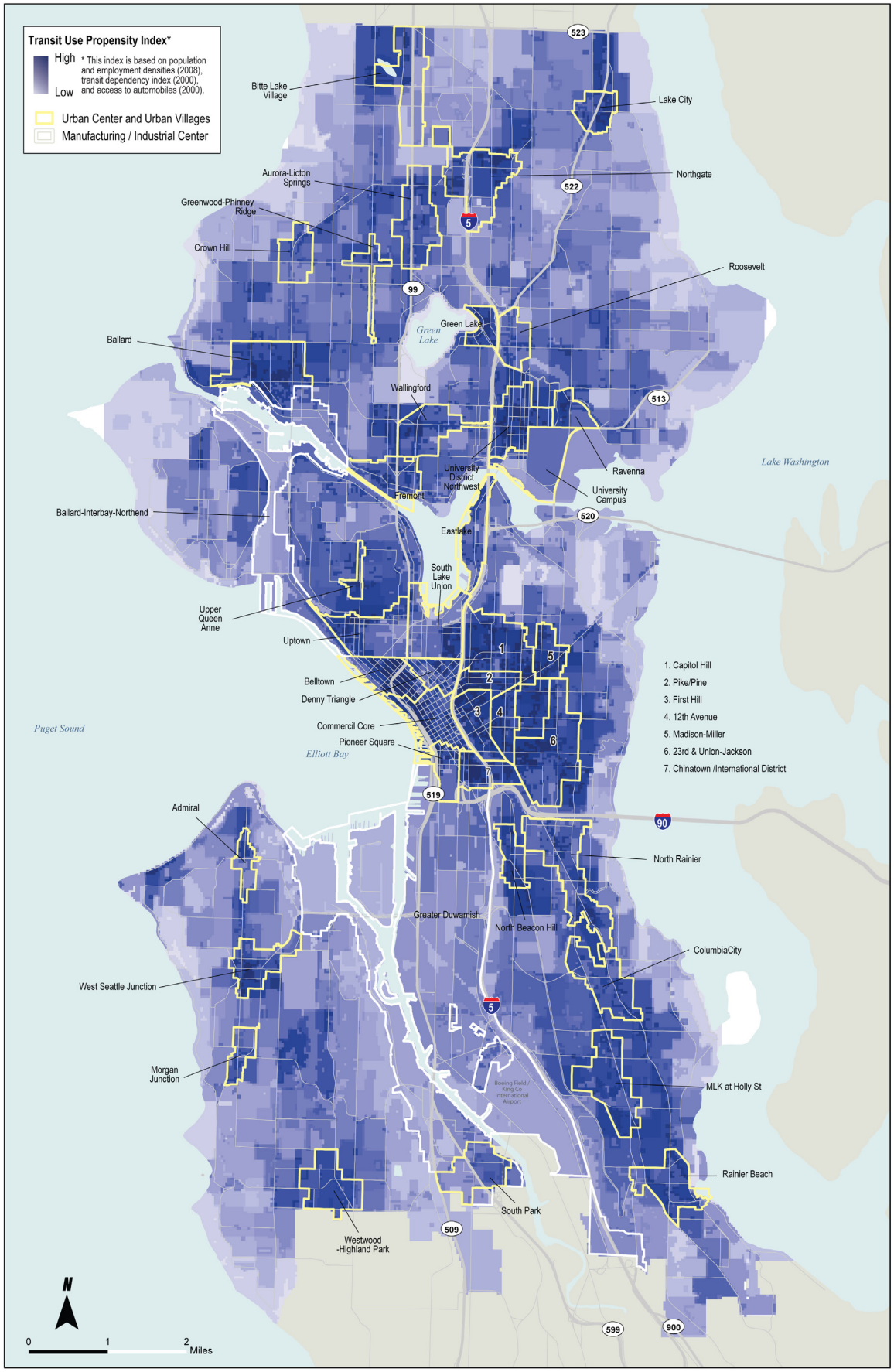
Transit Use Propensity (TUP) Index

- The TUP index combines the strongest indicators of transit demand. It is based on population and employment densities, a transit dependency index (low income households, persons with disabilities, and seniors aged 65+), and rates of access to automobiles.
- TUP scores are highest in urban centers and residential urban villages.
- Areas where TUP scores are high, but are not in a designated urban center or village include the following arterial corridors: 15th Avenue NW to the north of Ballard, Aurora north of Greenwood-Phinney Ridge, Lake City Way north of Lake City, along NE 75th Street, along 35th Avenue NE, along Rainier Avenue south of Columbia City, and along Delridge Way SW.

FIGURE 2-11 TRANSIT USE PROPENSITY INDEX (TUP) AND URBAN VILLAGE AND CENTER BOUNDARIES (2000)



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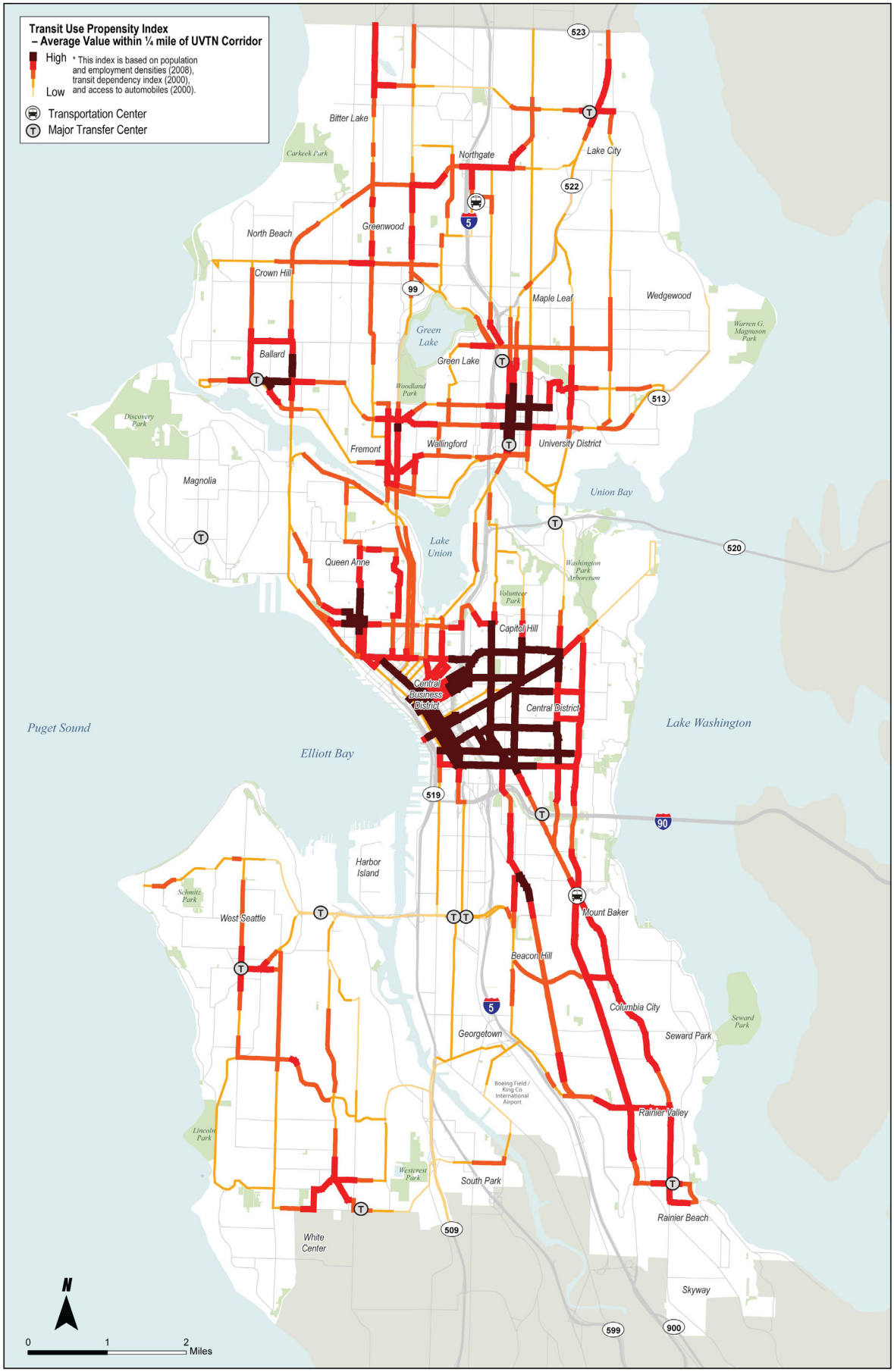
Transit Use Propensity (TUP) and the Urban Village Transit Network

- This map provides a different perspective on the TUP, relating it to the Urban Village Transit Network (UVTN). The UVTN, described in more detail in Chapter 4: Existing and Planned Transit Services, is Seattle's vision for a core network of transit corridors connecting Seattle's urban villages and centers with high quality, reliable service.
- The TUP scores for land uses within a quarter mile of UVTN route segments are averaged to provide an indicator of the overall transit-supportiveness of land uses along each UVTN segment. (Note that not all UVTN analysis segments have UVTN levels of service in place.)
- Areas with a network of dark or light red lines are areas where land uses are most supportive of transit use. These areas include: the Central District/Center City, University District, Queen Anne, Ballard and Fremont.

