

# **REPORT ON THE RESIDENTIAL REFILL STUDY FOR 97 – 98**

**January 2000**

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## **Introduction**

### Pertinent Findings

The present report updates the February 1999 Metro study based on 95 – 96 building permit activity<sup>1</sup>. In the previous study, we estimated a residential refill rate of 25.4%. For the present study, the actual observed rate is 26.3%. Weighting for dwelling unit type mix and specific jurisdiction capacity yields a plausible range of 25.7% to 30.4%. In sum the residential refill rate has slightly increased since last estimated for 95 – 96.

### Background

We define residential refill as additional building on land that the Regional Land Information System (RLIS) classes as already developed. Refill consists of infill and redevelopment. Infill means additional building without demolishing existing structures. Redevelopment means additional building at a higher capacity after existing structures have been demolished. We have coined the term refill for the increase in capacity of developed land achieved through infill and redevelopment.

Residential refill constitutes a substantial source of dwelling unit building capacity within the existing Urban Growth Boundary (UGB). For instance, in the context of the Urban Growth Report, a 1% change in the refill rate expands or decreases UGB capacity by roughly 2000 dwelling units. Given its significant role in UGB capacity estimates, Metro has invested considerable effort in measuring the actual volume of refill. The February 1999 study represented the first complete results of a work effort that had developed and matured over a period of several years.

### Study Protocols

We retained the study protocols developed in the prior study for this study. Essentially we use the RLIS database to combine several data streams. These data streams are:

1. Geo-code of all new residential building permits by dwelling unit type for July 1997 – June 1998.
2. RLIS classification of developed and vacant land as of roughly July 1 1997.
3. Region-wide air photo coverage as of July 1997.
4. Region-wide air photo coverage as of July 1998.
5. Building permit description for each new dwelling unit for the period July 1997 – June 98.

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<sup>1</sup> Metro Data Resource Center, *Technical Report Residential Refill Study*, (February 1999), 25 pages.

6. Assessor's tax lot description of each lot on which a new dwelling unit building permit geo-coded for the period July 97 – June 98.

Using the database resources listed above, we scrutinize the new dwelling unit building permits to answer two questions. One, did the new building occur on land we consider developed as of July 1, 1997 or did it occur on land we consider vacant? Second, if the building occurred on developed land, was the dwelling built as infill or was an existing structure first demolished? Answering the first question determines the refill rate; answering the second question partitions the refill rate between infill and redevelopment.

Unlike the prior study, air photos and all map coverages for the relevant years were available in digital form rather than hardcopy only. In addition DRC staff developed a custom geographic information system application that allows all relevant data for a particular building permit to be on screen simultaneously.<sup>2</sup> Besides vastly speeding up the research process, the new procedures allowed us to draw a random sample of all building permits<sup>3</sup> rather than a stratified sample of air photo ¼ sections. This substantially reduced the number of building permits we needed to evaluate and simplified the problem of expanding sample results back to population control totals. A student intern<sup>4</sup> then checked and classified each building permit. Work that in the previous study required almost a person year of staff time has been reduced to roughly four person months.

The simplicity and effectiveness of the above research procedures underscore the utility and importance of the databases developed and maintained by Data Resource Staff. From a data user perspective, it is far too easy to take for granted research capabilities that in fact depend on diverse databases requiring thousands of staff hours each year to obtain, verify, update and archive. Though seemingly simple and well within the capability of a bright, motivated student intern, we presently know of no other comprehensive study of infill and redevelopment. Database completeness and continuity will always be critical to studies of this type.

## **Study Results**

### Bottom Line Numbers

Figure One reports by dwelling unit type the estimated refill rates for 1997 – 98 for areas within the present UGB. We report rates for vacant, infill and redevelopment for single family, multi-family under 20 units, multi-family 20 units or more and total units. Total unit data (see Exhibit Five) are weighted so that the rates accurately reflect each dwelling unit type's share of the 97 – 98 market. From Figure One, we discern that over 75% of single family development in 97 – 98 took place on land classed as vacant. Almost 20% of single family development occurred as infill and about 5% occurred as the result of redevelopment. Multi-family development of less than 20 units had the highest refill rates of over 32%. Multi-family development of 20 or more had a refill rate

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<sup>2</sup> Karen Larson, GIS Analyst, assembled the databases and developed the user software routines.

<sup>3</sup> As we discuss in the results section, the extremely skewed distribution of multi-family building permits with respect to number of units required us to evaluate all multi-family permits with 20 or more units. However, the number of multi-family permits evaluated remained small (<150).

<sup>4</sup> Janet Foxman, student intern, performed the work with oversight from DRC staff.

of about 28% with redevelopment comprising 18%, the highest redevelopment rate for any category. Overall, the weighted refill rate for all units built in 97 – 98 amounts to over 26% with infill contributing 16% and redevelopment 10%. By way of comparison the 95 – 96 weighted refill rate amounted to 25.4% with over 20% coming from infill and 5% from redevelopment.

As noted above the 26.3% rate for 97 – 98 is slightly higher than 25.4% rate recorded in 95 – 96. The 97 – 98 rate would have been somewhat higher were it not for changes in the RLIS developed land coverage. In 97 – 98 many multi-family and single family permits located on land that RLIS considers vacant. Most of these areas are City of Portland redevelopment sites. As the resolution level of the database increases, these sites previously classed as developed are more often reclassified to vacant. Consequently, in contrast to the 95 – 96 data, we observed a considerable number of permits classed as occurring on vacant land. From an economic perspective these are redevelopment and infill sites. However, to be consistent with our land accounting system and avoid double-counting capacity<sup>5</sup>, we must regard these units as developing on vacant land<sup>6</sup>.

