Transportation Planning and Travel Demand Forecasting

CEE 320
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Outline

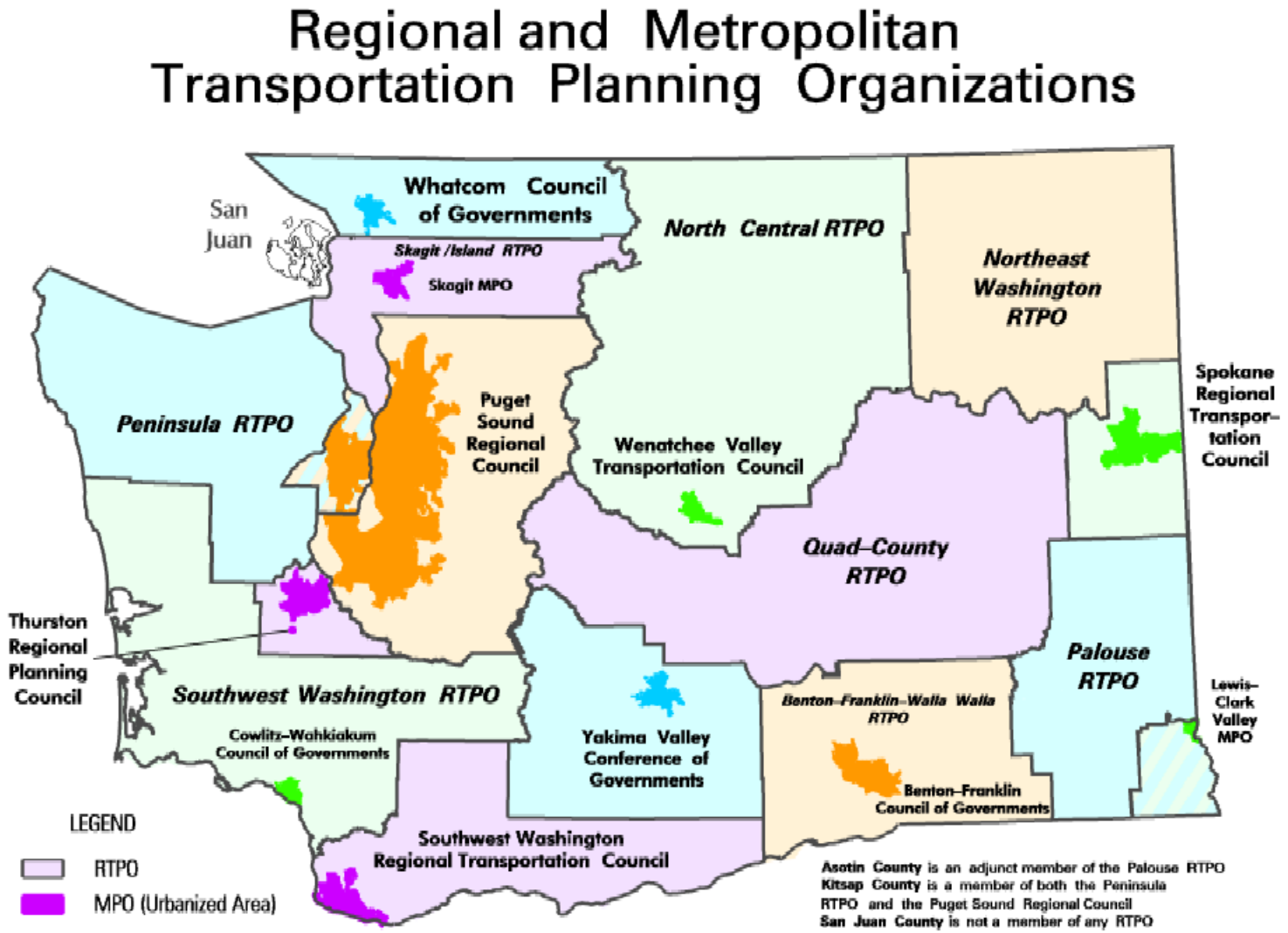
1. Transportation Planning
   - Defined
   - Transportation Planning Organizations
   - Long term plan example
   - Short term plan example
2. Travel Demand Forecasting
   - 4 step process

- **Who conducts transportation planning?**
- **Why?**
- **How?**

Transportation Planning

- **Transportation planning**
  - **The process to provide the information needed for decision makers to choose among alternative strategies for improving transportation system performance.**
- **Transportation planning is future-oriented**
  - **Uncertainty in predictions**
  - **Balance short-term and long-term benefits**
- **The problem is not isolated and independent**
  - **Hierarchical structure**
  - **Broad impact and involvements**

Transportation Planning Organizations



Federal transportation legislation

- Requires that a Metropolitan Planning Organization (MPO) be designated for each urbanized area with a population of more than 50,000 people in order to carry out the metropolitan transportation planning process, as a condition of Federal aid.

- In 1990, the Washington State Legislature passed the Growth Management Act authorizing the Regional Transportation Planning Program and the formation of Regional Transportation Planning Organizations (RTPOs).

- RTPOs develop regional plans and policies for transportation, growth management, environmental quality, and other topics determined by the RTPO.