FIGURE 2-12 TRANSIT USE PROPENSITY BY URBAN VILLAGE TRANSIT NETWORK SEGMENT (2008)



Source: City of Seattle

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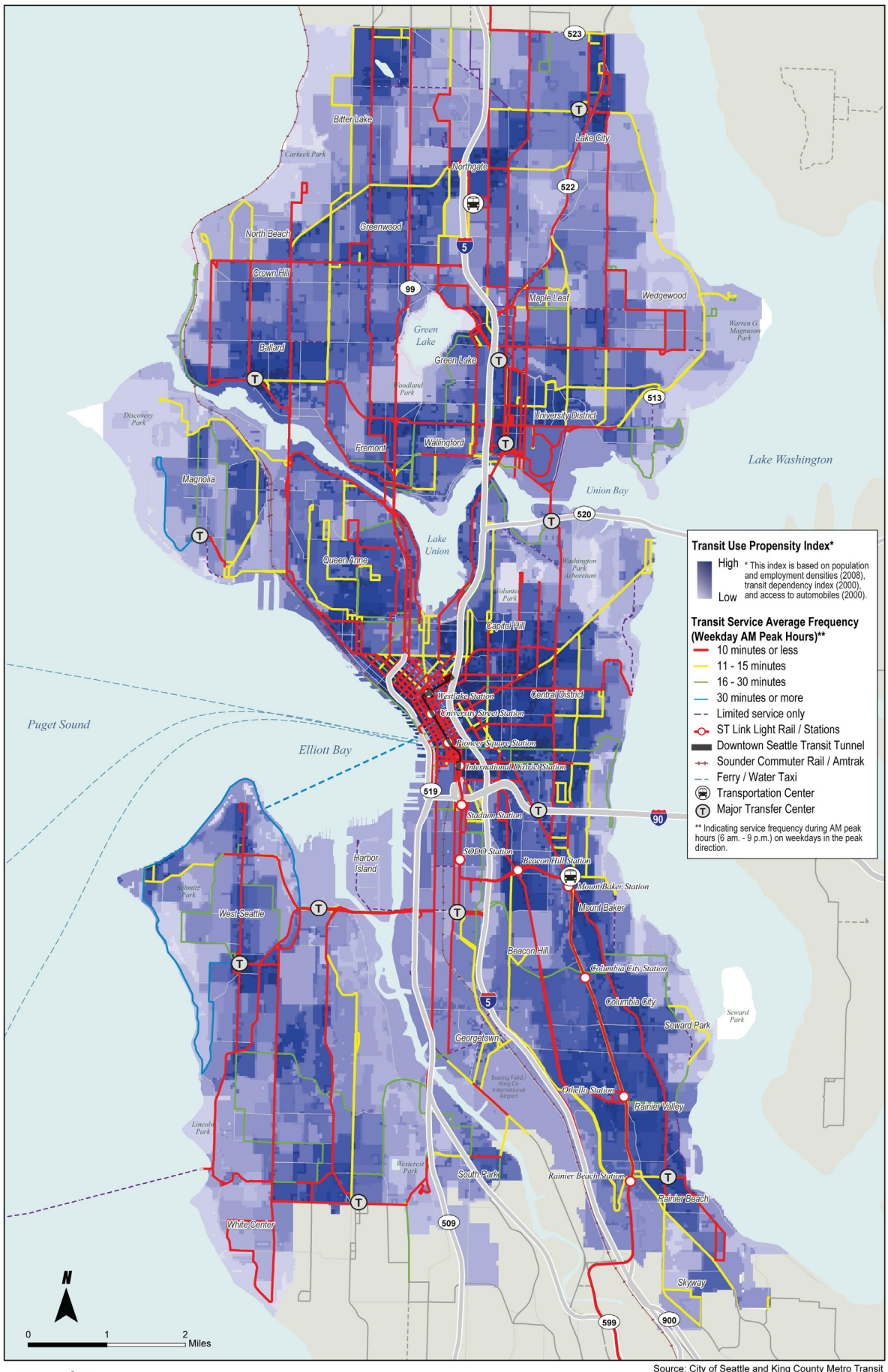
Transit Use Propensity (TUP) Index and Transit Service Coverage (Peak Period)

- The King County Metro (KCM) transit network and Sound Transit Link light rail provide coverage to all Seattle neighborhoods, particularly to areas showing the highest TUP values.
- In the AM peak, frequent transit service (every 15 minutes or less) is readily accessible (within one-half mile or a 10 minute walk) to all areas with high TUP index values.
- Parts of Magnolia, Queen Anne, the Central District, Ravenna, Maple Leaf, and in northwest Seattle lack access to very frequent transit service (10 minutes or less) during the AM peak.
- Areas with a high TUP index value coincide with urban center and urban village areas. The relationship between high frequency transit corridors and high TUP index values reinforces the city's comprehensive plan goals of promoting and managing growth within designated urban centers and urban villages.

FIGURE 2-13 TRANSIT USE PROPENSITY INDEX AND TRANSIT SERVICE IN THE AM PEAK PERIOD



Source: City of Seattle and King County Metro Transit

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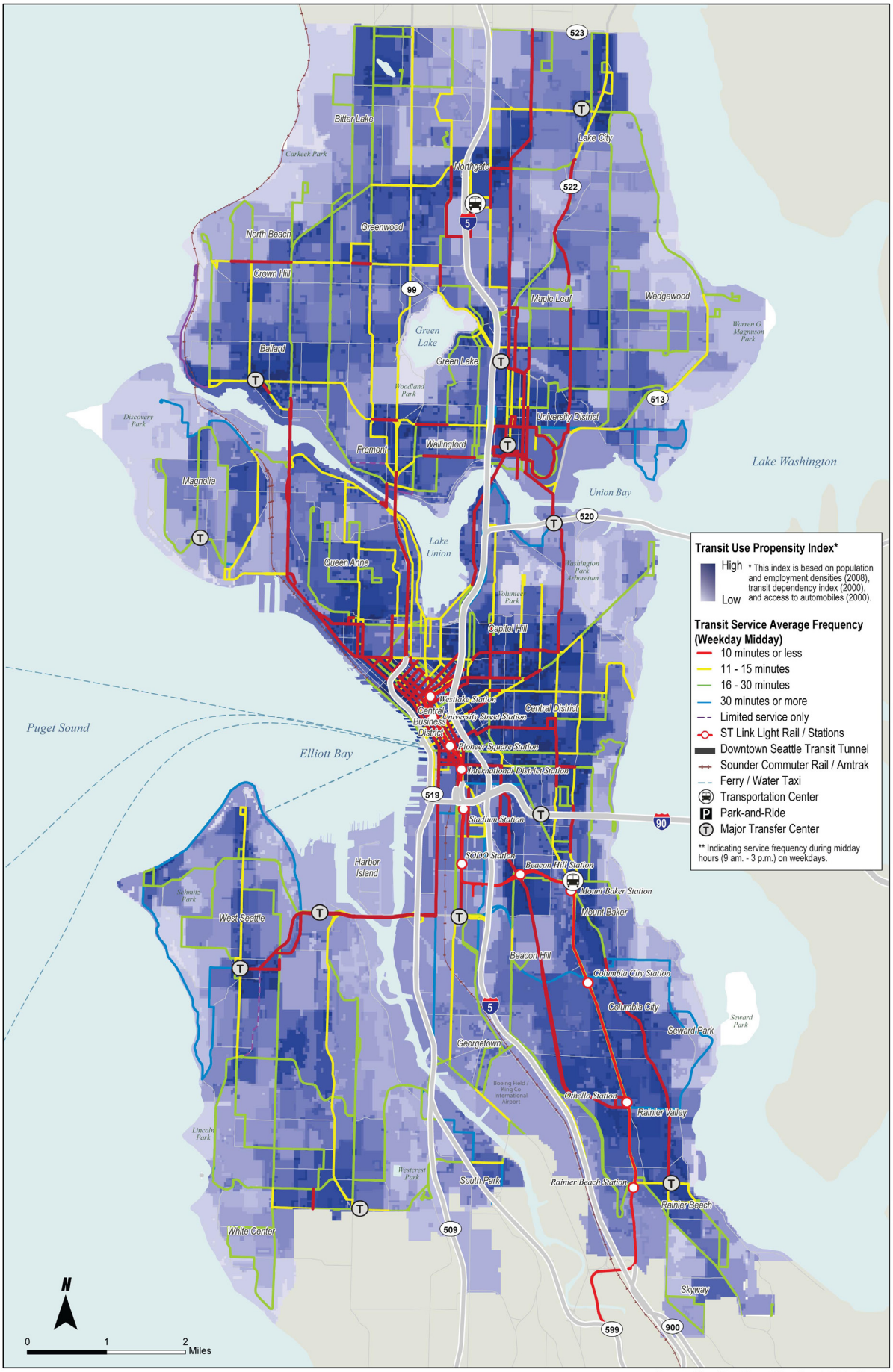
Transit Use Propensity (TUP) Index and Transit Service Coverage (Midday Period)

- During the midday, frequent transit service (arriving every 15 minutes or less) is limited to corridors connecting major activity centers and urban villages with downtown.
- Areas with high TUP index values that lack transit service coverage are more prevalent in the midday; for example, in Bitter Lake, parts of Ballard, Wedgwood, View Ridge, parts of Magnolia and Queen Anne, Madison Park, Leschi, Morgan Junction, Fauntleroy/ Arbor Heights, and South Park.
- During the midday there are limited cross-town, high-frequency connections outside of the Center City.
- North Seattle activity centers have high-frequency connections to downtown Seattle but not between one another.

FIGURE 2-14 TRANSIT USE PROPENSITY AND TRANSIT SERVICE IN THE MIDDAY PERIOD



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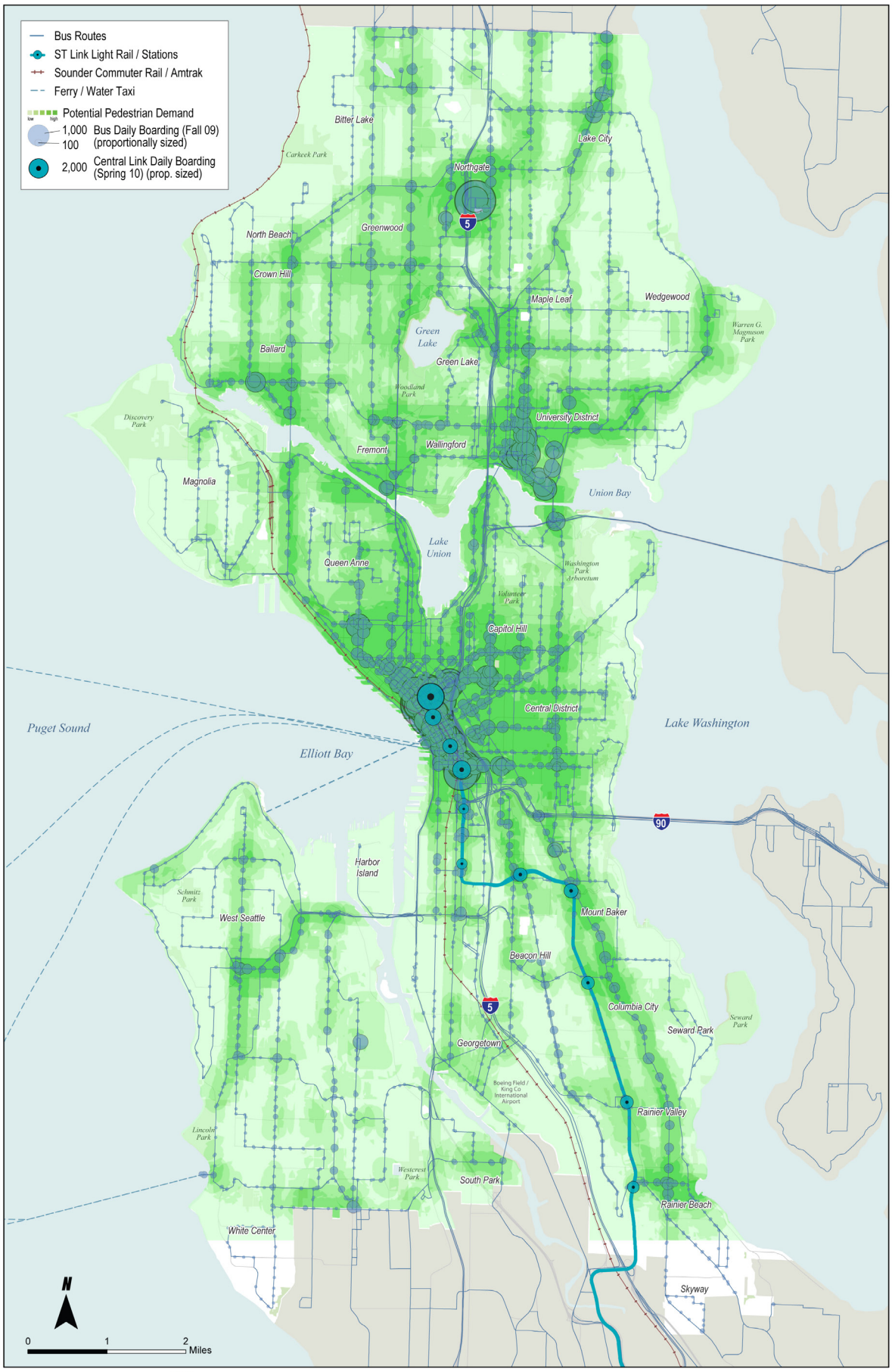
Potential Pedestrian Demand in Seattle

