

**To:** Becky Knudson, Oregon Department of Transportation

**From:** Joel Freedman, PB Consult

**Date:** October 31, 2005

**Subject:** COSMO Project Data Expansion Methodology Deliverable

---

One of the deliverables under the Continuous Survey Project (COSMO), effective date September 9, 2004 and amended on April 8, 2005, is the provision of a technical memorandum (# 4) identifying a data weighting and expansion plan. However, at this point there are too many unknowns (size of sample per year, urban versus rural split, and number of cross-sectional versus longitudinal panel households) to exactly define what the data weighting and expansion plan should be. Additionally, weighting of longitudinal panel data requires knowledge of the number of observations and the periodicity of the panel as well as the data items to be analyzed – none of which is available at this point in time. This information will only be available once the Oregon Department of Transportation (ODOT) and the Oregon Modeling Steering Committee (OMSC) and its members determine the funding levels available to conduct the survey. As an alternative to the deliverable described in the original scope of work, this memorandum provides a general description of the data expansion technique used for construction of the Gen2 Oregon Statewide models.

Two independent household travel surveys were conducted in Oregon, one in 1994 and the other in 1996. The data collected from these surveys were used to calibrate the Personal Transport (PT) module of the second generation Transportation Land Use Model Improvement Program (TLUMIP) model. To calibrate the PT module, the survey data was expanded to equal the number of households in 1990, the base year of the model.

### **1994 Household Survey**

The first household activity survey was conducted in 1994. This survey included households in the regions of Salem-Kaiser, Eugene Springfield, Medford, and Portland. The three counties of Polk, Marion and Yamhill were also surveyed. Table 1 shows the number of households surveyed in each region.

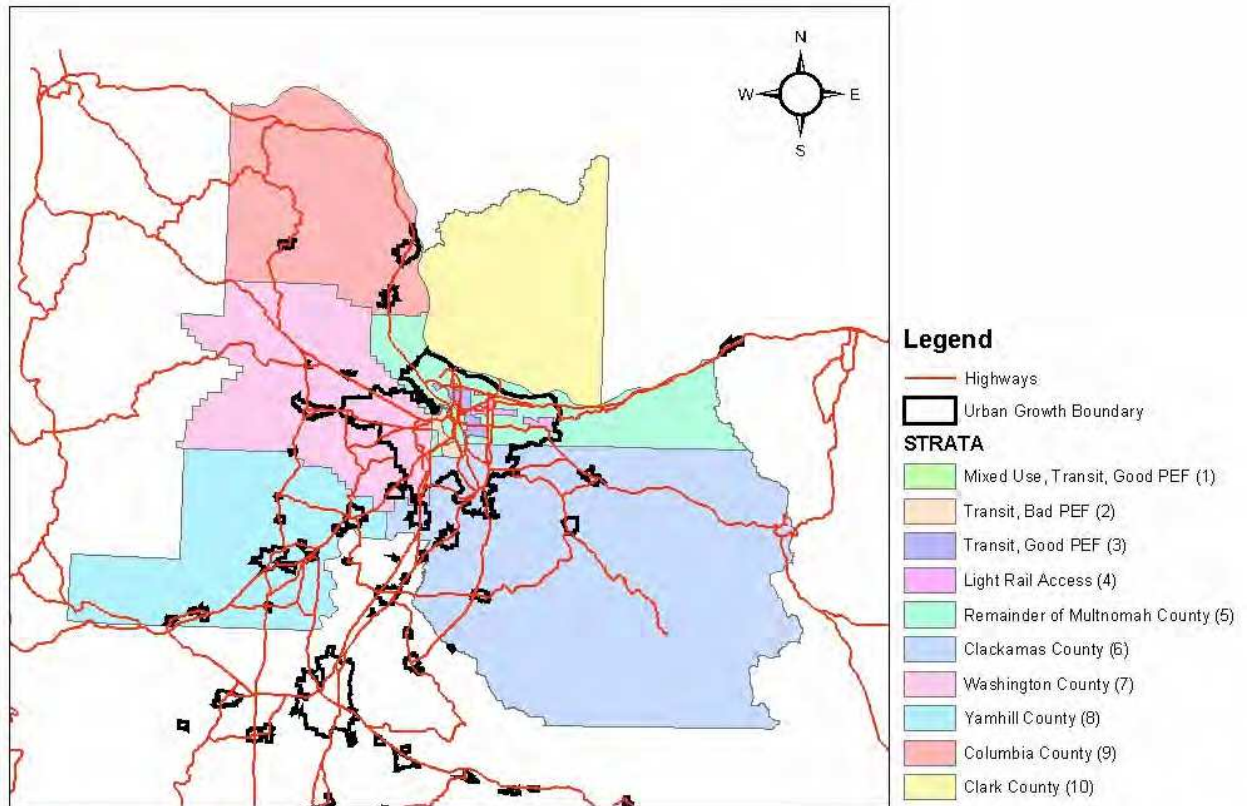
Each region in the survey was divided into strata based on location within the region. The purposes of the strata are to accurately account for differences between households whose travel behavior is affected by location, pedestrian environment factors (PEF), and access to transit and amenities.