Puget Sound Regional Council

- **Regional Transportation Planning Organization**
- **Association of cities, towns, counties, ports, and state agencies that serves as a forum for developing policies and making decisions about regional growth and transportation issues in the four-county (Pierce, King, Snohomish and Kitsap) central Puget Sound region)**

Transportation Planning

Long term (strategic) planning

- Very complex
- Based on long-term predictions
- Involves multiple levels of government, administration, and the public

• Short to medium term planning

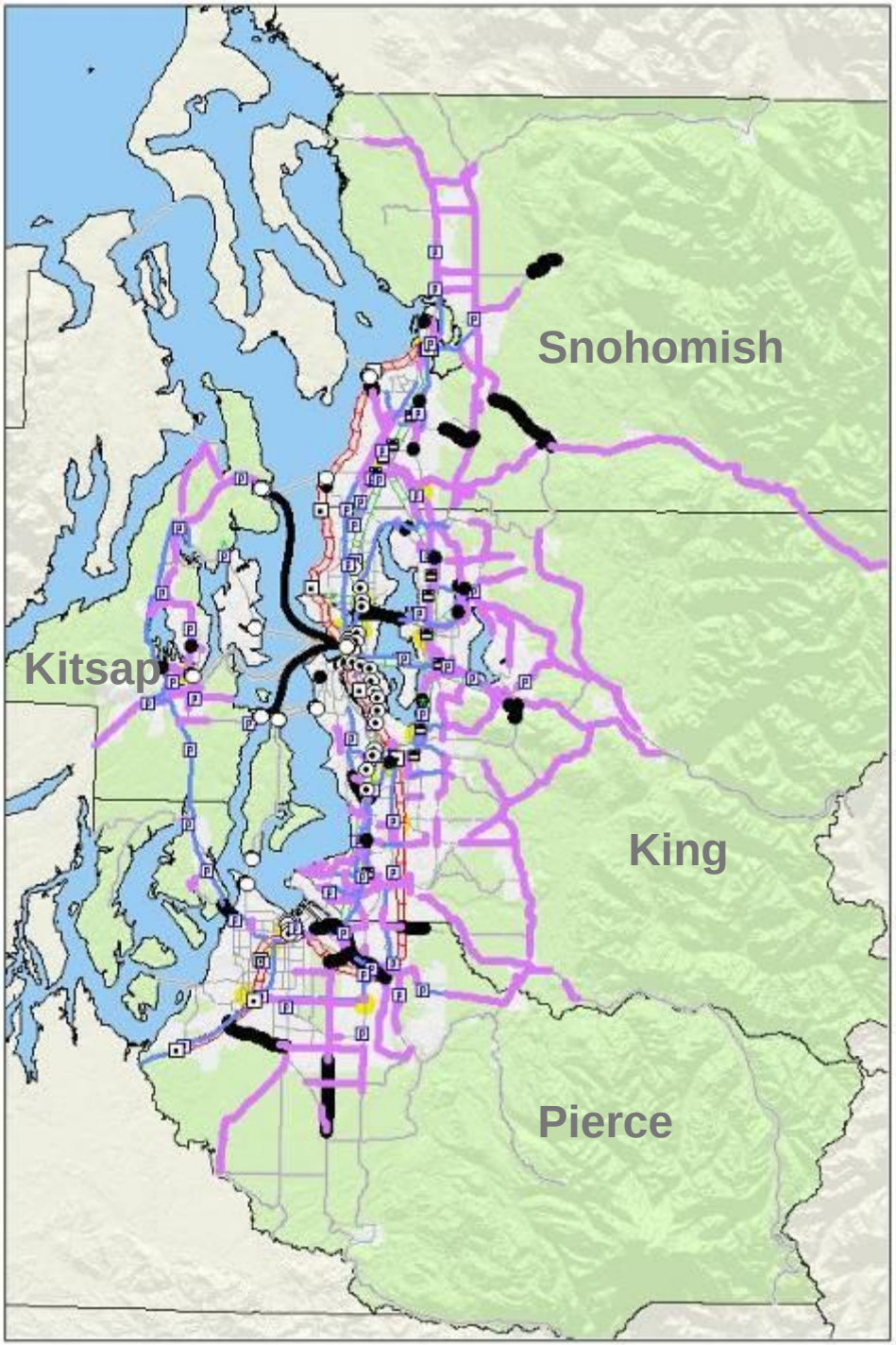
- Less complex
- Reduced uncertainty
- More specific
- Involves public

A Long-Term Transportation Plan

- **PSRC's long-term plan:**
  - **Transportation 2040 and Destination 2030**



Source: PSRC Website: http://www.psrc.org/projects/mtp/index.htm



DESTINATION 2030

Key Messages from Destination 2030

- Puget Sound is a Growing Region
- We Have a Balanced Plan
- Linking Land Use and Transportation
- Investment and Finance Principles
- Monitoring Performance

A Long-Term Transportation Plan

- **Destination 2030 is comprehensive:**
  - **Identifies over 2,200 specific projects that have been designed to result in improved roads, transit, and ferry service.**
  - **Over 2000 miles of new and improved regional state roadways.**
  - **More than 2000 miles of new walkways and bikeways to connect communities with transit, shopping, and services.**
  - **Incentives to better transit service, carpools, etc.**

A Long-Term Transportation Plan

- **Programs:**
  - **State Ferry and Highway Programs**
  - **Local Transit**
  - **Seattle Monorail**
  - **Regional Transit**
  - **Non-motorized**
  - **Freight**
  - **Aviation**

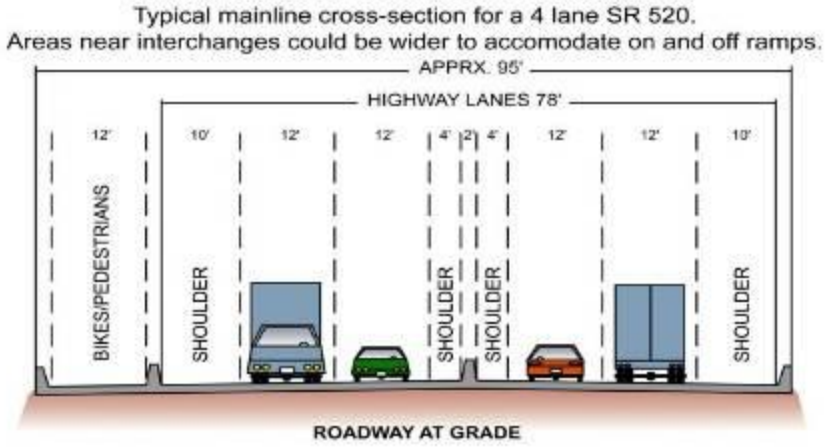
More information at:http://www.psrc.org/projects/mtp/d2030plan.htm