- Pedestrian demand is calculated using a composite index that includes major pedestrian generators (e.g., hospitals, schools, colleges and universities, retail and commercial destinations), population and employment density projections, the distance people are willing to walk, and proximity to bus and light rail stops and stations. This analysis was developed during the Seattle Pedestrian Master Plan.
- The majority of transit corridors in the city are in high pedestrian demand areas.
- Most high pedestrian demand areas have high population and employment density and are areas of the city with the greatest diversity and clustering of land uses.
- Seattle does not allow the development of park-and-ride facilities in city boundaries, making safe, comfortable walk and bicycle access to transit is all the more critical.

FIGURE 2-15 POTENTIAL PEDESTRIAN DEMAND IN SEATTLE

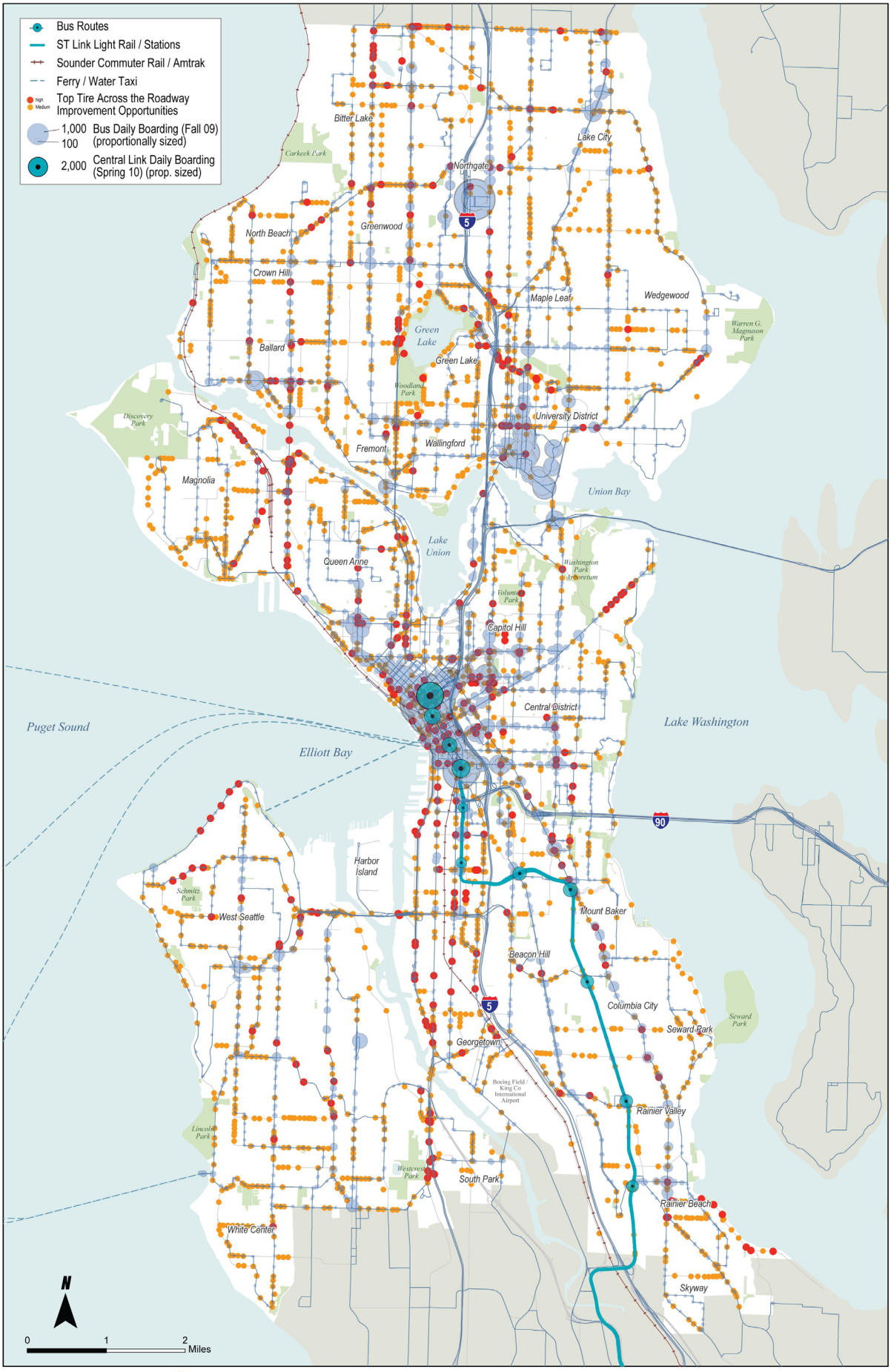


Source: City of Seattle

Pedestrian Improvement Opportunities in Seattle

- This map illustrates where improvements are most needed to make crossing the roadway (intersections) safe and comfortable. The opportunities for improvements are identified using variables that contribute to the pedestrian environment, including presence of sidewalks, sidewalk condition, posted speed limit, roadway width, and the presence of features such as traffic signals, curb ramps, and crosswalks.
- Among the areas where intersection improvements are most needed are along major transportation corridors and transit routes.
- Conditions for walking to planned transit corridors (i.e., RapidRide corridors) are in need of attention; for example, the West Seattle RapidRide between the West Seattle Junction and the West Seattle Bridge, and Aurora Avenue in the Green Lake and Greenwood areas. Similarly, major transit corridors such as Rainier Avenue show significant need for improvement at major transit boarding intersections.
- Conditions for walking are best along residential streets. Transit boarding data shows that older residential neighborhoods attract significant transit ridership, despite being lower density. Safe, comfortable pedestrian access to transit is an important reason for this.

FIGURE 2-16 PEDESTRIAN IMPROVEMENT OPPORTUNITIES IN SEATTLE – INTERSECTIONS

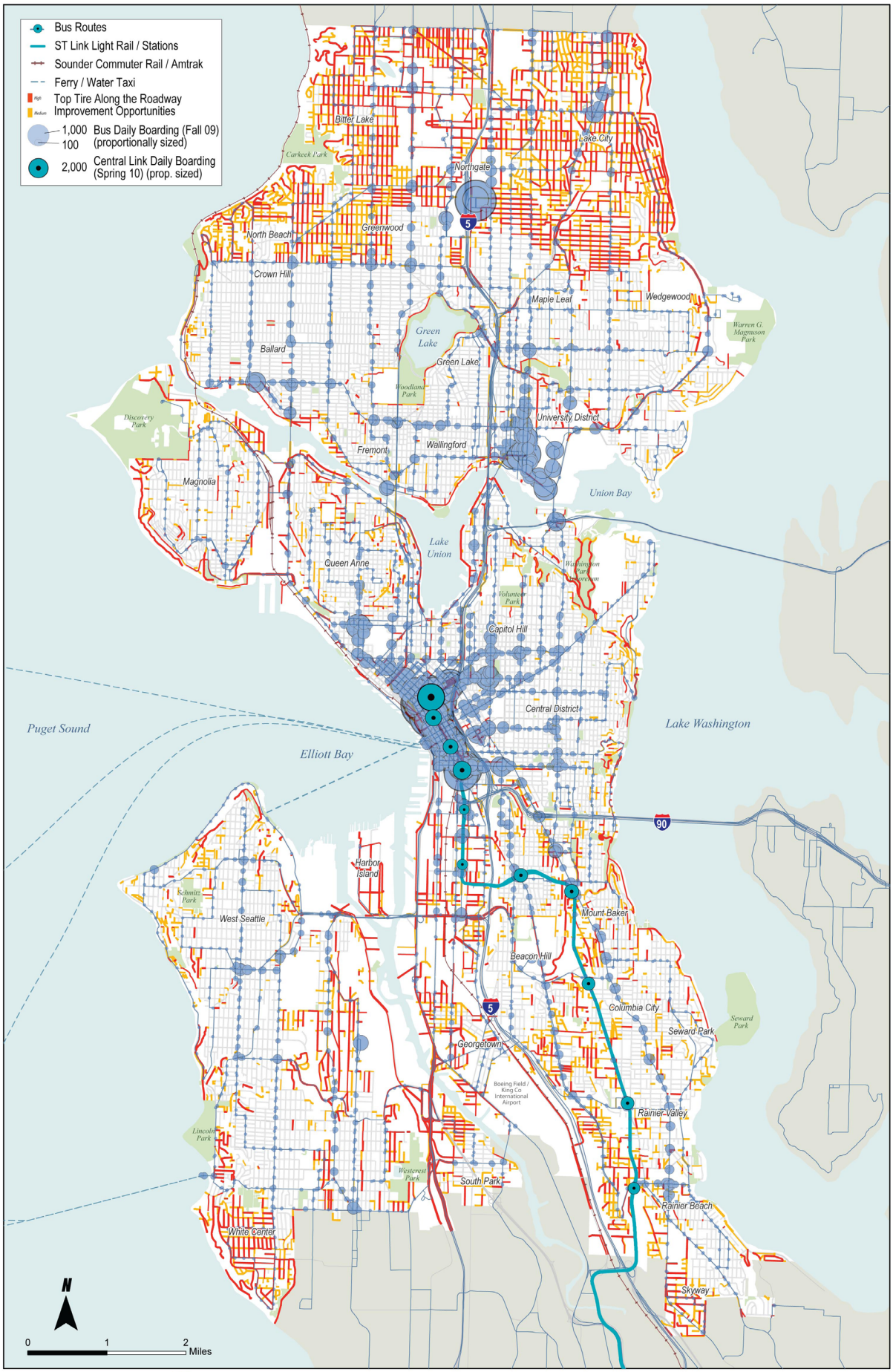


Source: City of Seattle, Sound Transit

Pedestrian Improvement Opportunities in Seattle

- This map illustrates where improvements are most needed to make walking along the roadway (sidewalks) safe and comfortable. The opportunities for improvements are identified using variables that contribute to the pedestrian environment, including presence of sidewalks, sidewalk condition, posted speed limit, roadway width, and the presence of features such as traffic signals, curb ramps, and crosswalks.