Figure Two presents 97 – 98 refill rates by jurisdiction ranked from highest to lowest. In interpreting the data, keep in mind that for a particular sample smaller jurisdictions may have low or high refill rates just by chance. However, from Figure Two we observe that jurisdictions that are older and more centrally located have higher refill rates and new jurisdictions located towards the edge of the UGB have lower refill rates.

Figure Three estimates that over 70,000 dwelling units of refill potential may exist within the UGB. To identify refill potential Figure Three takes the jurisdiction specific rates depicted in Figure Two, and multiplies them by the Functional Plan 1994 – 2017 regulatory residential capacity. For instance, the City of Portland has a Functional Plan capacity of over 70,000 dwelling units. Assuming Portland’s 55% refill rate continues, results in over 40,000 units in Portland coming from refill. Similarly, the Washington County unincorporated area has over 55,000 units of Functional Plan capacity and an 18% refill rate. The 18% rate yields about 10,000 refill units for Washington County. In sum using disaggregate, jurisdiction based refill rates and applying them to jurisdiction specific capacity, yields refill estimates consistent with our aggregate approach used in the Urban Growth Report.<sup>7</sup>

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<sup>5</sup> Cleared land or newly partitioned lots are moved from the developed class to the vacant class in the RLIS land inventory. As the resolution level of the RLIS system increases, more vacant land is “detected” and moved to the vacant category. While increasing the vacant inventory, the increase in RLIS accuracy reduced the refill rate.

<sup>6</sup> To be totally consistent, we should also now be predicting how much additional vacant land will be “found” due to increases in RLIS resolution. While we are in effect reducing the refill rate to reflect increases in land inventory accuracy, we do not make an adjustment for future increases in vacant land associated with increasing RLIS accuracy.

<sup>7</sup> The Urban Growth Report uses the region-wide refill rate to reduce the amount of dwelling unit demand that need be accommodated on vacant land. Concern has been expressed that the refill rate was increased by jurisdictions that would have relatively little future output, thus overstating the number of future dwelling units that could be accommodated on developed land. The Figure Three results suggest the present Urban Growth Report methods are appropriate.

The outcome depicted in Figure Three is not trivial. It means that our present estimate refill rate is consistent with our 20 year forecast for individual jurisdiction growth. For instance, it is conceivable to observe a measured refill rate that is quite high that depends on the 1 year growth of a jurisdiction that is not anticipated to grow much over a 20 year time span. As a consequence, applying the 1 year rate to the 20 year time span would substantially overstate regional capacity owing to refill. Figure Three indicates our short run measurement of refill is consistent with our long run application.

#### Future Concerns

One may legitimately question whether the Functional Plan capacities will be achieved and whether the refill rates in each jurisdiction will remain constant. However, as detailed in Exhibit Nine we also used the 94 – 2015 projections and the 97 – 98 building permit rate and obtained similar results. To better understand the relationships between total output, refill rates, refill stock, housing prices, regulations, etc. we are continuing to analyze the building permit data. At some point in the future we will be prepared to incorporate all relevant existing and future factors into our calculation of future refill output.

#### **Study Details**

Exhibits One through Nine detail how we performed the study. The attached Exhibits also provide more details than contained in the above Figures.

#### Exhibit One 1997 – 98 Residential Building Permits

Exhibit One shows by jurisdiction and type the 97 – 98 building permits issued in the 3 County area for new dwelling units. In 97 – 98 Portland had the most building permits with over 3,000 followed by Hillsboro and Washington County unincorporated area. Within the 3 County area over 12,000 new residential building permits were issued. Portland, Gresham, Hillsboro and Washington County unincorporated located large numbers of apartments. Portland located the largest number of high density, owner occupied production consisting of condominiums, mixed use development and row houses.

#### Exhibit Two Applicable Building Permit Population

Our first step was to eliminate building permits outside the UGB and auxiliary units from the population. We eliminated auxiliary units because they are counted in a separate calculation. This procedure eliminates double counts. The result is that the applicable 1997 – 98 dwelling unit population amounts to 11,680 units.

#### Exhibit Three Regroups Building Types for Sampling Purposes

The second step collapses the eight building types into 3 sample sets: single family, multi-family under 20 units, and multi-family 20 units or more. The extremely skewed<sup>8</sup> distribution of multi-family units per building permit requires that all multi-family building permits with 20 or more units be included in the sample. Consequently, we divided the multi-family building permit data into two groups. Single family by virtue of being one unit per permit does not require such an adjustment. We note from

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<sup>8</sup> In 97 – 98 we recorded one 700 plus DU permit and several in the 300 – 500 range.

Exhibit Three that 4,222 multi-family units were in developments of 20 or more units. Developments of less than 20 units comprised 1,724 units.

#### Exhibit Four Records Sampling Rates and “Confidence Intervals” for Sample Data

Exhibit Four shows population size, sample size and calculated confidence intervals for the data. Confidence intervals are for classical sampling error only. Measurement error and response error are not accounted for. Note that confidence intervals are given by building type for sample totals only. Jurisdiction specific error limits are much larger, particularly for smaller jurisdictions.

#### Exhibit Five Presents Refill Rates by Dwelling Type

Exhibit Five gives the details of the refill rate by dwelling unit type both for the sample and for the total population in 97 – 98. For all dwelling units, we estimate 8,610 occurred in vacant land, 1,903 were infill and 1,168 were on redeveloped land.

#### Exhibit Six Splits the Sample by Jurisdiction and Building Type

In Exhibit Six we present the raw sample data by jurisdiction and dwelling unit type. 4 jurisdictions have sample totals under 20. These data should be regarded cautiously. Fortunately, total output in these jurisdictions for the year 97 – 98 is fairly low; so bias here does not affect overall results.