**Table 1 – Number of households surveyed in 1994**

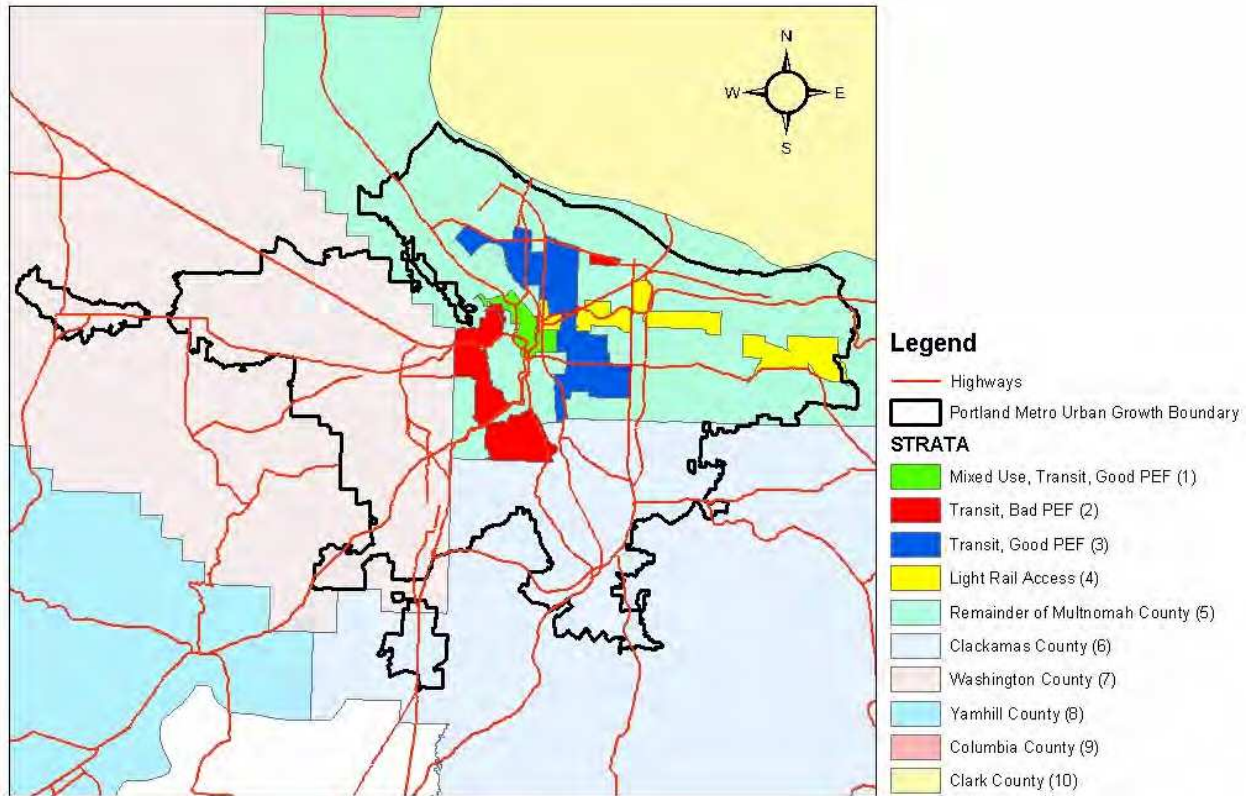
<b>Region</b>	<b>MPO</b>	<b>Surveyed Households</b>
Portland Metro	Portland Metro	5,863
Salem	Mid-Willamette Valley Council of Governments (MWVCOG)	1,520
Eugene	Lane Council of Governments (LCOG)	1,631
Medford	Rogue Valley Council of Governments (RVCOG)	1,779
3 County	Parts of Portland Metro, MWVCOG, and non-MPO	969
<b>Total</b>		<b>11,762</b>

The Portland Metro region is separated into ten stratum. Within Multnomah County, stratum definitions are 1) urban areas with transit service, mixed land use, and good transit access to transit, 2) urban areas with transit service and poor PEF, 3) urban areas with transit service and good PEF, 4) urban areas within a MAX light rail corridor, and 5) the remainder of Multnomah County, 6) Clackamas County, 7) Washington County, 8) Yamhill County, 9) Columbia County, and 10) Clark County, Washington. Figure 1 shows the stratum boundaries for the Portland Metro region. Figure 2 details the stratum within the Portland Metro Urban Growth Boundary (UGB).