FIGURE 2-17 PEDESTRIAN IMPROVEMENT OPPORTUNITIES IN SEATTLE – SIDEWALKS

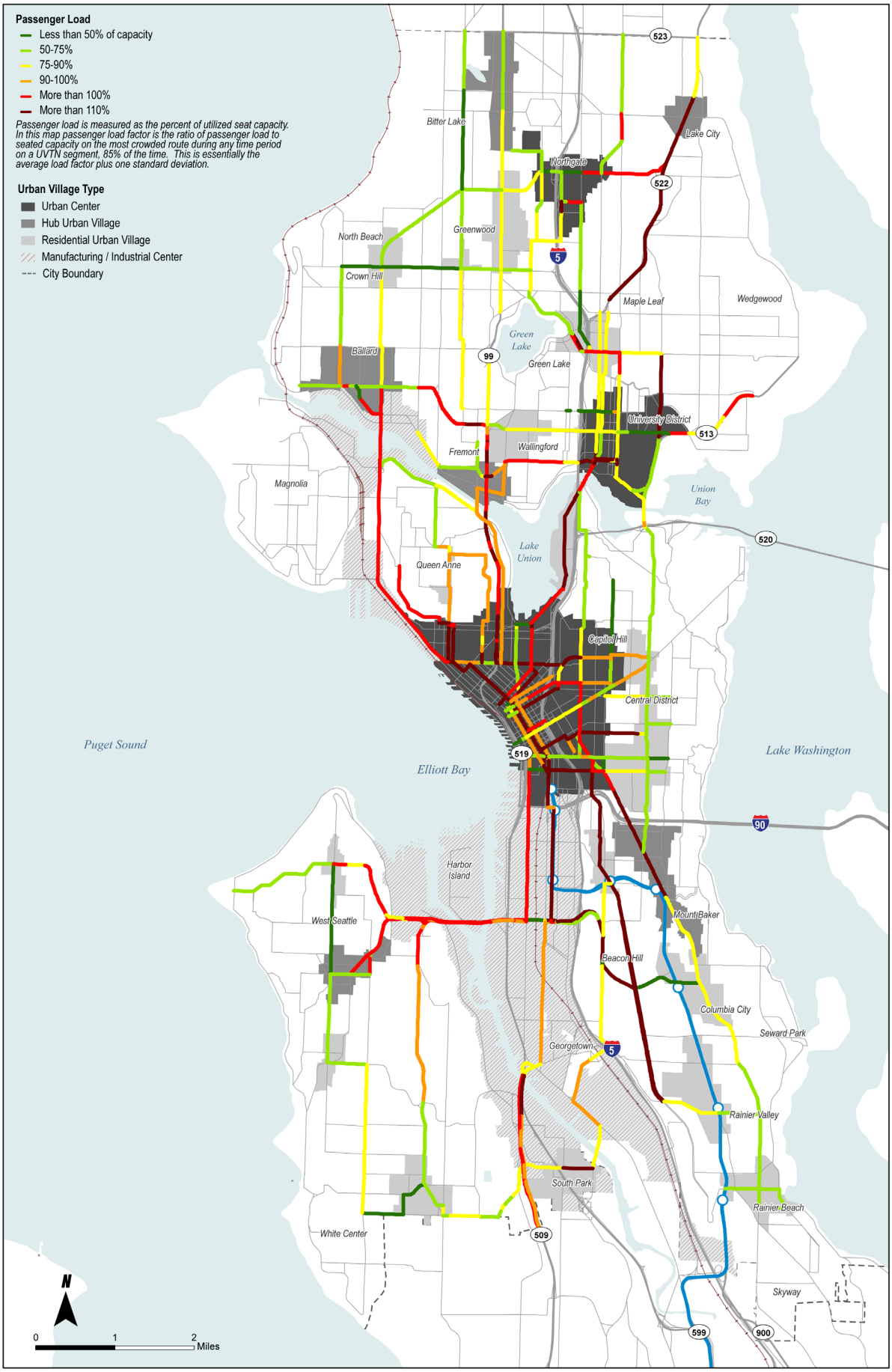


Source: City of Seattle, Sound Transit

Passenger Loads on the Urban Village Transit Network (2007)

- Passenger load is measured as the percent of utilized seat capacity. The UVTN monitoring analysis uses a measure that is the ratio of passenger load to seated capacity (load factor) on the most crowded route during any time period, 85% of the time. This is essentially the average load factor plus one standard deviation.
  - Average load, the condition a passenger is likely to experience most of the time, is lower than the UVTN load measures.
  - King County Metro considers an "overload" condition to be 120% of seated capacity occurring for more than a 20-minute period. The UVTN analysis considers any value over 90% to be deficient.
  - Passenger load is an important measure that provides insight into a range of important factors affecting transit riders and operators, including:
    - ◊ **Passenger comfort.** When overcrowded buses can be uncomfortable.
    - ◊ **Pass-ups.** This is where an overcrowded bus passes waiting passengers. This is a very discouraging experience for transit customers and if consistent will force people to other modes.
    - ◊ **Frequency improvements.** Consistently high passenger loads are a signal to providers that service frequency should be improved or larger vehicles be deployed.
- High passenger loads on Center City-bound bus routes are of greatest concern where standing loads in excess of 110% occur over a mile from the Center City. This occurs on routes serving the Lake City Way, Fremont Ave, Eastlake Ave, 15th Ave S., Rainier Ave, and the SR 509/East Marginal Way corridors.

FIGURE 2-18 PASSENGER LOADS ON THE URBAN VILLAGE TRANSIT NETWORK (2007)



Source: City of Seattle

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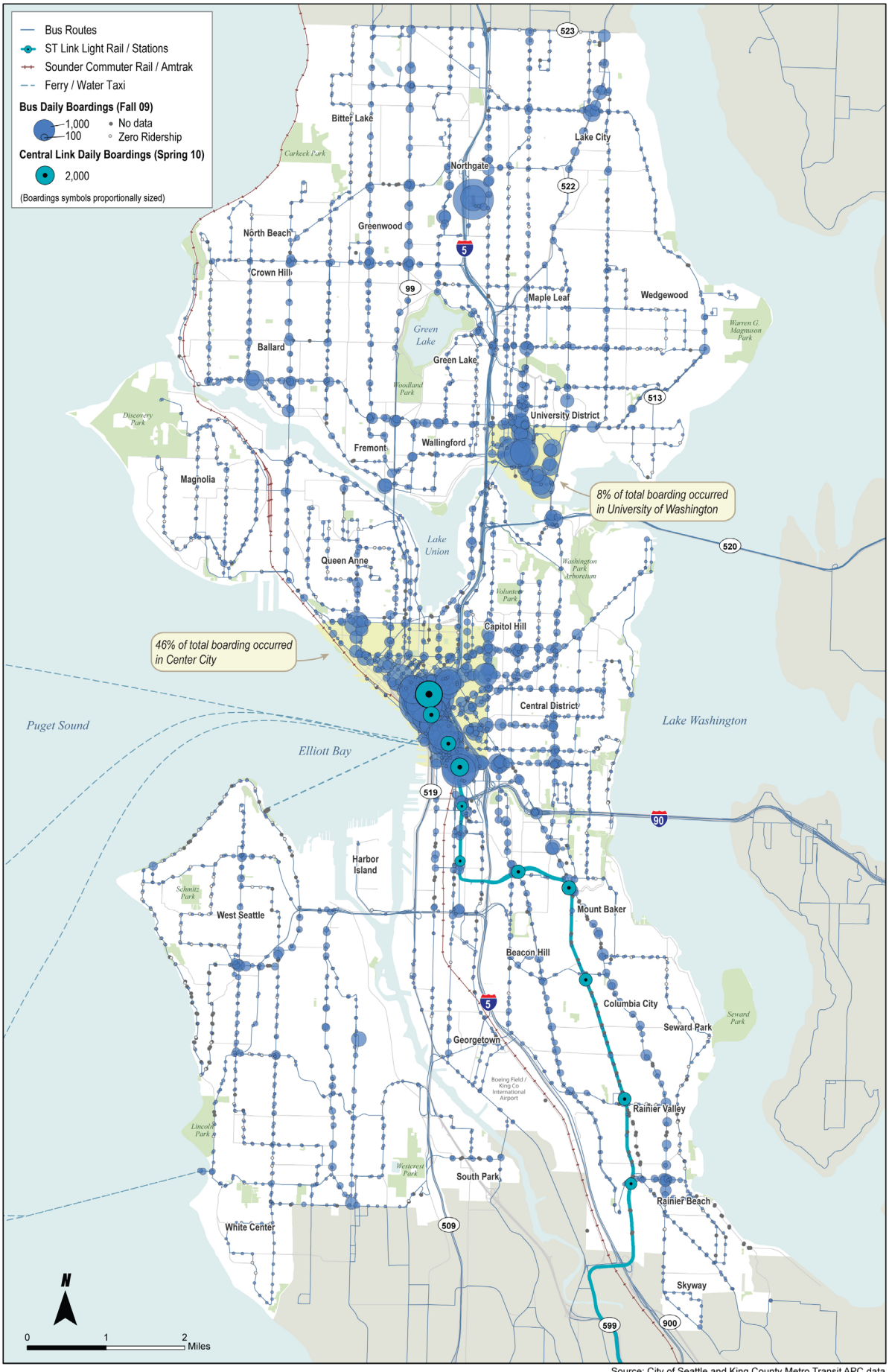
Daily Transit Boardings in Seattle (2009)

- Daily boardings are based on 2009 data from King County Metro and from Sound Transit.
- Most daily boardings coincide with transit corridors providing the highest service frequency during both peak and off-peak hours.
- Center City and adjacent neighborhoods (e.g., Lower Queen Anne, Belltown, South Lake Union, Denny Triangle, Capitol Hill, First Hill, Downtown, and the International District) account for over 45% of daily transit boardings in the city.
- Boarding levels are highest on arterial streets in the central part of the city and major north-south (downtown oriented) corridors in north, west, and south Seattle.
- Outside the Center City, boardings are high at the University District, the UW Campus, and at major activity centers such as Northgate, Lake City, Ballard, Fremont, Greenwood, Queen Anne, the West Seattle Junction, Delridge/White Center Junction, Rainier Beach, Mount Baker, Beacon Hill, and SODO.