#### Exhibit Seven Expands the Sample Data to Total Dwelling Unit Output by Jurisdiction

We have taken the data in Exhibit Six and expanded to the total number of dwelling units produced in each jurisdiction in 1997 – 98. For a few jurisdictions for which we had some output, we have no sample points. In these instances, about 4 or 5 we used the regional averages to impute values. Imputation and weighting by jurisdiction produces a total refill rate 2.4% higher than the refill rate weighted at the regional level.

#### Exhibit Eight Presents Percent Vacant, Infill and Redevelopment by Jurisdiction

This Exhibit depicts the same data as Exhibit Seven but by percentage rather than total.

#### Exhibit Nine Displays 20 Year Refill Rates by Jurisdiction Using 3 Weighting Methods

Both the Peer Review group and the Westside Economic Alliance requested that the refill rate be applied in the Urban Growth Report disaggregated by jurisdiction and weighted by the long run (20 year) growth of each jurisdiction. Exhibit 9 performs this calculation using 3 different long run weighting methods. Using the total 97 – 98 refill rate by jurisdiction, we have first applied the 94 – 2017 Functional Plan capacity as the jurisdiction specific weight. Doing this yields a refill total of over 74,000 units which amounts to 30.4% of total capacity. Adjusting for possible imputation bias reduces the percentage to 28.6%. We can also weight by the March 1996 growth allocation workshop projection. In this instance we end up with a refill output of 59,900 between

1994 and 2015, which constitutes 29.6% of output (27.8% adjusted for possible bias). Finally, we can simply take the 97 – 98 total dwelling unit output by jurisdiction and multiply it by 20. While very crude and simple minded, it nevertheless should bear some resemblance to our long term projections and capacity assessments. This procedure produces 65,400 refill units over 20 years. This figure constitutes 28.0% of total output (26.3% with the adjustment). In sum capacity, projection and 1 year trend extrapolation all produce roughly similar results.