A Short-Term Transportation Plan

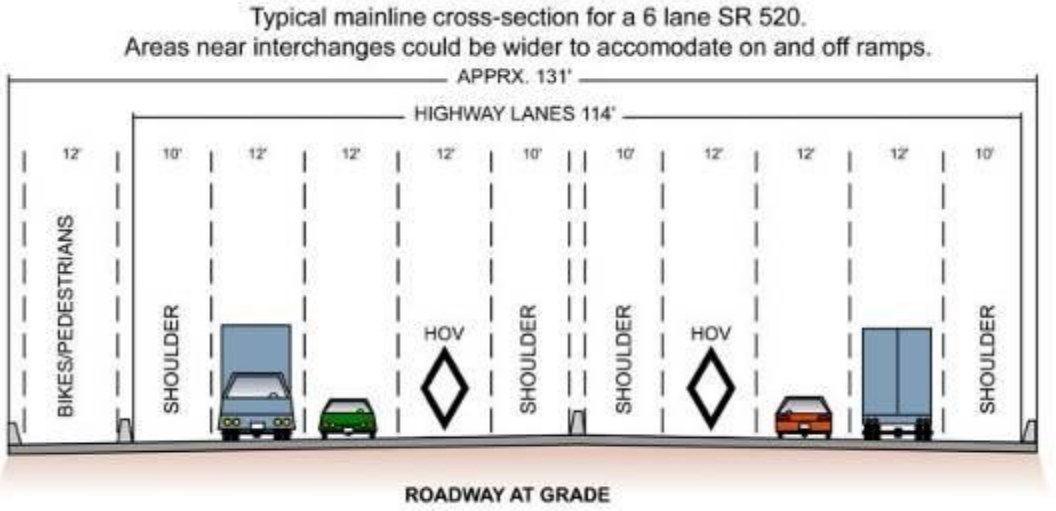
- **SR 520**
  - **Freeway bottleneck**
  - **Old and at end of useful life**
  - **http://www.wsdot.wa.gov/projects/SR520Bridge/**

A Short-Term Transportation Plan

4-lane alternative

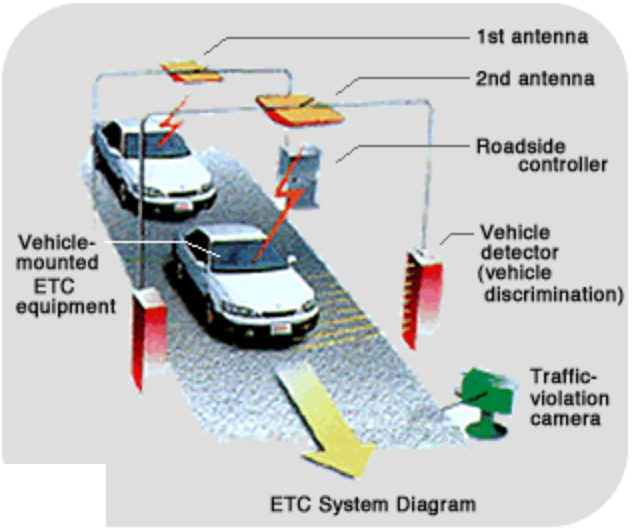


6-lane alternative ($4.5-6.6 billion)



A Short-Term Transportation Plan

Electronic Toll Collection



Why is transportation planning difficult?

Planning Realities

- **Uncertainty in predicting the future**
  - **Economy, fuel, population growth**
- **Analytical limitations**
  - **Inventory, forecasting, performance measures**
- **Influence of politics**
  - **MPO is an explicitly political forum**
  - **In a democracy, elected officials should make key decisions**

Travel Demand Forecasting

Need for Travel Demand Forecasting

- **Impacts of facilities or modes of travel**
  - **Delay on existing roads**
  - **Roads**
  - **Light rail**
  - **Bus service**
- **Geometric design**
- **Pavement design**
- **Infrastructure development**

Traveler Decisions

- **Types of decisions**
  - **Time (when do you go?)**
  - **Destination (where do you go?)**
  - **Mode (how do you get there?)**
  - **Route choice (what route do you choose?)**
- **Influences**
  - **Economic**
  - **Social**

Predicting Travel Decisions

- Collect data on travel behavior
  - Observation (number of buses, cars, bikes, etc.)
  - Surveys
    - Collect data on what travelers have done
    - Collect data on their values and choices (utility)
- Inexact nature of prediction
  - Incomplete data
  - Reporting problems

Travel Demand Forecasting

- **Divide process into 4 steps:**
  - **Trip Generation**
  - **Trip Distribution**
  - **Mode Split**
  - **Trip Assignment**