FIGURE 2-19 DAILY TRANSIT BOARDINGS IN SEATTLE (2009)



Source: City of Seattle and King County Metro Transit APC data

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Travel Origin – Destination Travel Analysis

A matrix of origin-destination trips was produced (for work and "all other trips") based on Seattle Travel Demand Model results for year 2008. In this section, the matrix is illustrated to describe travel demand between Seattle neighborhoods and between Seattle and the region. Maps in the following sections illustrate major point-to-point travel patterns within Seattle and between Seattle and the region. Travel is segmented by trip purpose, geography and mode to provide a more complete picture of local and regional travel patterns.

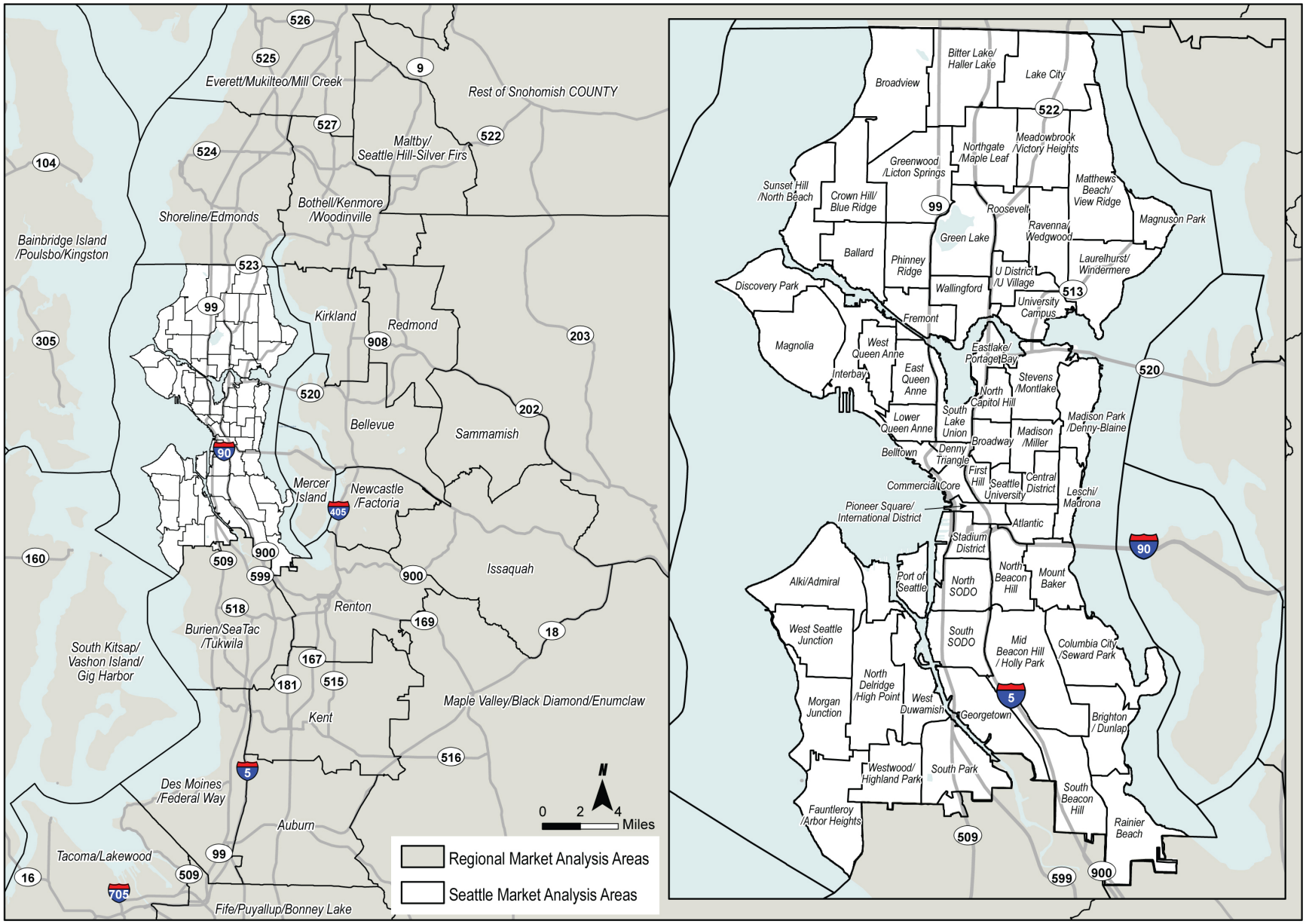
The travel analysis requires that a set of geographies be identified, since it is not possible to analyze every individual point of travel. This analysis uses two levels of geographic zones.

1. **Local Market Analysis Areas (MAA):** The City of Seattle travel demand model evaluates travel between 518 transportation analysis zones (TAZ). This analysis combines these zones into 63 market analysis areas that best represent key travel markets. Urban villages and urban centers and key travel corridors are included within single zone boundaries. In some cases, Center City MAAs are aggregated.
2. **Regional Market Analysis Areas (RMAA):** These zones are large and often include multiple cities. They are organized to represent areas of the region that flow into Seattle on the relatively few major highway and transit corridors that enter the city.

In viewing the following maps, it is important to consider a few facts:

- Data is from the 2008 Seattle travel demand model and is calibrated using actual travel counts where available; however, much of the data is simply a calculation of presumed travel based on model algorithms.
- Travel origin – destination pairs show travel in both directions for the entire day.
- Trips internal to MAAs or RMAAs are not illustrated. In Seattle, these are shorter trips that would be expected to have a high walk mode share, but certainly include transit and driving trips.
- This point-to-point analysis does not consider assignment of trips to available streets or transit routes. In viewing the data, it is helpful to think about how various point-to-point travel markets aggregate in actual travel corridors.
- Trips are not segregated by time of travel (i.e., peak vs. off-peak). In general, home-based work travel is heaviest in the traditional morning and evening peak periods. All other trips are spread more evenly across the day, reaching heaviest levels in early- to mid-afternoon.
- Unless otherwise stated, these maps present data for trips on all modes.

FIGURE 2-20 LOCAL AND REGIONAL MARKET ANALYSIS AREAS

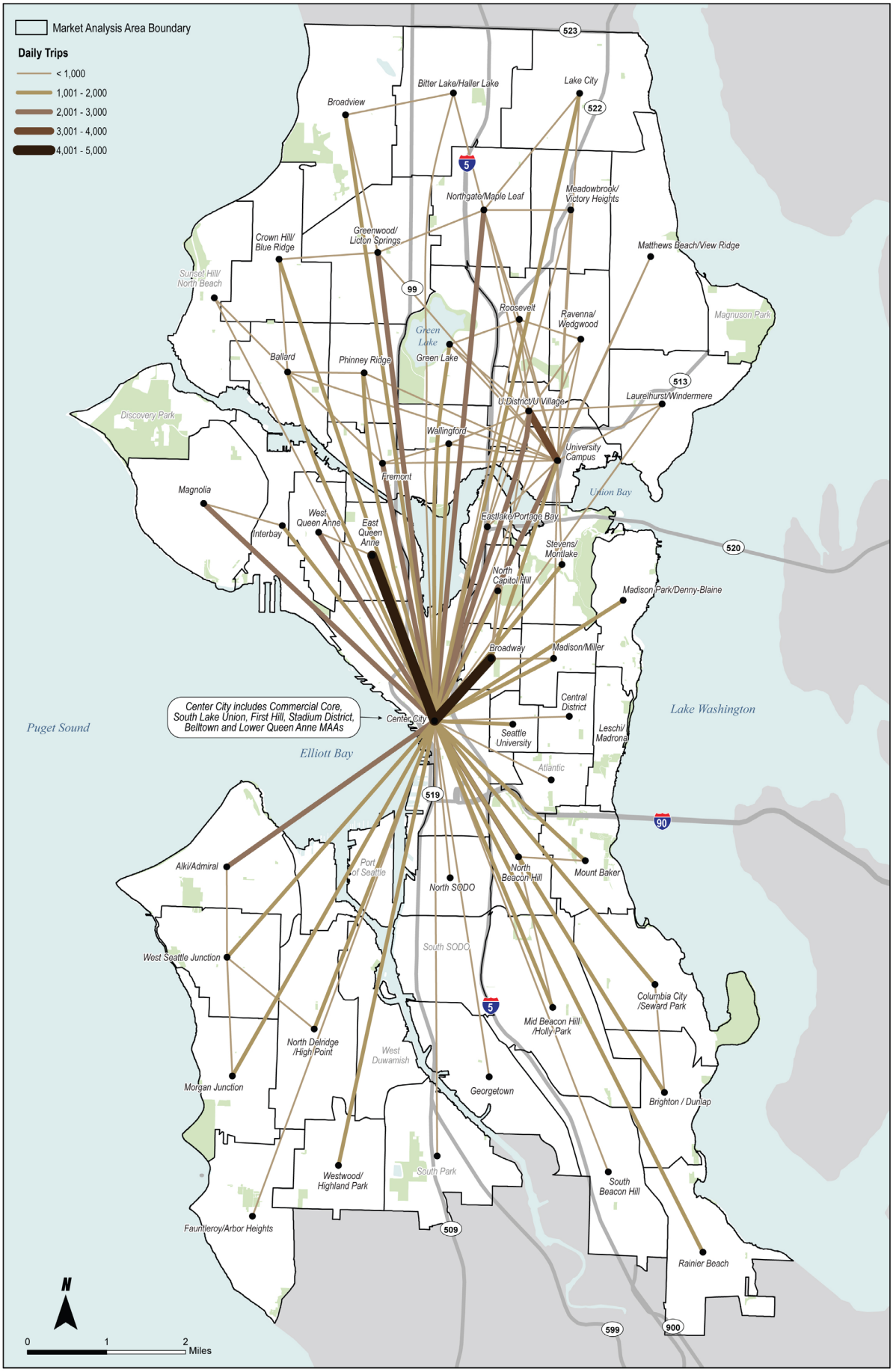


Source: City of Seattle

Major Transit Travel Pairs in the City of Seattle

- Transit travel pairs illustrated in this map were generated with data from the Seattle Travel Demand Model, which is calibrated using stop level ridership data collected by King County Metro and Sound Transit. In this analysis, Center City neighborhoods are aggregated. Therefore, short distance trips between Center City neighborhoods are assumed to be internal and are not illustrated.
- Seattle Center City is the most significant destination for transit trips in the region. Nearly 40 of the top 50 most significant trip pairs include an end in the Center City.
- Outside the Center City, the University District/UW Campus and Northgate are the two other major transit demand attractors.
- From north Seattle, transit travel pairs naturally are served by six major corridors crossing the Ship Canal and Montlake Cut. These include: 15th Avenue NE, Fremont Avenue/Dexter Avenue, Aurora, I-5, the University Bridge, and the Montlake Bridge. This supports intermediate and high capacity transit development plans, including Aurora and Ballard RapidRide and University Link light rail.
- Several market areas in north Seattle generate trips to other north Seattle areas and show a multi-center pattern. This reflects overall travel demand in these markets as well as the presence of better cross-town transit service than exists in south Seattle.