**Figure One: 97 - 98 Residential Rates for Building on Vacant, Infill and Redevelopment Lands by Dwelling Unit Type**

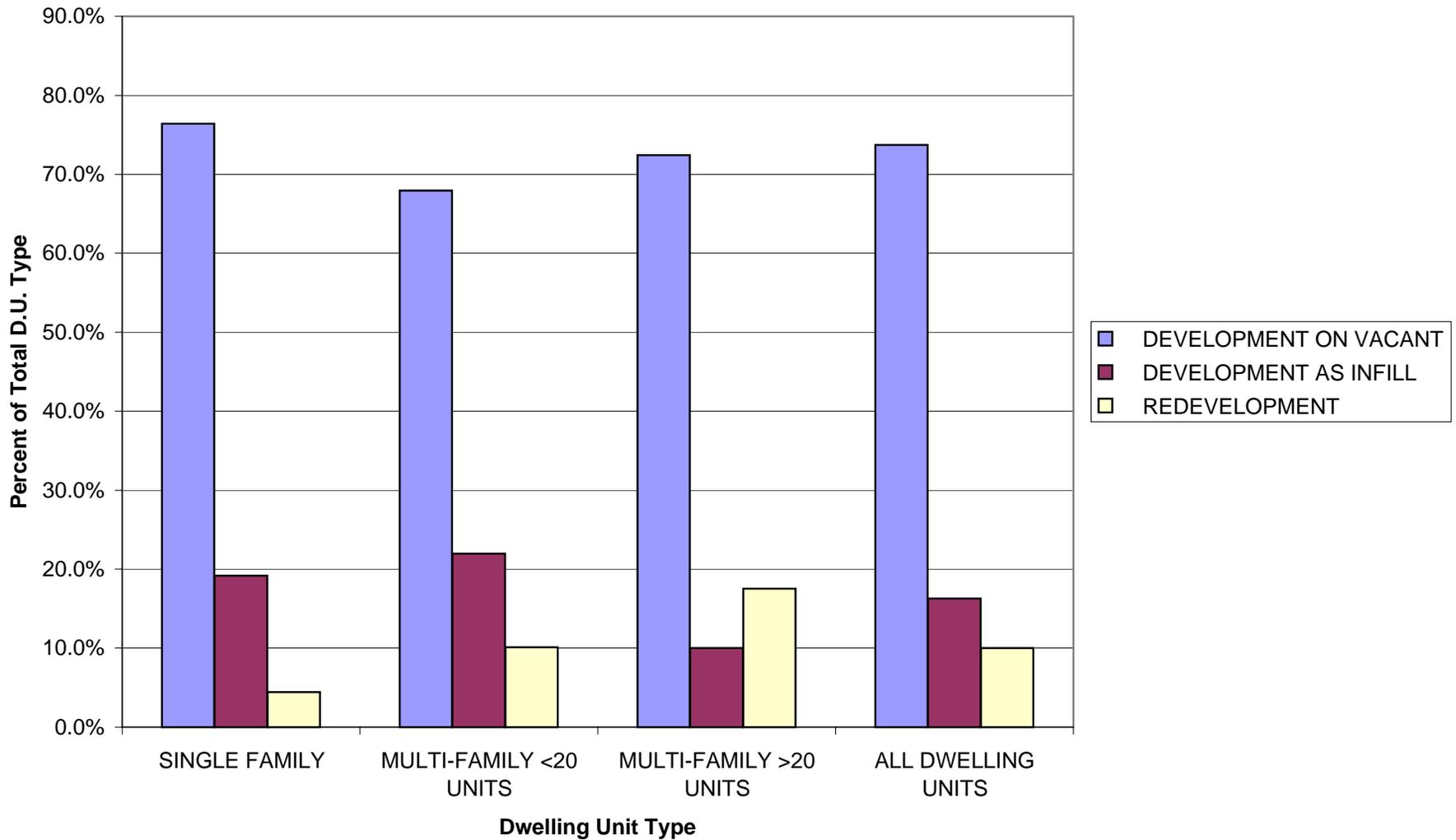


Figure Two: 97 -98 Residential Refill Rate by Jurisdiction

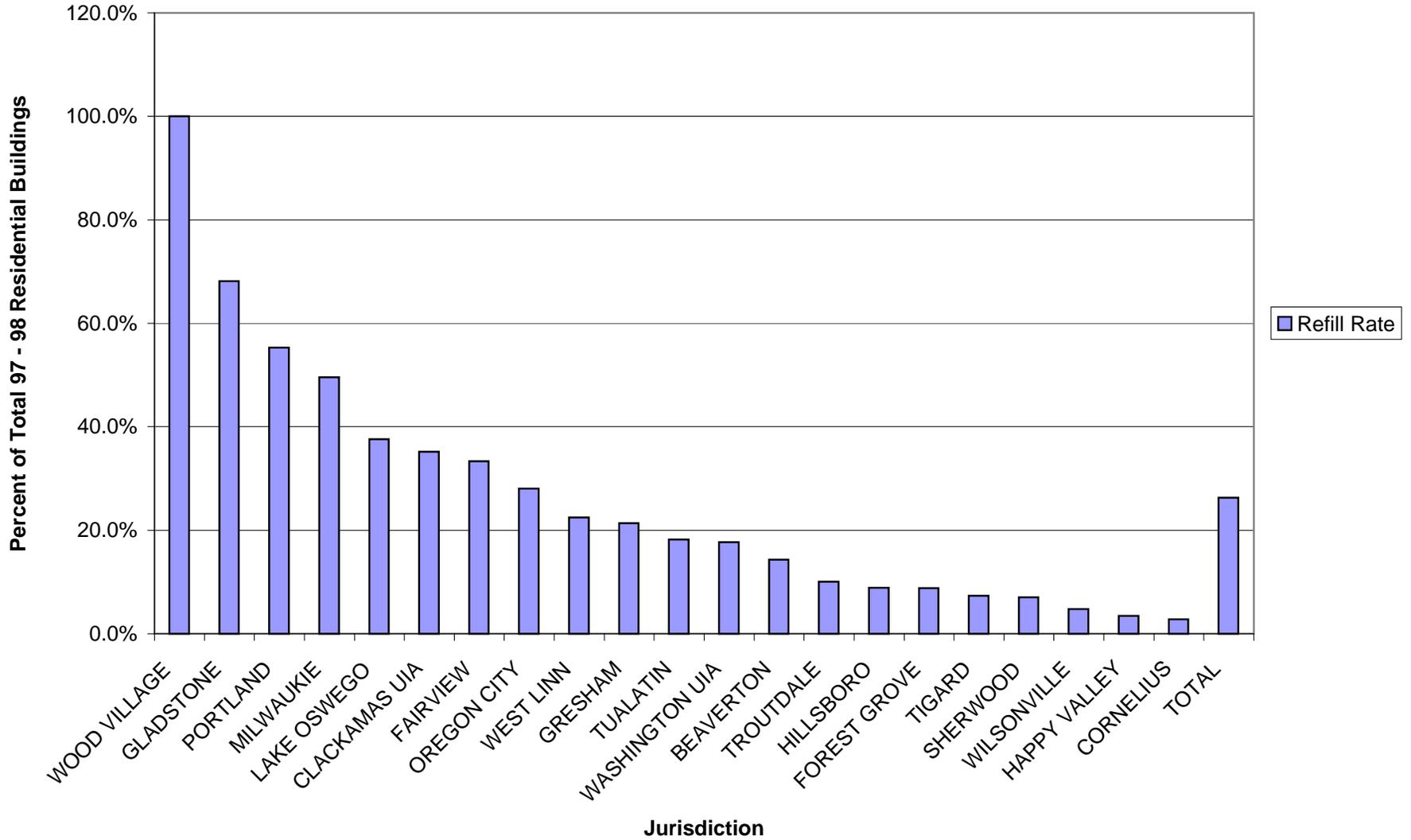
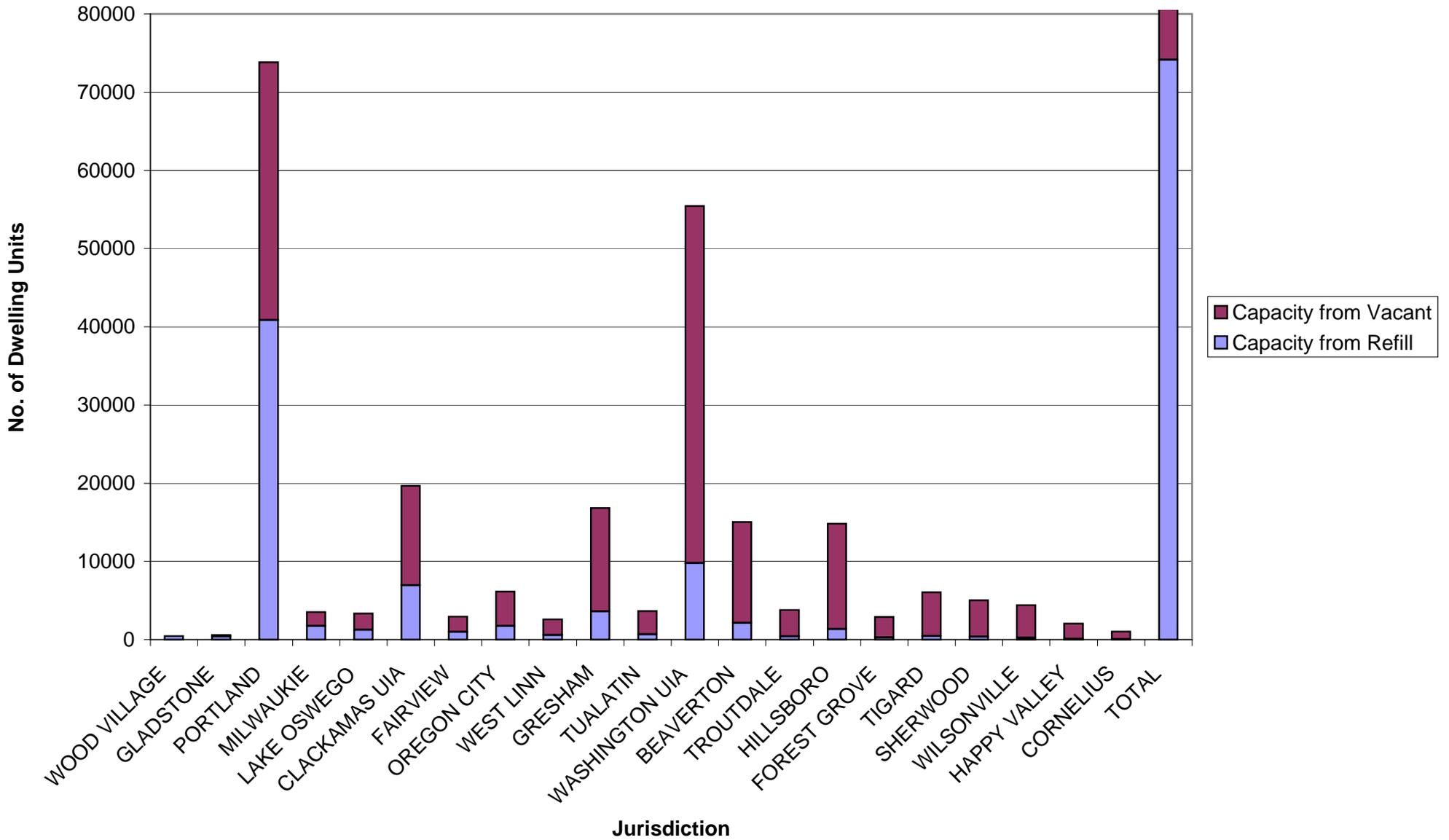