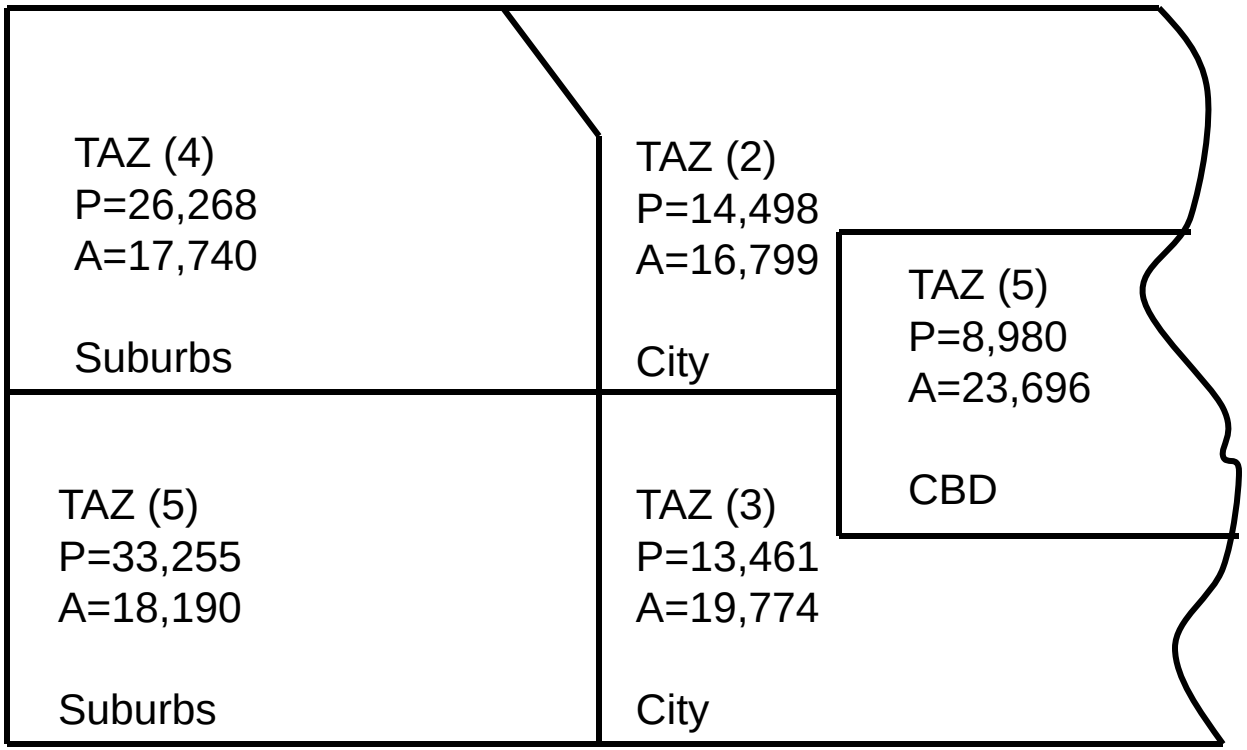
- **We will explore further:**
  - **Trip generation Poisson models**
  - **Mode choice logit models**
  - **Trip assignment route choice models**

Trip Generation

- Relates the number of trips being produced from a zone or site by time period to the land use and demographic characteristics found at that location.
- Assumptions:
  - Trip-making is a function of land use
  - Trips are made for specific purposes (work, recreation)
  - Different trip types are made at different times of the day
  - Travelers have options available to them
  - System modeling is based on Traffic Analysis Zones and networks
- Poisson model often used

Trip Generation

An example trip generation map:



P = trips produced, A = trips attracted

Trip Distribution

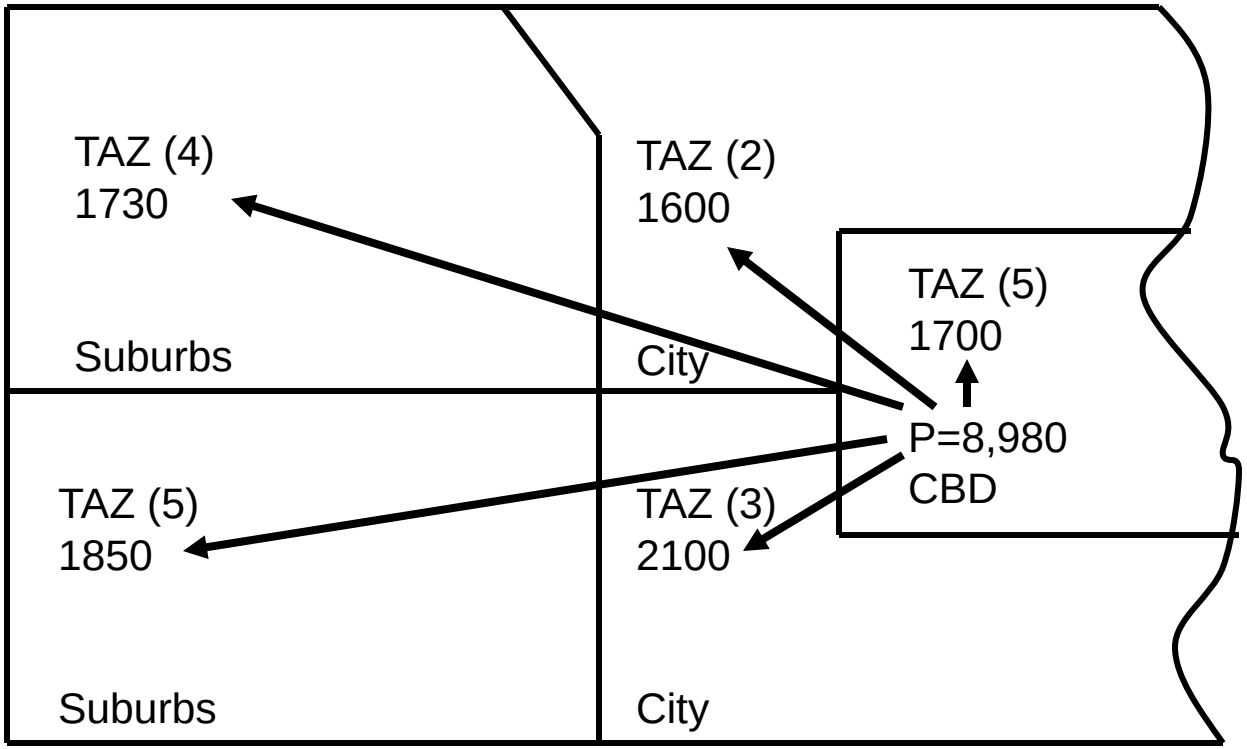
- **Connect trip origins and destinations estimated by the trip generation models**
- **Different trip distribution models are developed for each of the trip purposes for which trip generation has been estimated**
- **Most common model in practice is the "gravity model"**

Gravity Models

- **Distribution of trips is:**
  - **Proportional to the number of trips produced and attracted by each zone**
  - **Inversely proportional to the separation between the origin and destination zones**
- **Widespread use because of its simplicity, its reasonable accuracy and support from the USDOT**