Figure 1: Portland Region Survey Area and Stratum Definitions

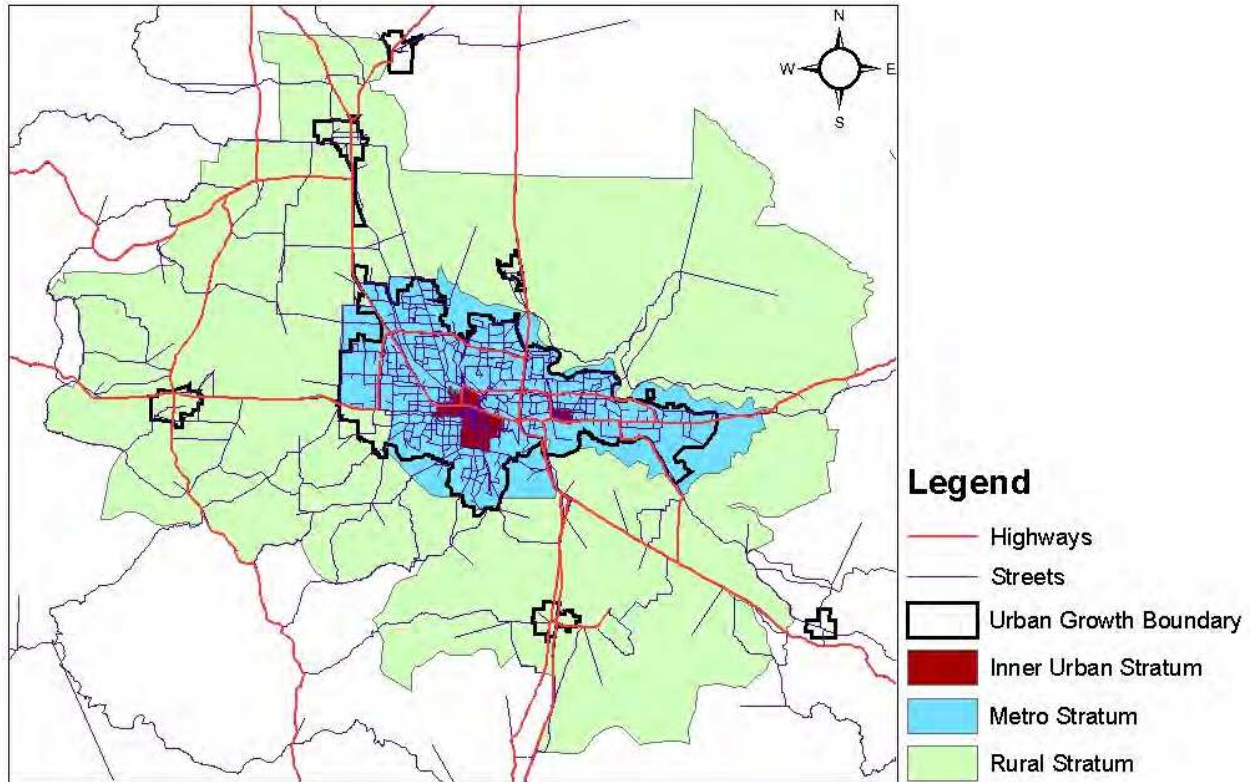


**Figure 2: Portland Region Survey Area and Stratum Definitions, Focused on Metro Urban Growth Boundary**



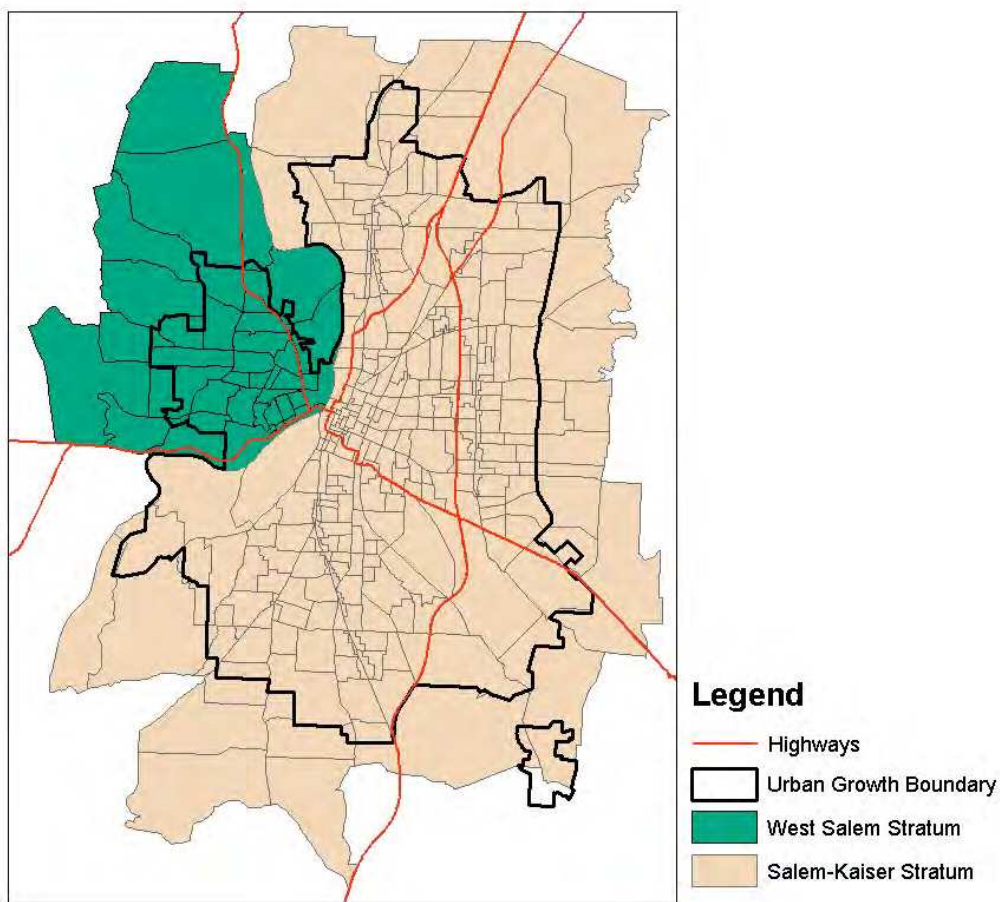
The Eugene region is separated into three strata. One stratum is defined as Inner Urban Mixed Use Districts, characterized by a grid street pattern and good pedestrian, bicycle, and transit accessibility. This stratum is comprised of two districts, one centered in the Eugene Central Business District (CBD) and the University of Oregon. The other is centered in the Springfield CBD. The second Eugene stratum is the remainder of the Eugene-Springfield Metropolitan area, roughly corresponding to the Urban Growth Boundary (UGB). The third Eugene stratum is the Rural Area surrounding the Eugene-Springfield Metropolitan Area, including satellite communities of Creswell, Veneta, Cheshire, Junction City, Marcola, Waltherville, and Dexter. Figure 3 shows the Eugene stratum boundaries.

**Figure 3: Eugene Study Area and Stratum Definitions**



Salem is separated into two stratum. One is defined as West Salem. The second is defined as Salem-Kaiser. Figure 4 shows the Salem stratum boundaries.