Figure Three: 94 - 2017 Functional Plan Capacity from Vacant and Refill Lands



**EXHIBIT ONE: 1997 - 1998 BUILDING PERMITS ISSUED 3 COUNTIES  
BY JURISDICTION AND BY BUILDING TYPE**

<b>JURISDICTION</b>	<b>AUX</b>	<b>CON</b>	<b>GRQ</b>	<b>MAN</b>	<b>MFR</b>	<b>MHR</b>	<b>MIX</b>	<b>ROW</b>	<b>SFR</b>	<b>Grand Total</b>	
BEAVERTON			10		3	116			12	142	283
CANBY					3	109				69	181
CLACKAMAS UIA	20			0		163				657	840
CORNELIUS					46					91	137
ESTACADA					1					4	5
FAIRVIEW								17		75	92
FOREST GROVE	1				2	16				96	115
GLADSTONE						4				7	11
GRESHAM	1	12		0	8	754		3	24	167	969
HAPPY VALLEY										114	114
HILLSBORO					12	1433				693	2138
LAKE OSWEGO		21				2				73	96
MILWAUKIE				0	2	32				29	63
MOLALLA					27	4				67	98
MULTNOMAH UIA					3					11	14
OREGON CITY					9	1				194	204
PORTLAND		277		74	75	1530	34	341	283	872	3486
SANDY					9	2				37	48
SHERWOOD										372	372
TIGARD					1	5				260	266
TROUTDALE					21	14		2		86	123
TUALATIN										41	41
WASHINGTON UIA					55	604			6	1173	1838
WEST LINN				0	0	252				122	374
WILSONVILLE					3	246				120	369
WOOD VILLAGE					1					8	9
<b>Grand Total</b>	<b>22</b>	<b>320</b>	<b>74</b>	<b>281</b>	<b>5287</b>	<b>34</b>	<b>346</b>	<b>342</b>	<b>5580</b>	<b>12286</b>	

**KEY:** AUX=auxilliary unit; CON=condominium; MAN=manufactured; MFR=multi-family; MHR=multi-family; MIX=mixed use;  
ROW=row house; SFR=single family

**EXHIBIT TWO: 1997 - 1998 BUILDING PERMITS ISSUED INSIDE UGB  
BY JURISDICTION AND BY BUILDING TYPE**

<b>JURISDICTION</b>	<b>CON</b>	<b>GRQ</b>	<b>MAN</b>	<b>MFR</b>	<b>MHR</b>	<b>MIX</b>	<b>ROW</b>	<b>SFR</b>	<b>Grand Total</b>	
BEAVERTON	10			3	116			12	142	283
CLACKAMAS UIA			0		163				524	687
CORNELIUS				46					91	137
FAIRVIEW								17	75	92
FOREST GROVE				2	16				96	114
GLADSTONE					4				7	11
GRESHAM	12	0	8	754			3	24	167	968
HAPPY VALLEY									114	114
HILLSBORO				12	1433				693	2138
LAKE OSWEGO	21				2				73	96
MILWAUKIE			0	2	32				29	63
OREGON CITY				9	1				194	204
PORTLAND	277	74	75	1530		34	341	283	872	3486
SHERWOOD									372	372
TIGARD				1	5				260	266
TROUTDALE				21	14		2		86	123
TUALATIN									41	41
WASHINGTON UIA				55	604			6	1068	1733
WEST LINN			0	0	252				122	374
WILSONVILLE				3	246				120	369
WOOD VILLAGE				1					8	9
<b>Grand Total</b>	<b>320</b>	<b>74</b>	<b>238</b>	<b>5172</b>	<b>34</b>	<b>346</b>	<b>342</b>	<b>5154</b>	<b>11680</b>	