Gravity Models

- **Development**
  - **Trail and error process**



Trip Distribution

$$T_{ij} = P_i \left(\frac{A_j F_{ij} K_{ij}}{\sum_{all\ zones} A_j F_{ij} K_{ij}} \right) \qquad F_{ij} = \frac{c}{t^n}$$

T_{ij} = Number of trips produced in zone i and attracted to zone j

P_i = Number of trips produced by zone i

A_j = number of trips attracted by zone j

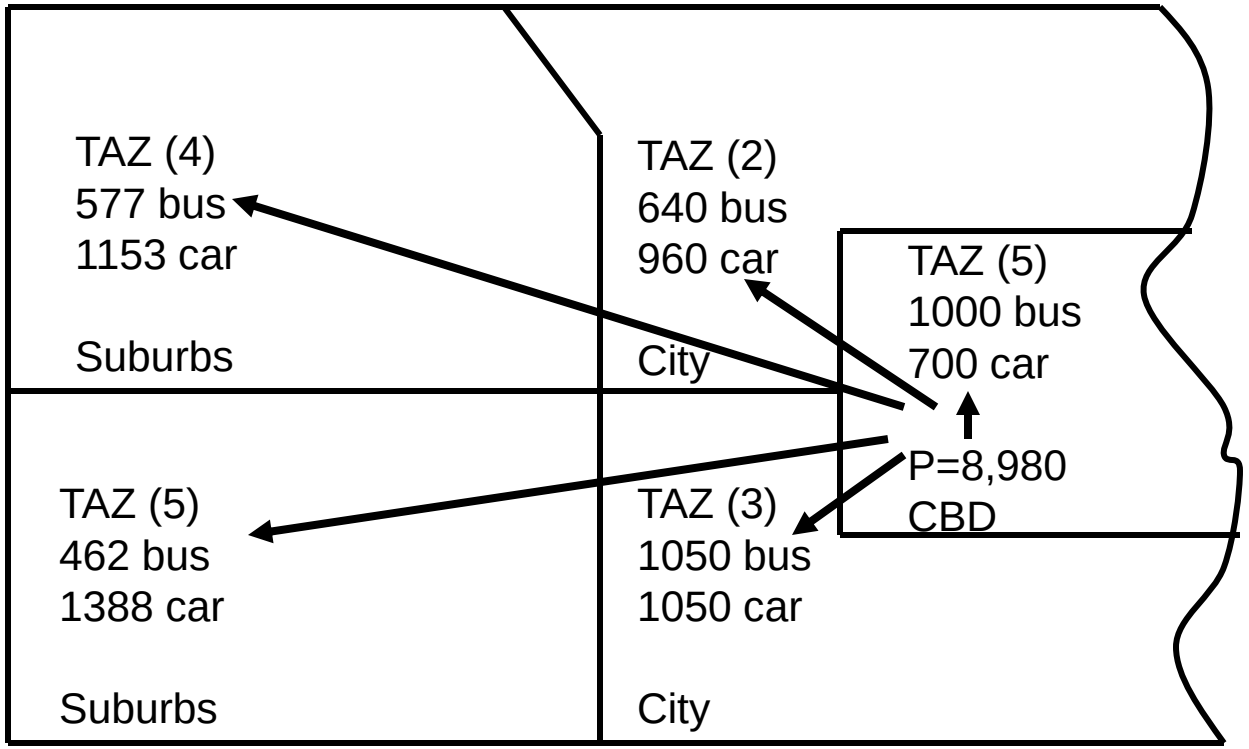
F_{ij} = friction factor (the gravity part)
c is often 1 and n is often 2