**Figure 4: Salem Study Area and Stratum Definitions**

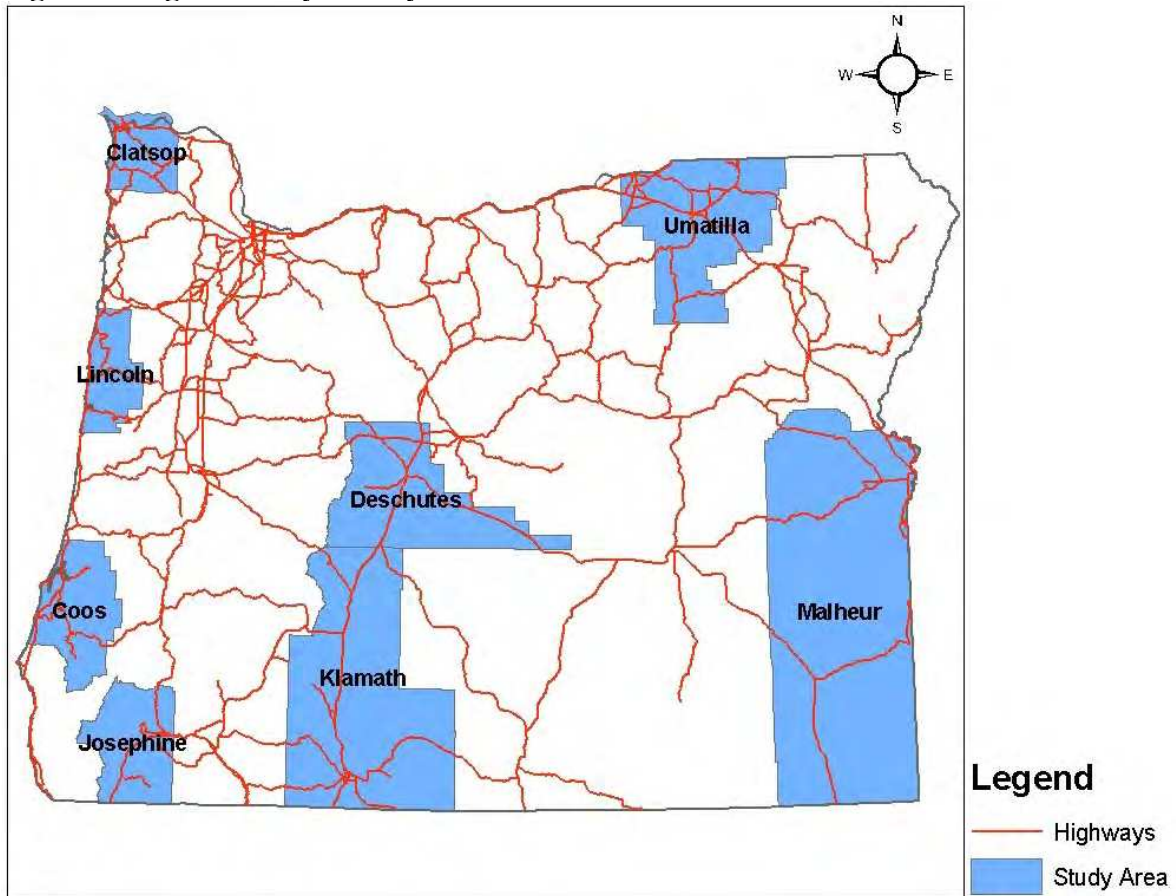


The Medford survey did not include stratum definitions. All households within urbanized Rogue County were treated the same in regards to location.

**1996 Eight County Household Survey**

In 1996, a second household activity survey was conducted in the counties of Clatsop, Coos, Josephine, Kalamath, Deschutes, Umatilla, Malheur and Lincoln. Within these eight counties, 3,193 households completed surveys. Stratums were not defined for this survey. Figure 5 shows the eight county survey study area.

**Figure 5: Eight County Survey Area**



### **Survey Data Collected**

The household information collected was the consistent across both surveys and included the physical address of the residence, type of residence, years the household has occupied the residence, own/rent status, household size, vehicles available, and household income.

For each member of the household, information gathered included name, relationship in household, gender, age, whether they are licensed, employment status, occupation, whether they telecommute, educational attainment, ethnic background and information on disabilities.

Household members recorded their activities for a two-day period. Information recorded about each activity included the activity type, location, duration, trip time to activity, mode of transportation, whether a vehicle was available, the specific vehicle used, whether they paid to park, number of people in the vehicle, and whether they were the driver or passenger.

### **Expansion Factor Methodology**

The activity data recorded by Oregon households in the 1994 and 1996 surveys are used to calibrate the PT module of the second generation TLUMIP model. The household activity data were expanded to equal the number of households in Oregon in 1990, the base year for the model.

1990 Oregon household data were collected from the 1990 Census Transportation Planning Package (CTPP). The 1990 CTPP data were special tabulations from the 1990 Census that are specifically for transportation planning purposes. The data are based on the Census long form questionnaire mailed to one in six households.

1990 CTPP data were separated into a statewide element and an urban element. The urban element contains data for urban areas as defined by Oregon's Metropolitan Planning Organizations (MPOs). These data were summarized by TAZ for Eugene and census tract for Portland Metro, Salem and Medford.

Expansion factors were previously calculated for the Portland Metro, MWVCOG, and LCOG survey data. These factors were calculated by separating households by size, number of vehicles, income and number of workers.