FIGURE 2-21 TOP 100 TRANSIT ORIGIN-DESTINATION PAIRS IN THE CITY OF SEATTLE (2008)

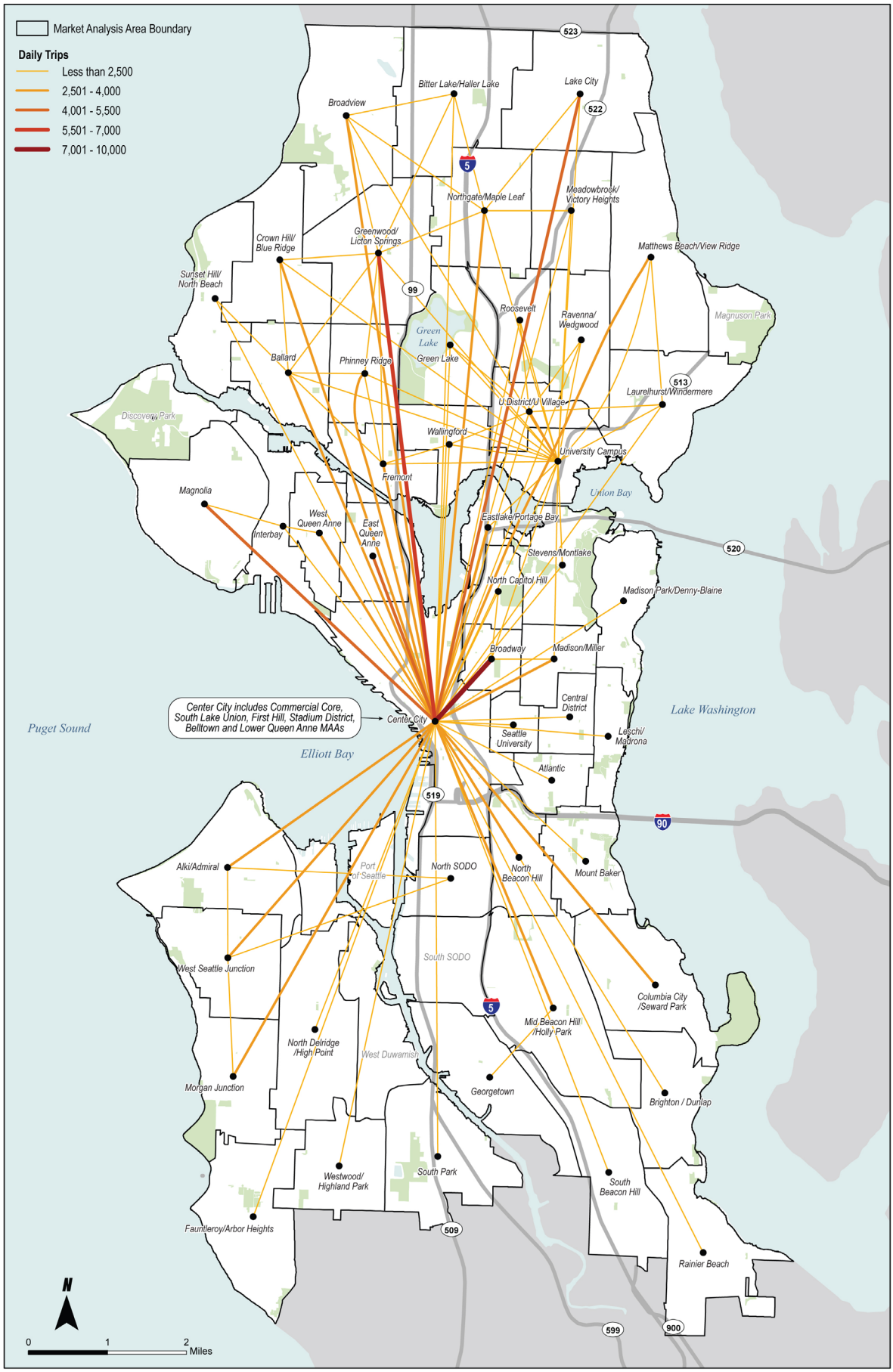


Source: City of Seattle

Home-Based Work Trips in the City of Seattle (2008)

- This map shows that home-based work trips (i.e. trips from home to work or school) are highly concentrated in the downtown "commercial core" and in the University District, and to a lesser extent in Belltown and South Lake Union.
- Downtown attracts work trips from all over the city including a significant number of long distance trips from neighborhoods and market areas near the northern and southern city boundaries such as Greenwood, Lake City, Fauntleroy/Arbor Heights, and Columbia City.
- Home-based work trips represent about 17% of all daily trips made in Seattle.
- West Seattle and south Seattle produce a significant number of home-based work trips to downtown Seattle. Origin-destination results show that the majority of work trips in both of these market areas does not stay within Seattle but travels to external zones.
- Most north Seattle work trips are also to downtown Seattle, but this area of the city also shows a multi-center structure with trips attracted to the UW Campus, Northgate, Children's Hospital, and to a lesser extent to Ballard.
- Industrial areas in the city do not show significant volumes of trips from a particular market area. Industrial areas are land intensive uses and therefore create low density employment areas. Some industrial employers rely on low-wage laborers, for whom transit access is particularly important.

FIGURE 2-22 TOP 100 ORIGIN-DESTINATION TRAVEL PAIRS FOR ALL DAILY HOME-BASED WORK TRIPS IN THE CITY OF SEATTLE (2008)

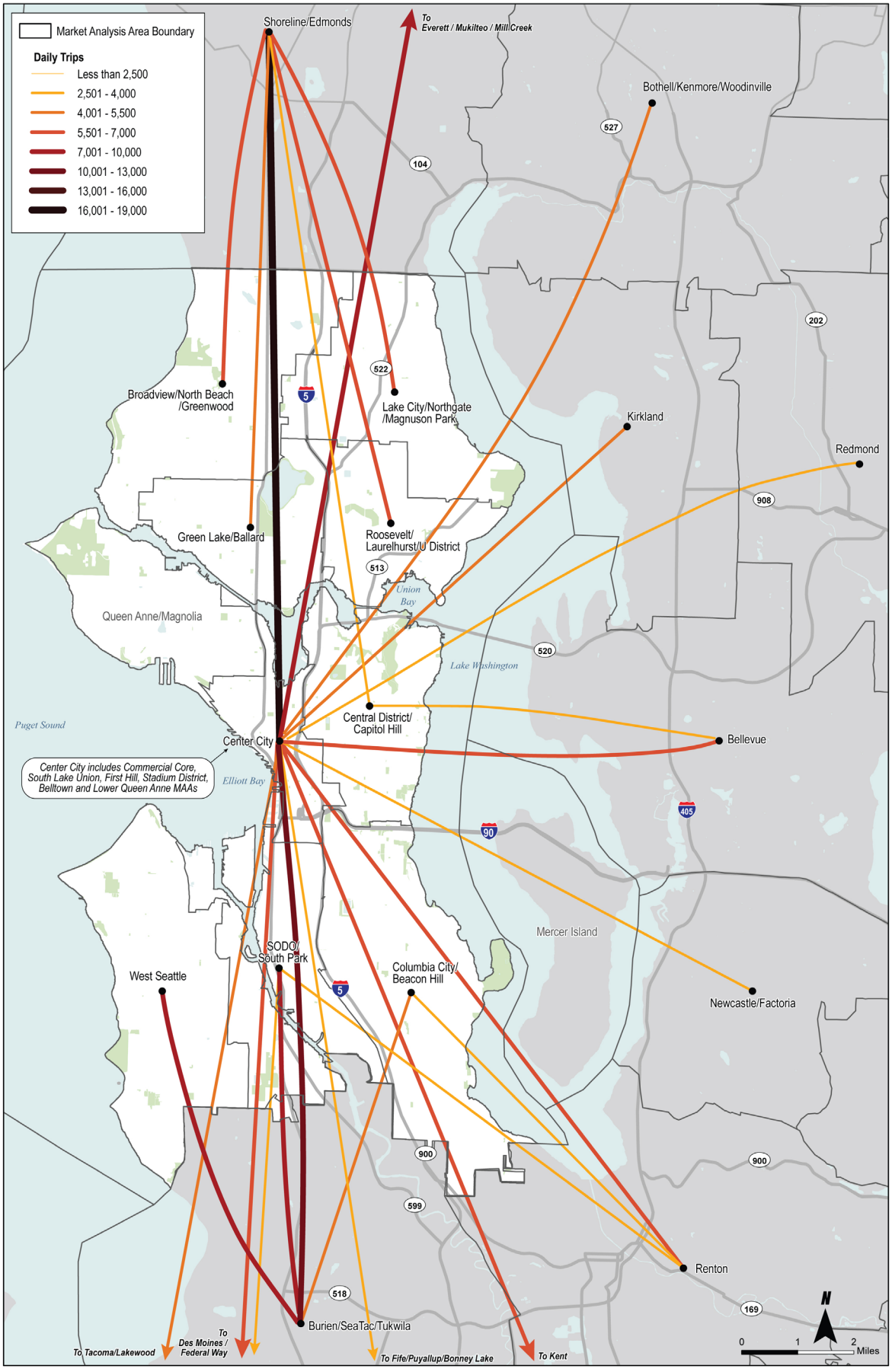


Source: City of Seattle

Home-Based Work Trips between Seattle and the Region (2008)

- Home-based work trips represent 30% of the total travel market between the city and regional market areas.
- The most significant concentration of travel patterns for home-based work trips, between Seattle and the region, occurs along the I-5 freeway.
- Downtown Seattle attracts many long distance trips from outlying areas such as Shoreline, Edmonds, Everett, Bothell/Mill Creek, Redmond, Issaquah, Kent, Auburn, Burien/Sea-Tac, Federal Way and Tacoma.
- North Seattle MAAs that attract the most trips from Snohomish County include University of Washington Campus, Northgate, Lake City, Broadview, Bitter Lake/Haller Lake, and Greenwood.
- The majority of trips from regional market areas south of the city is attracted to Georgetown, South SODO and North SODO. A significant number of trips from West Seattle and South Seattle are attracted to Sea-Tac, Tukwila, and Renton.
- Travel patterns in the south of the city seem to support planned transit corridors such as the West Seattle RapidRide, the Tukwila/Federal Way Rapid Ride, and the Burien/Renton RapidRide. They also support the idea of providing direct transit connections between West Seattle, South Seattle and market areas south of the city boundary.
- The highest travel pair connections between Bellevue/Redmond and Seattle market areas are to Downtown, Capitol Hill, First Hill, and the University District/UW Campus.
- Cross-Puget Sound travel on Washington State Ferries does not appear on this map due to the geographic spread of RMAAs west of the Sound. However, Colman Dock Ferry receives approximately six million foot passengers annually and is among the busiest transit hubs in the city.