t = travel time

K_{ij} = socio economic adjustment (fudge) factor

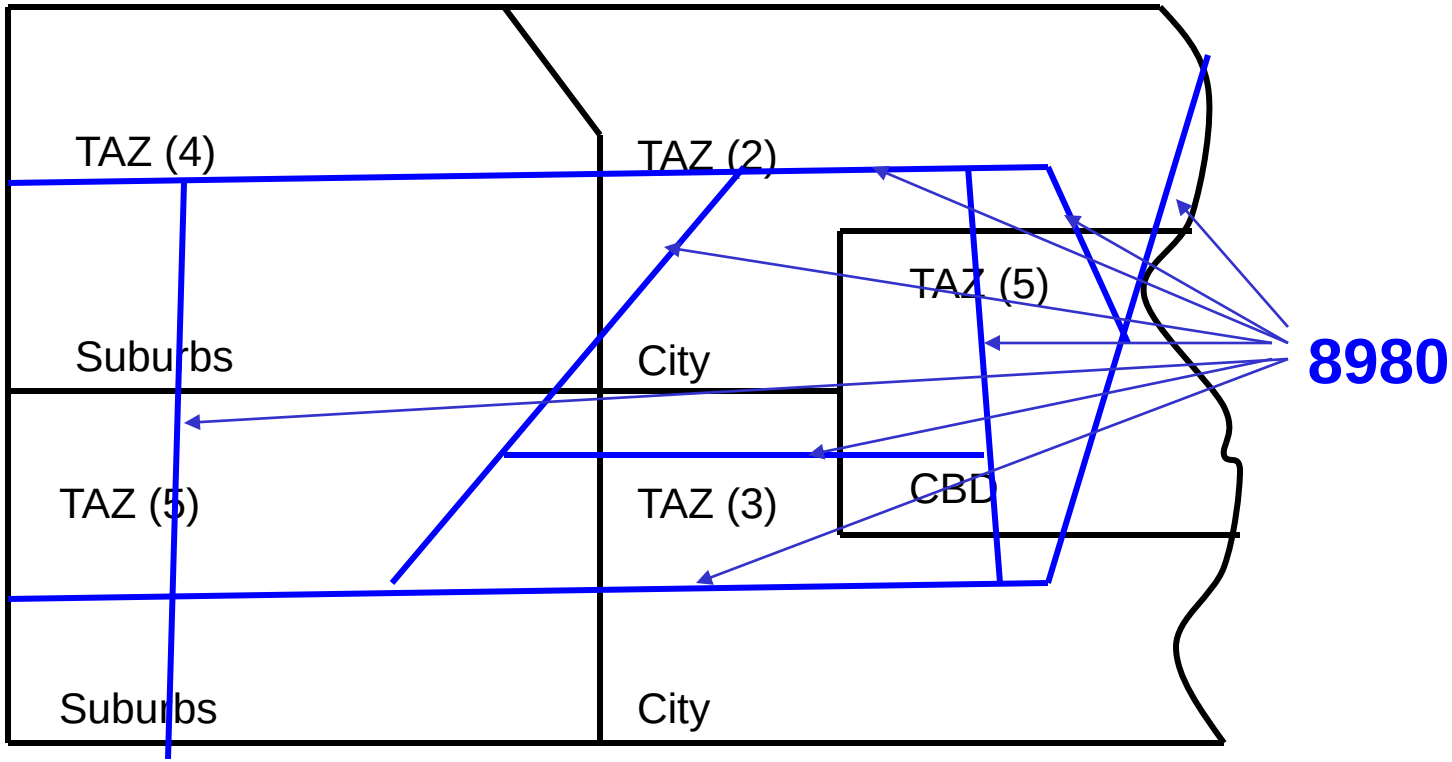
Mode Split

- **Based on utility (level of attractiveness) of modes**
- **Logit model most commonly used**

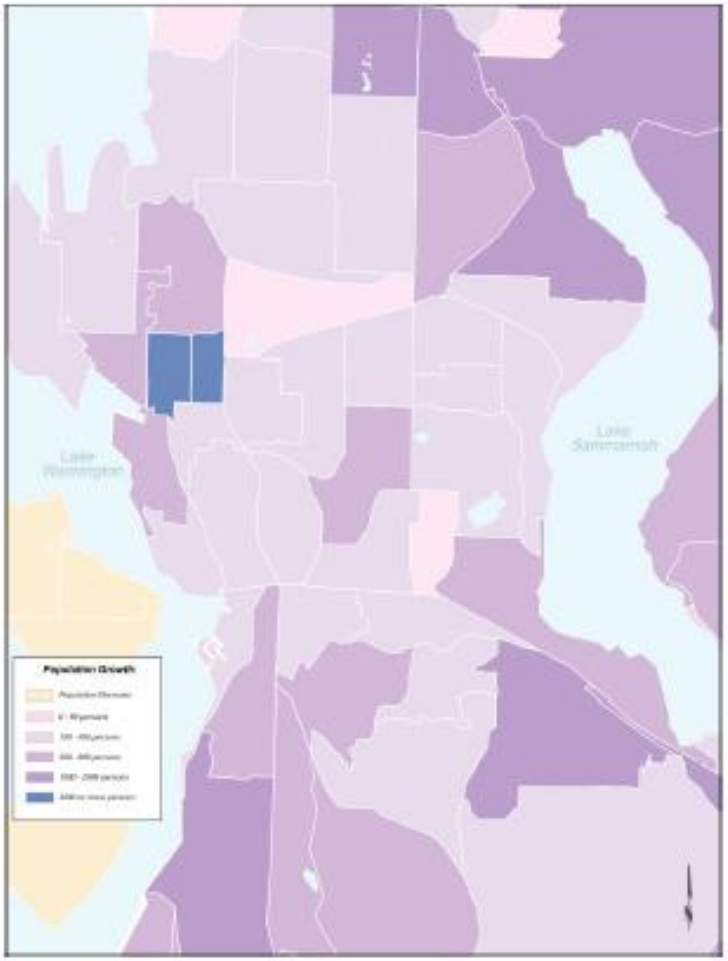


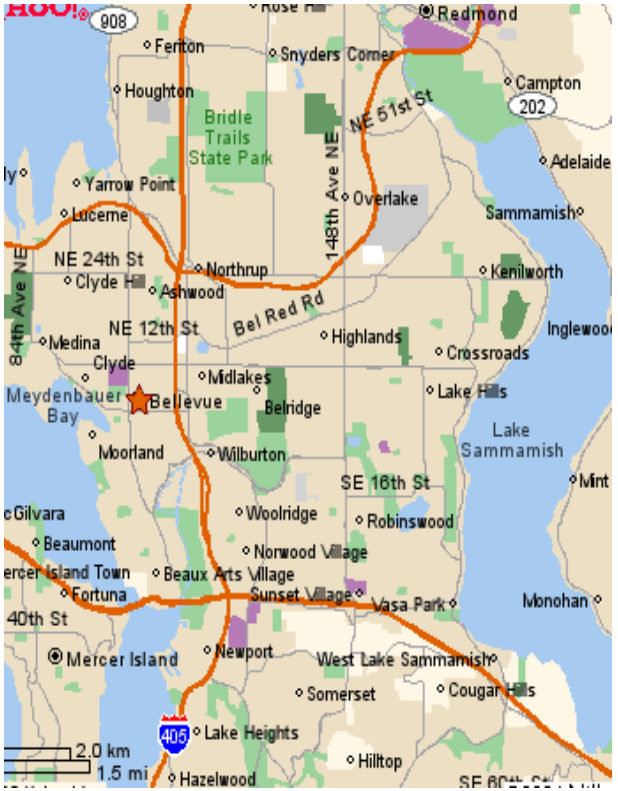
Trip Assignment

- **Assigns trips to paths through the network**
- **Two most common methods**
  - **All or nothing (shortest path) assignment**
  - **Capacity restraint (incremental) assignment**