These expansion factors were not used to calibrate the PT module for a few reasons. First, only one set of expansion factors were created for each household subset. Since the PT model creates weekday and weekend travel patterns, separate expansion factors were necessary for both weekend and weekday household observations. Also,



expansion factors were not created for rural data in a manner consistent with the MPO data. Therefore, it was necessary to re-expand the Portland Metro survey data and expand all other survey data using a consistent methodology.

New expansion factors were calculated by separating households within each stratum by household size and the number of vehicles available to the household. Households recorded activities over a two-day period. The recorded survey days were treated independently of the household. Therefore, there were two survey observations for each household. Table 2 lists the total survey days recorded.

**Table 2: Total Survey Observations**

	<b>Weekday Survey Days</b>	<b>Weekend Survey Days</b>	<b>Total Survey Days</b>
<b>3 County Total</b>	1563	375	1938
<b>Eugene Total</b>	2632	628	3260
<b>Medford Total</b>	2802	756	3558
<b>Metro Total</b>	9110	2614	11724
<b>Salem Total</b>	2429	611	3040
<b>Grand Total</b>	18536	4984	23520

The survey data were separated into weekday and weekend observations. The number of survey observations by stratum, household size and number of vehicles was expanded to equal the 1990 Census Transportation Planning Package (1990 CTPP) data for both weekday and weekend data.

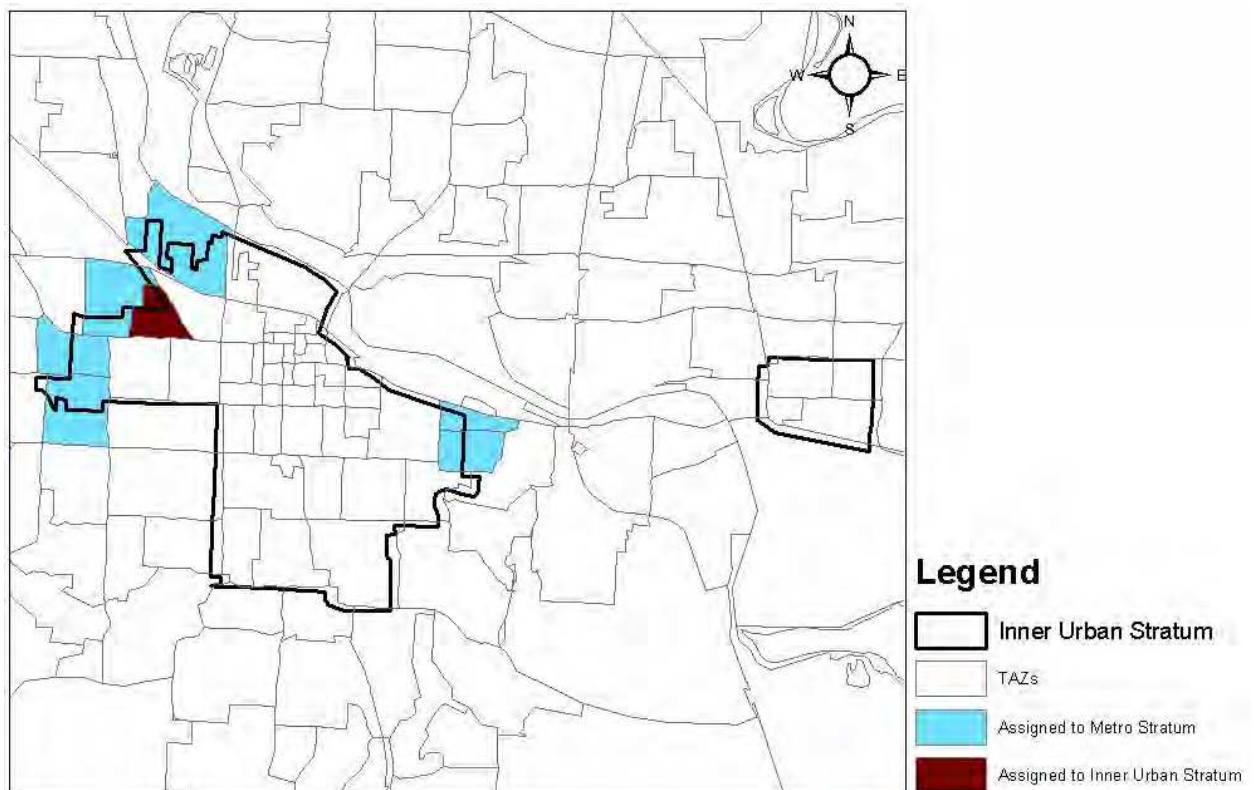
**Extracting CTPP data by stratums**

This section describes the procedures used to extract the proper 1990 CTPP data by stratum.

## Eugene

TAZ level CTPP data were available for the Eugene Metropolitan area. Seven TAZs are partially within both the Metro and Inner Urban stratum, as shown in Figure 6. These TAZs were placed in the stratum containing the largest geographic portion. Six of these TAZs were assigned to the Metro stratum, and one was assigned to the Inner Urban stratum.

**Figure 6: Eugene TAZs in both the Inner Urban Stratum and the Metro Stratum**



The Metro stratum boundary matched TAZ boundaries, as did the rural stratum boundary. Therefore, there are no TAZs that were only partially within the rural stratum. The appropriate rural stratum CTPP data was extracted by taking the TAZs that were completely within the stratum boundaries. The actual number of households

from the 1990 CTPP data was 15,997, nearly the exact estimate of 16,000 households given by LCOG. Table 3 shows the number of household survey days and the total number of households in each Eugene stratum from the 1990 CTPP data as well as the LCOG estimates.