FIGURE 2-23 TOP 50 MAJOR ORIGIN-DESTINATION TRAVEL PAIRS FOR HOME-BASED WORK TRIPS BETWEEN SEATTLE AND REGION (2008)

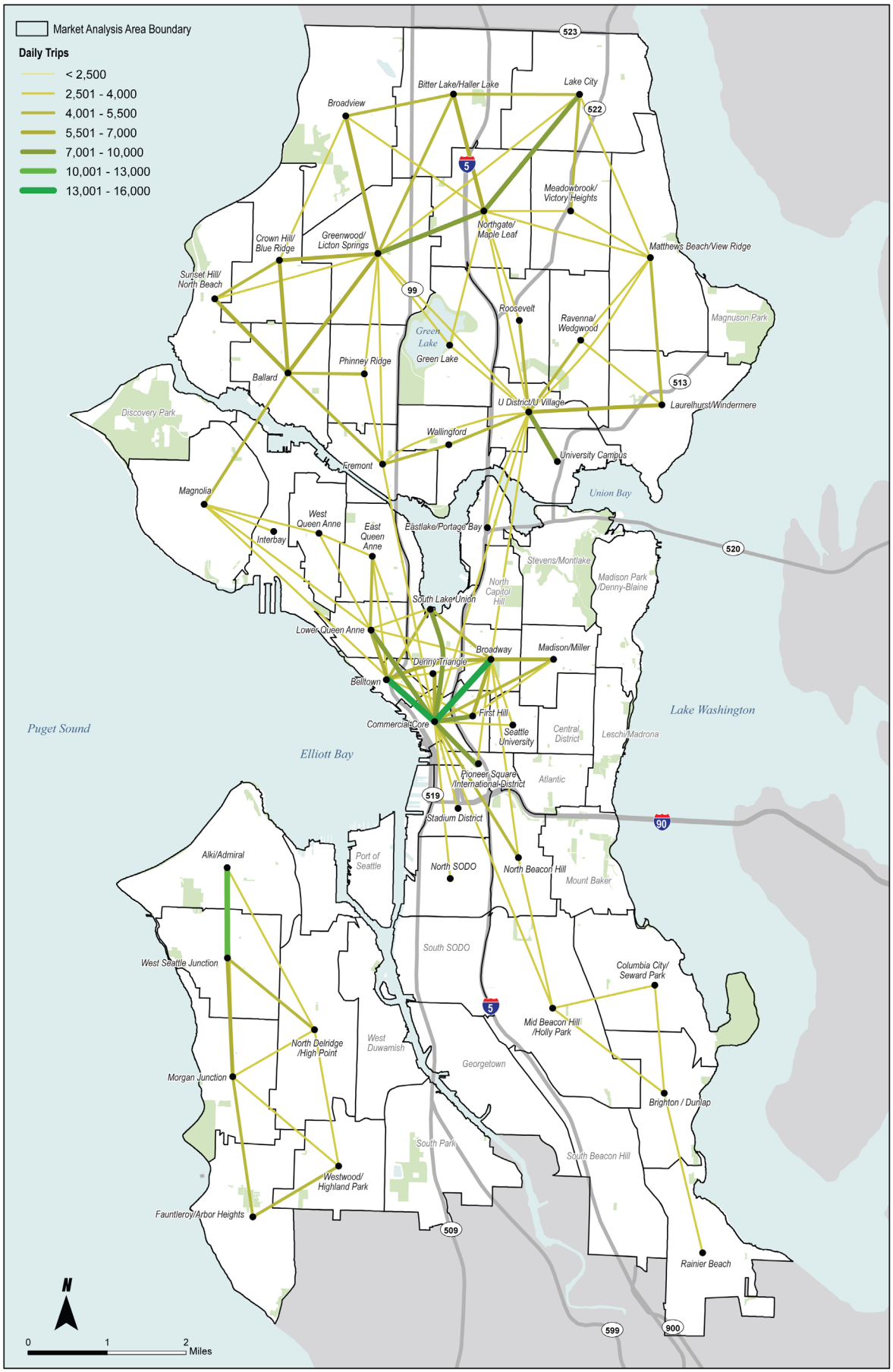


Source: City of Seattle

All Other Trips in the City of Seattle (2008)

- This map includes all non-home based trips and home based trips with a purpose other than work or school. For the purpose of this analysis we call these "all other trips." These trips are made throughout the day for appointments, shopping, recreation, etc. and include trips that start at home or are where the trip origin is not a person's home. (Often these trips are linked together.) This type of trip constitutes the biggest piece of the travel market, or about 83% of daily trips made internally in Seattle.
- Compared to work trips, "all other trips" are much less attracted to the downtown "commercial core." Market areas that stand out as major trip generators and attractors include: Ballard, Crown Hill, Greenwood, Northgate, Lake City, Fremont, and the University District, in North Seattle, and Alki/Admiral and the West Seattle Junction in West Seattle.
- "All other trips" are dispersed throughout the City and operate in the north-south and east-west directions, making use of the network of arterial streets. On average they are much shorter in distance than work trips. Most "all other trips" are made within individual MAAs (internal trips are not illustrated) and between contiguous MAAs.
- Many "all other trips" can be or are made on foot or on a bicycle. The competitive market between modes is very different for this trip type than for work trips. Home-based work trips are often longer, bound for urban centers where parking is priced, have much lower rates of trip "linking," and occur at peak times when congestion is a detractor to driving.
- The existing transit network is designed to serve the minority of trips—primarily work trips and trips bound to urban centers. This is not uncommon, or even illogical, given the higher penalties (traffic congestion, parking cost and availability) on driving to urban centers such as Downtown Seattle. However, it does illustrate the challenge to making transit travel an attractive option for a broad range of non-commute, non-downtown trips.

FIGURE 2-24 TOP 100 ORIGIN-DESTINATION TRAVEL PAIRS FOR ALL OTHER TRIPS IN THE CITY OF SEATTLE (2008)



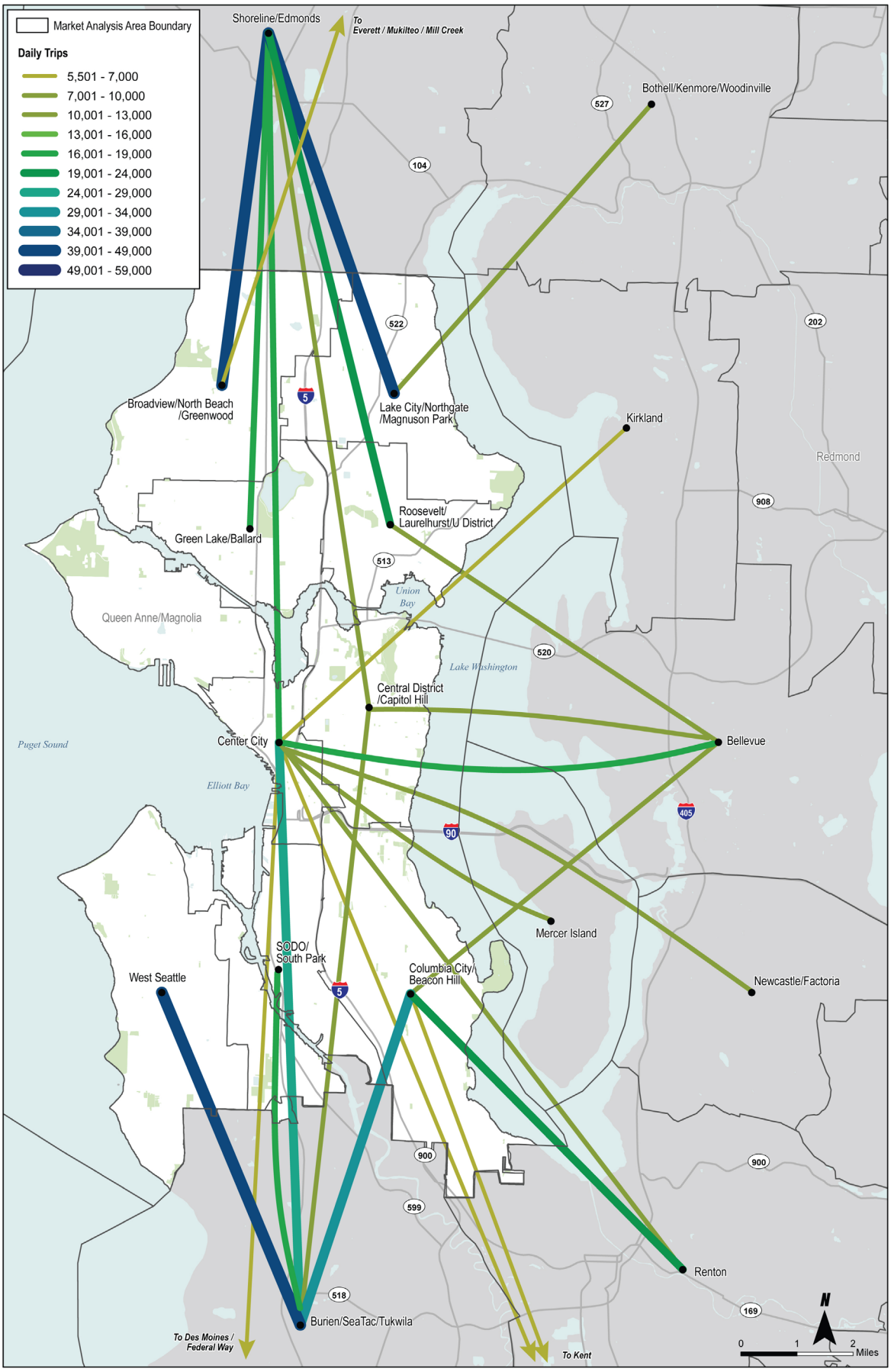
Source: City of Seattle

Nelson|Nygaard consulting associates

All Other Trips between Seattle and Region

- North: Major travel patterns for "all other trips" between Seattle and the region exist between Seattle outer neighborhoods, such as Northgate, Greenwood and Lake City, and close-in suburban cities such as Shoreline, Edmonds, and Mountlake Terrace.
- South: West Seattle and South Seattle shows significant demand for travel to and from market areas in Burien, Sea-Tac, Renton, and Tukwila.
- Downtown Seattle: Travel demand is greater for closer market areas such as Bellevue and Renton and less, although still significant, from Everett and Tacoma.
- Regional travel patterns support planned transit investments including: West Seattle RapidRide, the Tukwila/Federal Way Rapid Ride, and the Burien/Renton RapidRide. Direct connections between these lines would be responsive to current travel demand patterns.
- Providing effective cross-boundary transit connections between North Seattle and Shoreline and Southwest Snohomish County (i.e. interconnecting Swift with RapidRide) would have major benefits for travelers crossing the city/county boundary and would create potential to attract a higher number of transit rides.