Example: Bellevue 1999-2010

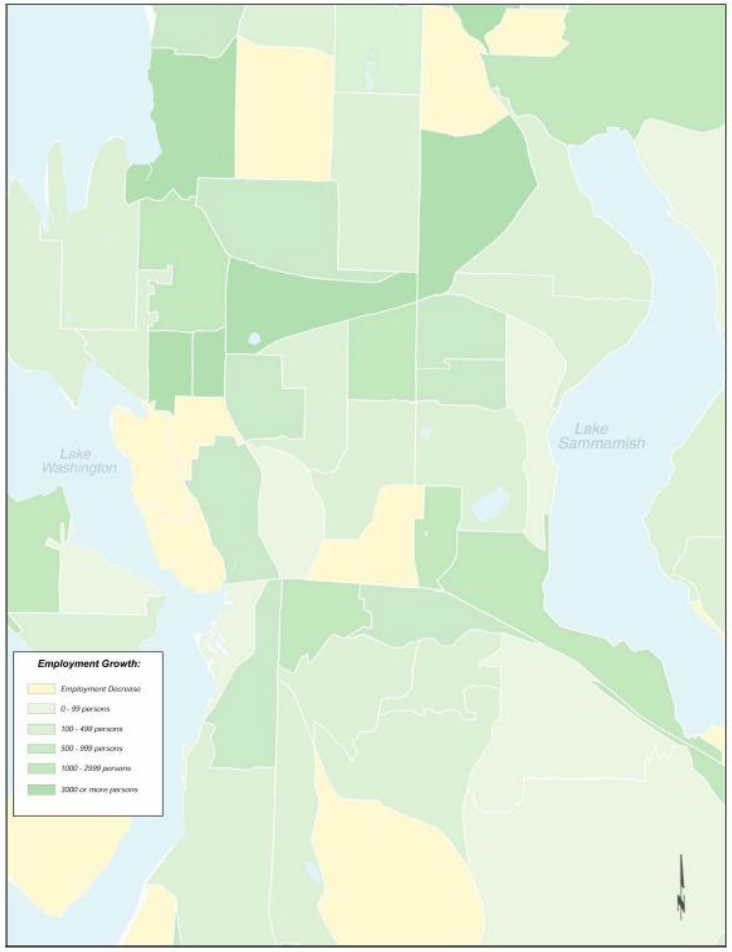




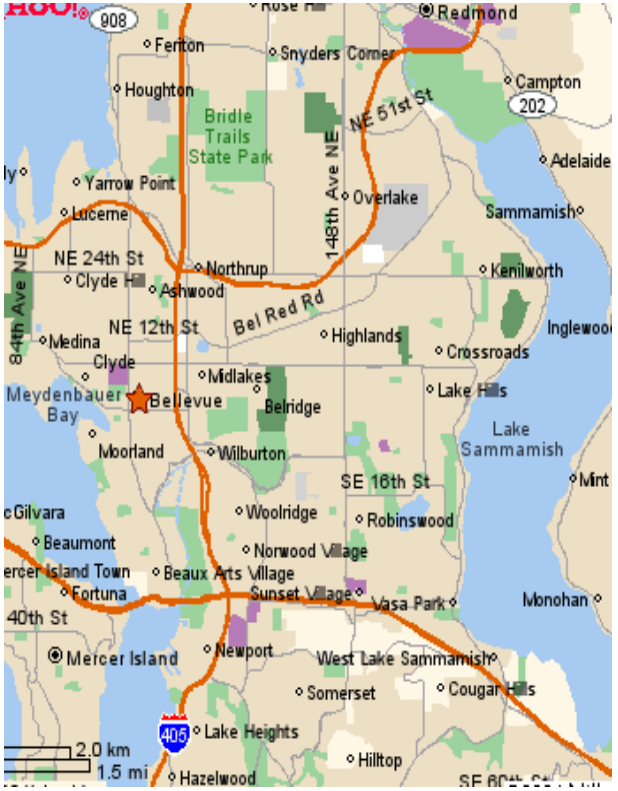
Forecasted Population Growth

Source: Bellevue Transit Plan 2001-2007

Example: Bellevue 1999-2010

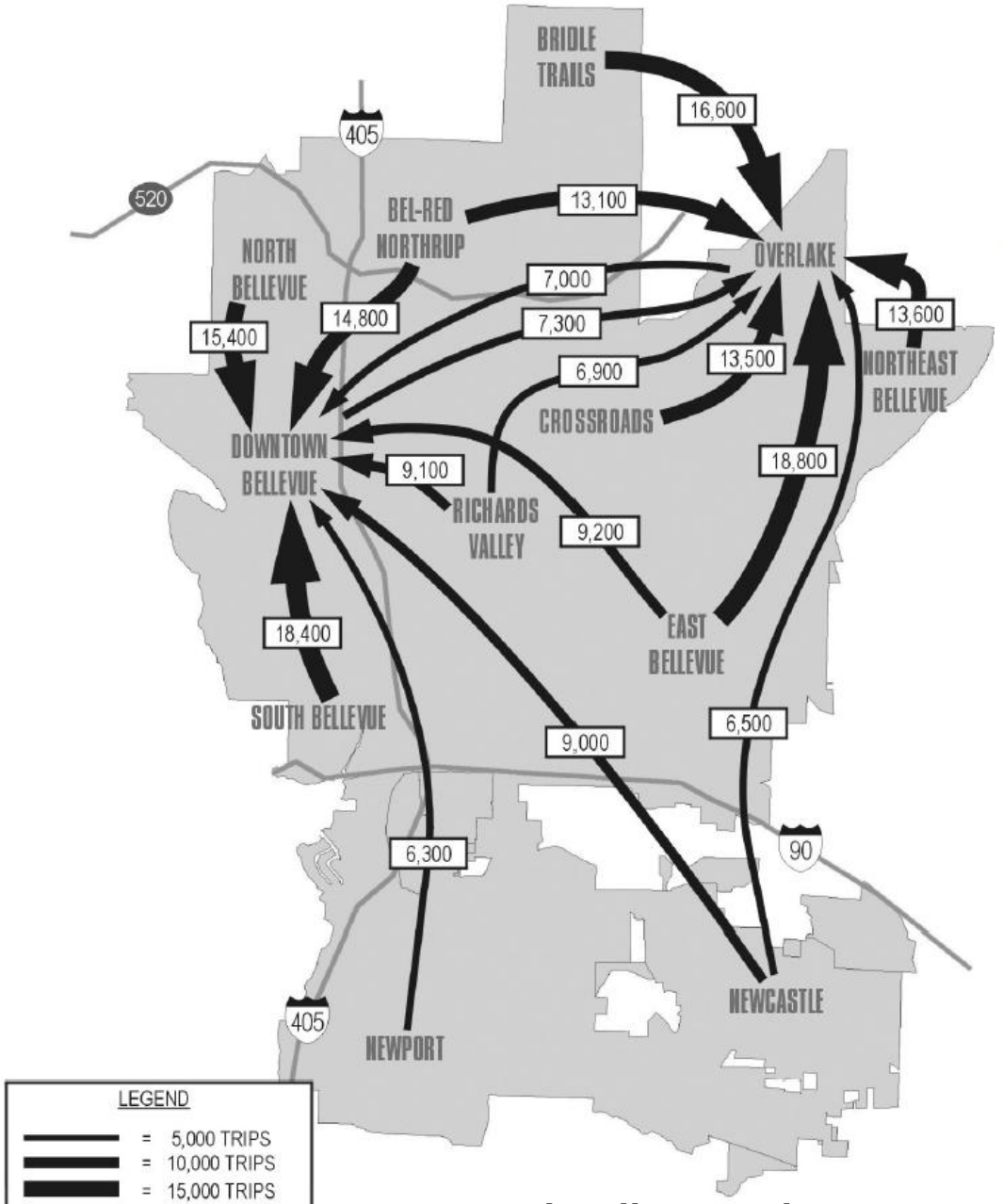


Decrease
0-99
100-499
500-999
1000-2999
3000+



Forecasted Employment Growth

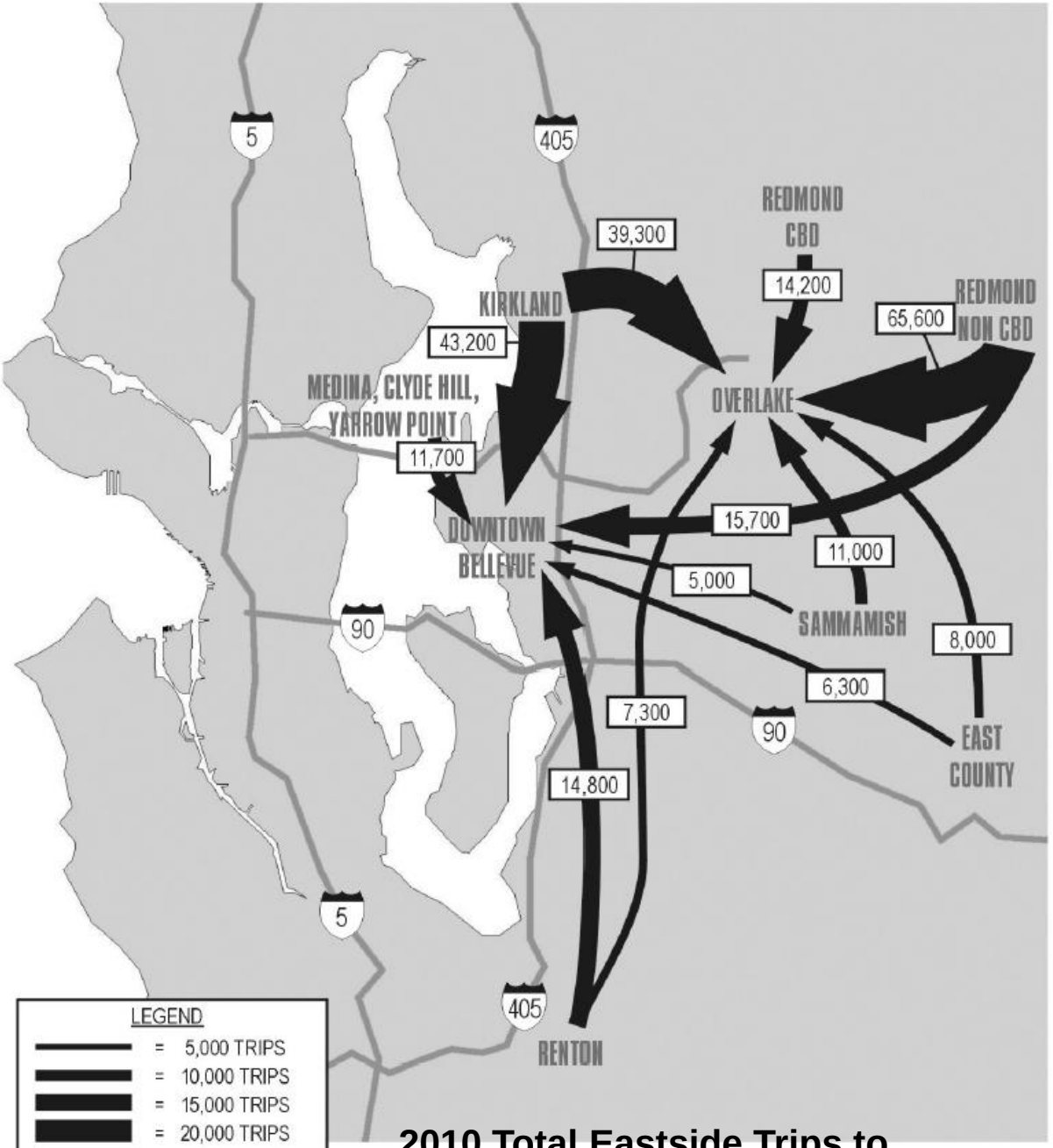
Source: Bellevue Transit Plan 2001-2007



5,000 trips
10,000 trips
15,000 trips
20,000 trips
25,000 trips

2010 Total Bellevue Trips to Downtown and Overlake

Source: Bellevue Transit Plan 2001-2007



5,000 trips
10,000 trips
15,000 trips
20,000 trips
25,000 trips
30,000 trips

2010 Total Eastside Trips to Downtown and Overlake

Source: Bellevue Transit Plan 2001-2007