**Table 3: Total Eugene Households by Stratum (Final numbers and LCOG estimate)**

<b>Eugene Stratum</b>	<b>Weekday Survey Count</b>	<b>Weekend Survey Count</b>	<b>CTPP Households (1990)</b>	<b>LCOG Estimate</b>
<b>Rural</b>	350	104	15,988	16,000
<b>Metro</b>	1,229	333	63,886	64,000
<b>Inner Urban</b>	760	114	13,127	14,000
<b>Total</b>	2,339	551	93,001	93,000

### **Metro**

In all cases, Metro stratum boundaries shared boundaries with 1990 CTPP census tracts. Therefore, there were no census tracts only partially within a stratum. CTPP data for all Metro stratum boundaries were extracted by separating the census tracts that were completely within each stratum. Table 4 shows the number of household survey days and the total number of households in each Metro stratum from the 1990 CTPP data.

**Table 4: Total Metro Households by Stratum**

Portland Metro Stratum	Weekday Survey Count	Weekend Survey Count	CTPP Households (1990)
1	566	172	10,788
2	530	152	16,013
3	1,055	313	60,256
4	671	181	25,951
5	1,534	456	129,312
6	921	259	103,635
7	975	305	119,158
8	321	87	22,399
9	313	89	13,966
10	2,224	600	88,571
<b>Total</b>	9,110	2,614	590,049

**Salem**

Salem stratum did not share boundaries with five 1990 CTPP census tracts. In the case of an overlap, the census tract data was included in the stratum for purposes of calculating expansion factors. Figure 7 shows the five overlapping census tracts. Table 5 shows the number of household survey days and the total number of households in each Salem stratum from the 1990 CTPP data.