FIGURE 2-25 TOP 50 MAJOR ORIGIN-DESTINATION TRAVEL PAIRS FOR ALL OTHER TRIPS BETWEEN SEATTLE AND REGION (2008)

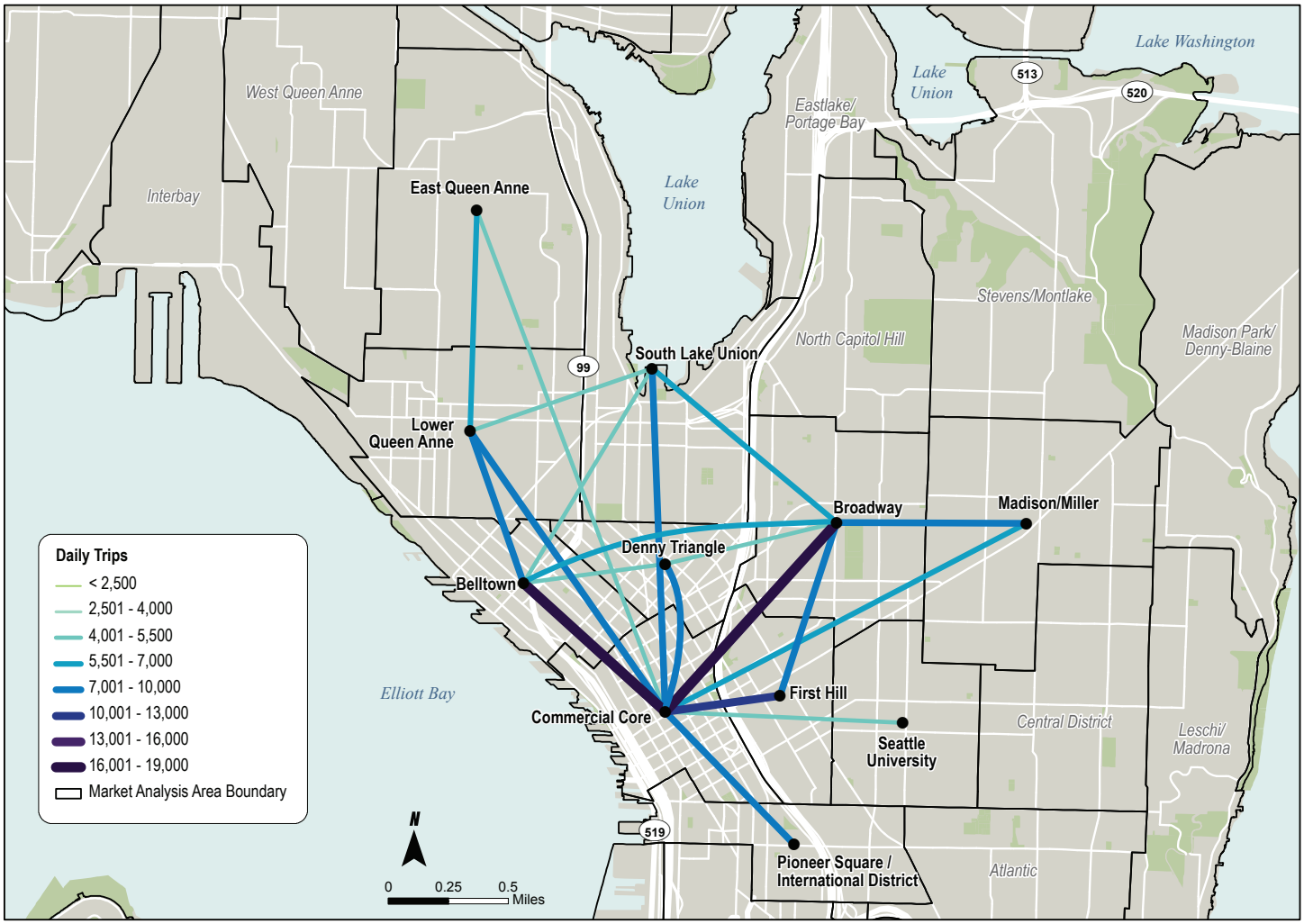


Source: City of Seattle

All Trips in Seattle Center City (2008)

- This map shows all daily trip making in the Center City, including home-based work and all other trips.
- A significant number of trips are made throughout the day between all market areas in the central part of the city; this same area is expected to accommodate a majority of population and employment growth in the next 20 years. Demand for short- to mid-length transit trips is high today and is likely to grow substantially.
- Major origin-destination pairs that do not include downtown are: Lower Queen Anne and Belltown, Belltown and Broadway/Capitol Hill, Capitol Hill and First Hill, and Capitol Hill and Madison-Miller, Belltown and South Lake Union, South Lake Union and Capitol Hill, Lower Queen Anne and Capitol Hill, and Pioneer Square and Capitol Hill.
- Most of these trips are short in distance, but are longer than the distance many people will choose to walk and often include challenging grades which discourage many travelers from bicycling or walking.
- More frequent, faster and more reliable transit service between these activity centers has the potential to attract many of these trips in the future.
- Transit service connections between Center City market areas (and Center City adjacent neighborhoods) vary widely in terms of service quality today. Although transit service frequency is generally 15 minutes or better, many connections cannot be completed in an amount of time comparable to the automobile or even the bicycle and often walk times are faster than transit travel times. A transit trip between Pioneer Square and Capitol Hill on local routes takes more than 30 minutes to complete. This would take about 10 minutes in a car and about 20 minutes on a bicycle. A transit trip between Belltown and Capitol Hill also takes about 30 minutes including walk time and wait time. This trip takes about eight minutes by car and 15 minutes on a bicycle.

FIGURE 2-26 MAJOR ORIGIN-DESTINATION TRAVEL PAIRS FOR ALL TRIPS IN SEATTLE CENTER CITY (2008)



Nelson\Nygaard consulting associates

Source: City of Seattle

CONCLUSIONS

Major findings of the Travel Demand and Transit Market Analysis include the following:

1. **Transit is still not the mode of choice for most travel in Seattle, as reflected by the share of overall travel demand served by transit.** Rather, transit demand is highest where disincentives to driving exist, where walking is safe and comfortable, and where service levels provide a reasonably fast and reliable way to travel. This analysis identified opportunities for improving service frequency and the pedestrian environment in areas that have relatively high propensity for transit use.
2. **King County Metro's transit network is primarily oriented toward commute trips to downtown and the University District.** About 45% of Metro service is provided during peak hours.[1] Peak service targets work trips, which are a stable but relatively small portion of the total travel market in Seattle (17% of all trips). A secondary focus of the transit network is on connections between urban villages (not including major centers). This service is generally less frequent, is all local (no express routes), and often requires a transfer.
3. **Transit corridors operating service every 15 minutes or less during the AM peak provide coverage to most areas in the city where land use analysis shows people would be most likely to use transit.** During the midday, 15-minute service coverage is reduced to major activity centers and urban centers and villages such as Ballard, the University District, Northgate, and the West Seattle Junction.
4. **Urban center and urban village boundaries contain most areas where the analysis shows people are most likely to use transit (transit use propensity index).** However, there are areas where TUP scores are high that are not in a designated urban center or village. These include the following arterial corridors: 15th Avenue NW to the north of Ballard, Aurora north of Greenwood-Phinney Ridge, Lake City Way north of Lake City, along NE 75th Street, along 35th Avenue NE, along Rainier Avenue south of Columbia City, and along Delridge Way SW. Land use policies that strengthen transit ridership on these "connecting corridors" are important to optimize the value of existing service investments.
5. **Transit-dependent residents are well located to access transit.** Areas with the majority of trip generation and attraction in the city are also the areas that show the largest proportions of population that depend on transit for their mobility, and that do not have regular access to an automobile.
6. **Improving pedestrian quality and safety along transit routes is a challenge.** Transit runs primarily on major arterial streets to maximize speed and reliability. However, these streets are the same locations where pedestrian improvement opportunities (as calculated in the Pedestrian Master Plan) are the highest. Focusing pedestrian improvements in major transit corridors is a key opportunity, with the greatest potential to maximize ridership and return on transit service and infrastructure investment.
7. **The greatest opportunities for sidewalk improvements on and near transit corridors are north of N. 85th Street and in southern Seattle neighborhoods such as Delridge and High Point.** These are also market areas with significant concentrations of senior housing. These neighborhoods show significant transit potential that may be limited by pedestrian access issues, along with transit network issues. Improving sidewalk conditions and the pedestrian environment in these locations would help to promote transit ridership by making it safer and more convenient to access transit services.
8. **Center City transit boarding levels and passenger loads are very high.** This area is expected to take on roughly 50 percent of the total population and job growth in the next 20 years. Increasing capacity—by improving frequency and/or providing higher capacity vehicle types (e.g., BRT coaches, streetcars, and LRT vehicles) will be essential to ensure transit remains a comfortable, reliable and convenient travel mode.
9. **Urban village to urban village trips made throughout the day represent a significant market opportunity for transit, but capturing these trips will require service that is more competitive with driving.** High levels of investment in service operations and/or changes in parking management and pricing in urban villages will be needed to attract these types of trips to transit.

1 Metro Route Performance Report, 2009.

10. **To reduce per capita driving and greenhouse gas emission from transportation, transit will need to serve the "all other trips" market more effectively.** While it is good policy to focus transit resources in commute-oriented markets where a higher mode share is achievable due to driving disincentives, transit will need to be more relevant to non-commute travelers to play a significant role in reducing per capita single-occupant travel. Non-work trips make up 83% of all trips within Seattle, and increasing off-peak transit use makes efficient use of existing system capacity.
11. **Transit is most competitive for longer trips made during peak hours when exclusive rights-of-way or HOV lanes provide the greatest travel time benefit.** The Center City attracts a significant number of long distance trips (i.e. trips longer than five miles). Transit mode share for travel pairs to downtown is much higher than non-downtown pairs.
12. **Home-based work trips make up approximately 17% of all trips made internal to the city each day.** These trips are highly concentrated in Seattle Center City and the University of Washington campus.
13. **In contrast, "all other trips" make up the majority of daily travel in the city, are dispersed throughout the city, and travel between a multitude of activity centers.** "All other trips" make more extensive use of the arterial street network, and are shorter in distance (less than three miles long). Most "all other trips" are made between contiguous market analysis areas or within a single area. Attracting these trips to transit will require services that circulate within and between neighborhoods to connect home and work locations to activity centers.
14. **Travel and transit demand patterns illustrate the importance of quality transit connections across north and south Seattle city limits.** Travel demand is clearly the result of residential and employment patterns and is not overly influenced by political or jurisdictional boundaries. Transit service should be organized to provide seamless connections over these boundaries to facilitate the observed travel patterns. Service discontinuities at boundary lines discourage use of transit in the neighborhoods on either side of the boundary.