**KEY:** AUX=auxilliary unit; CON=condominium; MAN=manufactured; MFR=multi-family; MHR=multi-family; MIX=mixed use;  
ROW=row house; SFR=single family

**EXHIBIT THREE: 1997 - 1998 BUILDING PERMITS ISSUED INSIDE UGB  
BY JURISDICTION, SINGLE FAMILY, MULTI-FAMILY  
UNDER 20 UNITS AND 20 UNITS OR MORE**

<b>JURISDICTION</b>	<b>SINGLE FAMILY</b>	<b>MULTI-FAMILY &lt;20</b>	<b>MULTI-FAMILY &gt;20</b>	<b>TOTAL</b>
BEAVERTON	157	126	0	283
CLACKAMAS UIA	524	85	78	687
CORNELIUS	137	0	0	137
FAIRVIEW	92	0	0	92
FOREST GROVE	98	16	0	114
GLADSTONE	7	4	0	11
GRESHAM	199	60	709	968
HAPPY VALLEY	114	0	0	114
HILLSBORO	705	168	1265	2138
LAKE OSWEGO	73	23	0	96
MILWAUKIE	31	8	24	63
OREGON CITY	203	1	0	204
PORTLAND	1230	765	1491	3486
SHERWOOD	372	0	0	372
TIGARD	261	5	0	266
TROUTDALE	107	16	0	123
TUALATIN	41	0	0	41
WASHINGTON UIA	1129	199	405	1733
WEST LINN	122	2	250	374
WILSONVILLE	123	246	0	369
WOOD VILLAGE	9	0	0	9
<b>Grand Total</b>	<b>5734</b>	<b>1724</b>	<b>4222</b>	<b>11680</b>

**KEY:** MAN + ROW + SFR = SINGLE FAMILY; CON + GRQ + MFR + MHR + MIX = MULTI-FAMILY

**EXHIBIT FOUR: DWELLING UNIT CLASSES BY POPULATION, VERIFIED SAMPLE, SAMPLE RATE AND CONFIDENCE INTERVALS**

<b>DWELLING UNIT</b>	<b>TOTAL POPULATION</b>	<b>VERIFIED SAMPLE</b>	<b>SAMPLE RATE</b>	<b>EXPANSION FACTOR</b>	<b>2 SIGMA INTERVAL</b>
<b>SINGLE FAMILY</b>	5734	1245	21.71%	4.606	+/- 2.5%
<b>MULTI-FAMILY &lt; 20</b>	1724	337	19.55%	5.116	+/-4.8%
<b>MULTI-FAMILY &gt; 20</b>	4222	3758	89.01%	1.123	NA

NOTES: Confidence intervals are given for 2 standard errors calculated assuming maximum variance and adjusting for finite population size. Intervals are calculated assuming classical sampling error, non sampling errors (various measurement errors and nonresponse errors) are not calculated.

**EXHIBIT FIVE: SAMPLE AND POPULATION ESTIMATES OF INFILL AND REDEVELOPMENT  
BY DWELLING UNIT TYPE 97 - 98 - UGB OVERALL**

DWELLING UNIT TYPE	SAMPLE RESULTS	EXPANDED TO POPULATION	% OF DU TYPE
<b>SINGLE FAMILY</b>			
DEVELOPMENT ON VACANT	951	4380	76.4%
DEVELOPMENT AS INFILL	239	1101	19.2%
REDEVELOPMENT	55	253	4.4%
SUBTOTAL	1245	5734	100.0%
REFILL SUBTOTAL	294	1354	23.6%
<b>MULTI-FAMILY &lt;20 UNITS</b>			
DEVELOPMENT ON VACANT	229	1172	68.0%
DEVELOPMENT AS INFILL	74	379	22.0%
REDEVELOPMENT	34	174	10.1%
SUBTOTAL	337	1724	100.0%
REFILL SUBTOTAL	108	552	32.0%
<b>MULTI-FAMILY &gt;20 UNITS</b>			
DEVELOPMENT ON VACANT	2722	3058	72.4%
DEVELOPMENT AS INFILL	377	424	10.0%
REDEVELOPMENT	659	740	17.5%
SUBTOTAL	3758	4222	100.0%
REFILL SUBTOTAL	1036	1164	27.6%
<b>ALL DWELLING UNITS</b>			
DEVELOPMENT ON VACANT	3902	8610	73.7%
DEVELOPMENT AS INFILL	690	1903	16.3%
REDEVELOPMENT	748	1168	10.0%
TOTAL	5340	11680	100.0%
REFILL SUBTOTAL	1438	3070	26.3%