Figure 7: Census tracts overlapping stratum boundaries

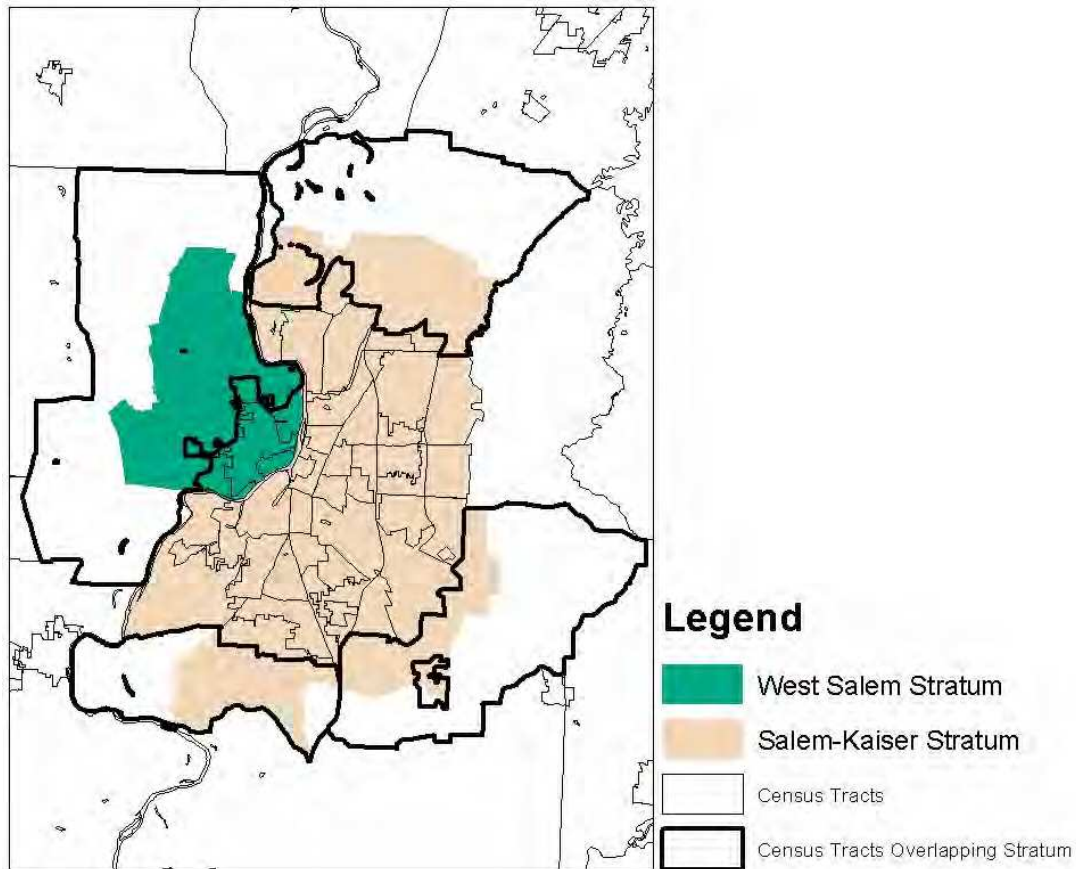


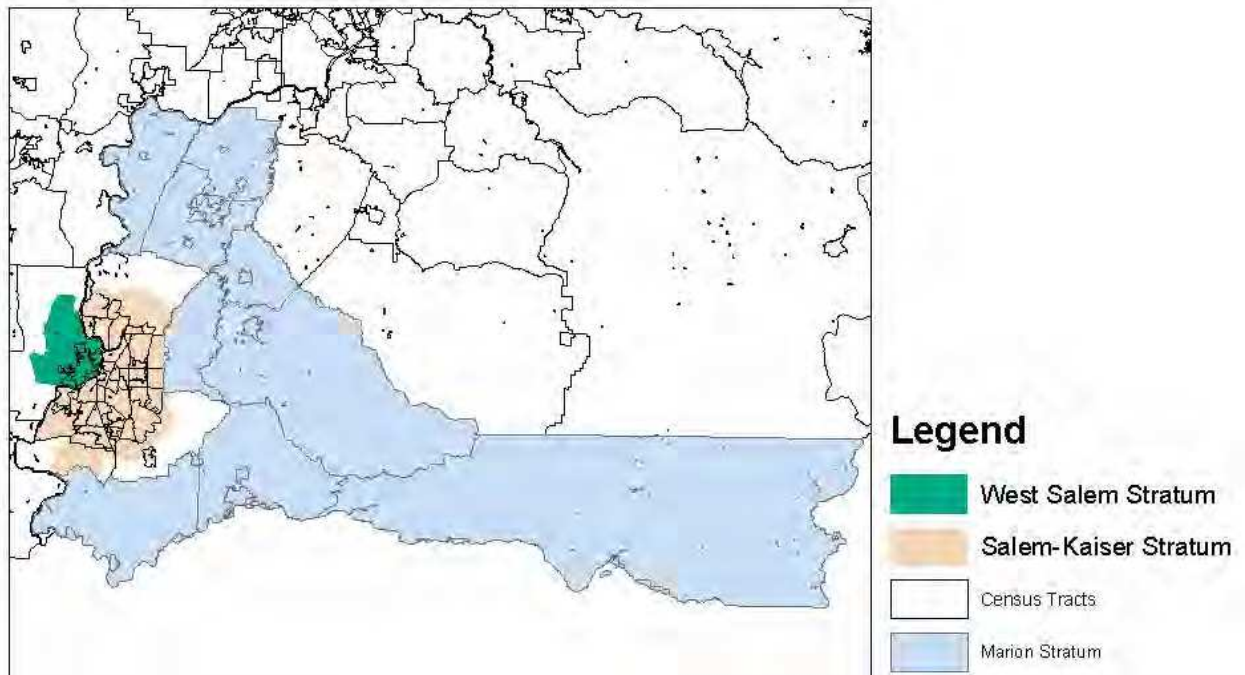
Table 5: Salem Households by Stratum

Salem Stratum	Weekday Survey Count	Weekend Survey Count	CTPP Households (1990)
West Salem	505	107	6,735
Salem-Kaiser	1,636	384	60,553
<b>Total</b>	<b>2,141</b>	<b>491</b>	<b>67,288</b>

**Marion County**

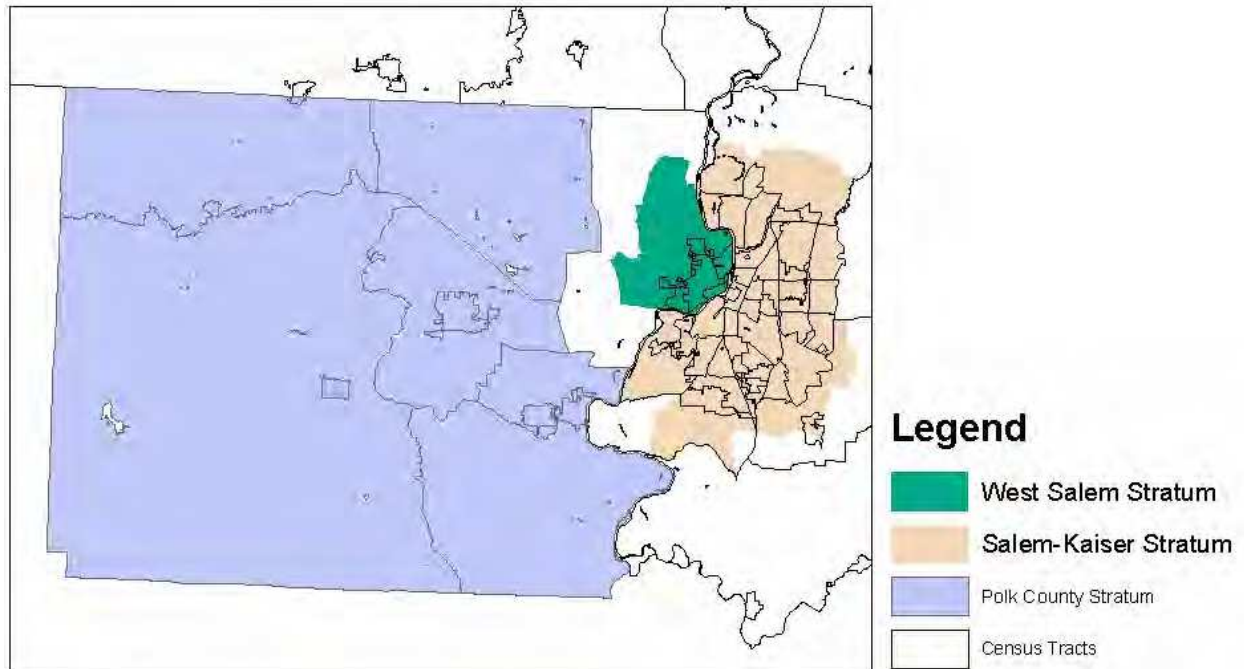
Marion County data were expanded using census tracts within Marion County that were not included in expanding the Salem-Kaiser stratum. Figure 8 shows the Marion County stratum boundary used to expand the 3 County survey data.

**Figure 8: Marion County Stratum**



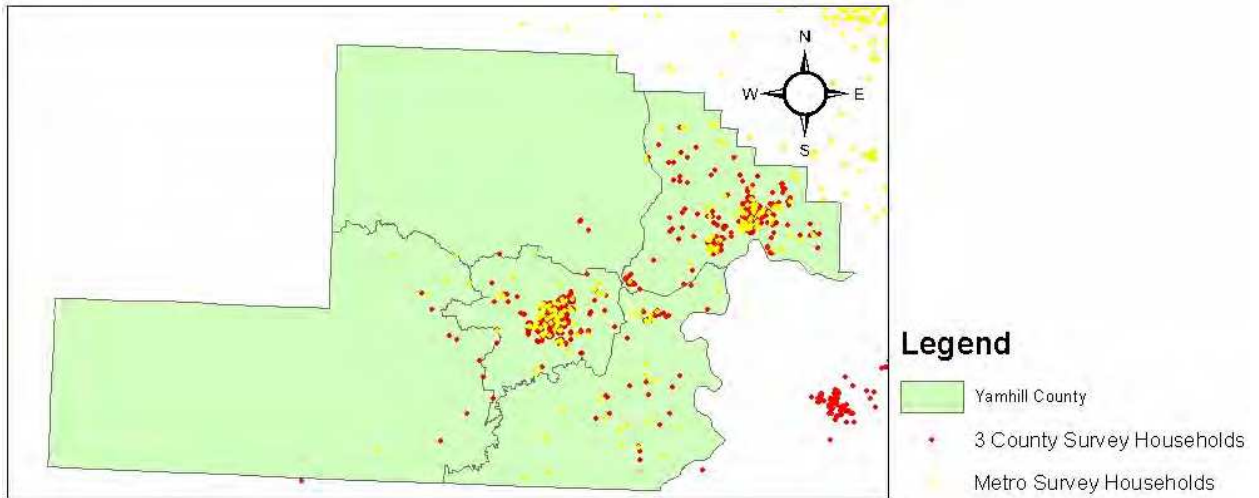
**Polk County**

Polk County survey data were expanded using census tracts within Polk County that were not included in expanding the West Salem stratum. Figure 9 shows the Polk County stratum boundary used to expand the 3 County survey data.

**Figure 9: Polk County Stratum****Yamhill County**

Both the Metro and the three county surveys included data on Yamhill County. There is some overlap of households surveyed by the Portland Metro and 3-County surveys as shown in Figure 10. For this reason, data from both surveys were combined to create one set of expansion factors for Yamhill County. Table 6 shows the survey counts and the number of households from the CTPP data for the three county study area..

**Figure 10: Location of Households Surveyed in Yamhill County**



**Table 6: Three County Households by Stratum**

Stratum	Weekday Survey Count	Weekend Survey Count	CTPP Households (1990)
Marion County	313	69	23168
Polk County	320	104	11287
Yamhill County (3 County Survey)	892	196	
Yamhill County (PDX survey)	321	87	
Yamhill Total	1213	283	22399
<b>Total</b>	<b>1846</b>	<b>456</b>	<b>56854</b>

**Medford**

Medford survey data was expanded using the Rogue County urbanized area as defined in the 1990 CTPP data. Table 7 shows the weekday and weekend survey counts and the number of households in the study area in 1990.



**Table 7: Medford County Household Survey Data**

<b>Survey</b>	<b>Weekday Survey Count</b>	<b>Weekend Survey Count</b>	<b>CTPP Households</b>
Medford	2,802	756	26,942

**Remainder of Oregon**

The 8 County survey data was expanded using the 1990 CTPP Statewide element. To calculate the eight county expansion factors, the population of the areas of Oregon not included in calculating the other expansion factors was used. The households in the following counties were not included in the Eight County expansion factors:

- Multnomah
- Clackamas
- Washington
- Yamhill
- Columbia
- Polk
- Marion

In addition, households in Lane County that were included in the Eugene survey were removed from the calculation, as were households in the urbanized portion of Rogue County.

**Table 7: Eight County Household Survey Data**

Stratum	CTPP Household s (1990)	Weekday Survey Count	Weekend Survey Count
8 County	382,198	5,911	475

**Expansion Factors**

*Eight County*

**8 County Weekday Expansion Factors**

Household size	Number of vehicles	CTPP Households	Weekday Survey Count	Weekday Expansion Factor	(Survey Count) * (Expansion Factor)
1	0	16,554	158	104.77	16,554
1	1	72,891	1,285	56.72	72,891
2,3,4+	0	6,642	18	369.00	** 6,642
2	1	34,651	434	79.84	34,651
2	2	106,907	2,270	47.10	106,907
3	1	12,515	86	145.52	12,515
3	2	24,152	274	88.15	24,152
3	3	19,840	352	56.36	19,840
4	1	13,837	63	219.63	13,837
4	2	42,868	423	101.34	42,868
4	3	31,341	548	57.19	31,341
<b>Total</b>		<b>382,198</b>	<b>5911</b>		

\*\* aggregated

**8 County Weekend Expansion Factors**

Household size	Number of vehicles	CTPP Households	Weekend Survey Count	Weekend Expansion Factor	(Survey Count) * (Expansion Factor)
1	0	16,554	12	1,379.50	16,554
1	1	72,891	109	668.72	72,891
2,3,4+	0	6,642	2	3,321.00	** 6,642
2	1	34,651	32	1,082.84	34,651
2	2	106,907	194	551.07	106,907
3,4+	1	26,352	11	2,395.64	** 26,352
3	2	24,152	18	1,341.78	24,152
3	3	19,840	26	763.08	19,840
4	2	42,868	35	1,224.80	42,868
4	3	31,341	36	870.58	31,341
<b>Total</b>		382,198	475		382,198

\*\* aggregated