**EXHIBIT SIX: RAW SAMPLE ESTIMATES OF INFILL AND REDEVELOPMENT  
BY DWELLING UNIT TYPE 97 - 98 - BY JURISDICTION**

JURISDICTION	SINGLE FAMILY				MULTI-FAMILY <20				MULTI-FAMILY >20			
	Vacant	Infill	Redevelop	Total	Vacant	Infill	Redevelop	Total	Vacant	Infill	Redevelop	Total
BEAVERTON	23	7	1	31	7	0	0	7	0	0	0	0
CLACKAMAS UIA	99	22	1	122	0	3	0	3	20	58	0	78
CORNELIUS	35	1	0	36	0	0	0	0	0	0	0	0
FAIRVIEW	10	3	2	15	0	0	0	0	0	0	0	0
FOREST GROVE	19	0	1	20	0	0	0	0	0	0	0	0
GLADSTONE	1	1	0	2	0	2	0	2	0	0	0	0
GRESHAM	26	9	4	39	4	6	3	13	610	51	48	709
HAPPY VALLEY	28	1	0	29	0	0	0	0	0	0	0	0
HILLSBORO	122	29	1	152	31	8	0	39	1249	16	0	1265
LAKE OSWEGO	15	4	0	19	1	0	9	10	0	0	0	0
MILWAUKIE	1	3	0	4	0	2	0	2	24	0	0	24
OREGON CITY	41	13	3	57	0	0	0	0	0	0	0	0
PORTLAND	138	79	42	259	52	51	22	125	500	166	611	1277
SHERWOOD	79	6	0	85	0	0	0	0	0	0	0	0
TIGARD	27	2	0	29	0	0	0	0	0	0	0	0
TROUTDALE	23	3	0	26	8	0	0	8	0	0	0	0
TUALATIN	9	2	0	11	0	0	0	0	0	0	0	0
WASHINGTON UIA	209	46	0	255	22	2	0	24	319	86	0	405
WEST LINN	22	3	0	25	0	0	0	0	0	0	0	0
WILSONVILLE	24	4	0	28	104	0	0	104	0	0	0	0
WOOD VILLAGE	0	1	0	1	0	0	0	0	0	0	0	0
<b>Grand Total</b>	951	239	55	1245	229	74	34	337	2722	377	659	3758

**EXHIBIT SEVEN: POPULATION ESTIMATES OF INFILL AND REDEVELOPMENT  
BY DWELLING UNIT TYPE 97 - 98 - BY JURISDICTION**

JURISDICTION	SINGLE FAMILY				MULTI-FAMILY <20				MULTI-FAMILY >20				TOTAL DWELLING UNITS			
	Vacant	Infill	Redevelop	Total	Vacant	Infill	Redevelop	Total	Vacant	Infill	Redevelop	Total	Vacant	Infill	Redevelop	Total
BEAVERTON	116	35	5	157	126	0	0	126	0	0	0	0	242	35	5	283
CLACKAMAS UIA	425	94	4	524	0	85	0	85	20	58	0	78	445	237	4	687
CORNELIUS	133	4	0	137	0	0	0	0	0	0	0	0	133	4	0	137
FAIRVIEW	61	18	12	92	0	0	0	0	0	0	0	0	61	18	12	92
FOREST GROVE	93	0	5	98	11	4	2	16	0	0	0	0	104	4	7	114
GLADSTONE	4	4	0	7	0	4	0	4	0	0	0	0	4	8	0	11
GRESHAM	133	46	20	199	18	28	14	60	610	51	48	709	761	125	82	968
HAPPY VALLEY	110	4	0	114	0	0	0	0	0	0	0	0	110	4	0	114
HILLSBORO	566	135	5	705	134	34	0	168	1249	16	0	1265	1948	185	5	2138
LAKE OSWEGO	58	15	0	73	2	0	21	23	0	0	0	0	60	15	21	96
MILWAUKIE	8	23	0	31	0	8	0	8	24	0	0	24	32	31	0	63
OREGON CITY	146	46	11	203	1	0	0	1	0	0	0	0	147	47	11	204
PORTLAND	655	375	199	1230	318	312	135	765	584	194	713	1491	1557	881	1047	3486
SHERWOOD	346	26	0	372	0	0	0	0	0	0	0	0	346	26	0	372
TIGARD	243	18	0	261	3	1	1	5	0	0	0	0	246	19	1	266
TROUTDALE	95	12	0	107	16	0	0	16	0	0	0	0	111	12	0	123
TUALATIN	34	7	0	41	0	0	0	0	0	0	0	0	34	7	0	41
WASHINGTON UIA	925	204	0	1129	182	17	0	199	319	86	0	405	1427	306	0	1733
WEST LINN	107	15	0	122	1	0	0	2	181	25	44	250	290	40	44	374
WILSONVILLE	105	18	0	123	246	0	0	246	0	0	0	0	351	18	0	369
WOOD VILLAGE	0	9	0	9	0	0	0	0	0	0	0	0	0	9	0	9
<b>Grand Total By Ratio</b>	<b>4380</b>	<b>1101</b>	<b>253</b>	<b>5734</b>	<b>1172</b>	<b>379</b>	<b>174</b>	<b>1724</b>	<b>3058</b>	<b>424</b>	<b>740</b>	<b>4222</b>	<b>8610</b>	<b>1903</b>	<b>1168</b>	<b>11680</b>
<b>Grand Total By Sum</b>	<b>4363</b>	<b>1109</b>	<b>262</b>	<b>5734</b>	<b>1059</b>	<b>493</b>	<b>172</b>	<b>1724</b>	<b>2987</b>	<b>430</b>	<b>805</b>	<b>4222</b>	<b>8410</b>	<b>2032</b>	<b>1238</b>	<b>11680</b>

**EXHIBIT EIGHT: RATES OF INFILL AND REDEVELOPMENT  
BY DWELLING UNIT TYPE 97 - 98 - BY JURISDICTION**

JURISDICTION	SINGLE FAMILY			MULTI-FAMILY			TOTAL DWELLING UNITS			Refill Rate
	Vacant	Infill	Redevelop	Vacant	Infill	Redevelop	Vacant	Infill	Redevelop	
BEAVERTON	74.2%	22.6%	3.2%	100.0%	0.0%	0.0%	85.7%	12.5%	1.8%	14.3%
CLACKAMAS UIA	81.1%	18.0%	0.8%	12.3%	87.7%	0.0%	64.8%	34.6%	0.6%	35.2%
CORNELIUS	97.2%	2.8%	0.0%	0.0%	0.0%	0.0%	97.2%	2.8%	0.0%	2.8%
FAIRVIEW	66.7%	20.0%	13.3%	0.0%	0.0%	0.0%	66.7%	20.0%	13.3%	33.3%
FOREST GROVE	95.0%	0.0%	5.0%	67.9%	22.0%	10.1%	91.2%	3.1%	5.7%	8.8%
GLADSTONE	50.0%	50.0%	0.0%	0.0%	100.0%	0.0%	31.8%	68.2%	0.0%	68.2%
GRESHAM	66.7%	23.1%	10.3%	81.7%	10.2%	8.0%	78.6%	12.9%	8.5%	21.4%
HAPPY VALLEY	96.6%	3.4%	0.0%	0.0%	0.0%	0.0%	96.6%	3.4%	0.0%	3.4%
HILLSBORO	80.3%	19.1%	0.7%	96.5%	3.5%	0.0%	91.1%	8.7%	0.2%	8.9%
LAKE OSWEGO	78.9%	21.1%	0.0%	10.0%	0.0%	90.0%	62.4%	16.0%	21.6%	37.6%
MILWAUKIE	25.0%	75.0%	0.0%	75.0%	25.0%	0.0%	50.4%	49.6%	0.0%	49.6%
OREGON CITY	71.9%	22.8%	5.3%	67.9%	22.0%	10.1%	71.9%	22.8%	5.3%	28.1%
PORTLAND	53.3%	30.5%	16.2%	40.0%	22.4%	37.6%	44.7%	25.3%	30.0%	55.3%
SHERWOOD	92.9%	7.1%	0.0%	0.0%	0.0%	0.0%	92.9%	7.1%	0.0%	7.1%
TIGARD	93.1%	6.9%	0.0%	67.9%	22.0%	10.1%	92.6%	7.2%	0.2%	7.4%
TROUTDALE	88.5%	11.5%	0.0%	100.0%	0.0%	0.0%	90.0%	10.0%	0.0%	10.0%
TUALATIN	81.8%	18.2%	0.0%	0.0%	0.0%	0.0%	81.8%	18.2%	0.0%	18.2%
WASHINGTON UIA	82.0%	18.0%	0.0%	83.0%	17.0%	0.0%	82.3%	17.7%	0.0%	17.7%
WEST LINN	88.0%	12.0%	0.0%	72.5%	10.1%	17.4%	77.5%	10.7%	11.8%	22.5%
WILSONVILLE	85.7%	14.3%	0.0%	100.0%	0.0%	0.0%	95.2%	4.8%	0.0%	4.8%
WOOD VILLAGE	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	100.0%
<b>TOTAL</b>	<b>76.4%</b>	<b>19.2%</b>	<b>4.4%</b>	<b>71.1%</b>	<b>13.5%</b>	<b>15.4%</b>	<b>73.7%</b>	<b>16.3%</b>	<b>10.0%</b>	<b>26.3%</b>

**EXHIBIT NINE: LONG RUN REFILL RATES WEIGHTED BY JURISIDICITION  
AND BY JURISDICTION SPECIFIC CAPACITY OR GROWTH ESTIMATE**

JURISDICTION	FUNCTION PLAN CAPACITY ESTIMATE			GROWTH ALLOCATION ESTIMATE		97 - 98 GROWTH TREND ESTIMATE	
	Refill Rate	Plan Capacity	1994 - 2017 Refill	1994 - 2015 Growth Allocation	1994 - 2015 Refill	D.U. Extrapolation	97 - 98 Trend Refill
BEAVERTON	14.3%	15021	2151	12904	1847	5660	810
CLACKAMAS UIA	35.2%	19683	6927	16683	5872	13740	4836
CORNELIUS	2.8%	1019	28	841	23	2740	76
FAIRVIEW	33.3%	2921	974	2694	898	1840	613
FOREST GROVE	8.8%	2873	253	1310	115	2280	201
GLADSTONE	68.2%	600	409	346	236	220	150
GRESHAM	21.4%	16817	3594	12161	2599	19360	4137
HAPPY VALLEY	3.4%	2030	70	1882	65	2280	79
HILLSBORO	8.9%	14812	1314	13236	1174	42760	3792
LAKE OSWEGO	37.6%	3353	1260	2456	923	1920	721
MILWAUKIE	49.6%	3514	1743	2880	1429	1260	625
OREGON CITY	28.1%	6157	1729	3196	898	4080	1146
PORTLAND	55.3%	73820	40840	57941	32055	69720	38572
SHERWOOD	7.1%	5010	354	4659	329	7440	525
TIGARD	7.4%	6073	448	5011	369	5320	392
TROUTDALE	10.0%	3789	380	2285	229	2460	247
TUALATIN	18.2%	3635	661	3077	559	820	149
WASHINGTON UIA	17.7%	55443	9798	52500	9278	34660	6125
WEST LINN	22.5%	2577	579	2094	470	7480	1681
WILSONVILLE	4.8%	4425	211	3963	189	7380	351
WOOD VILLAGE	100.0%	423	423	343	343	180	180
<b>TOTAL</b>	<b>26.3%</b>	<b>243995</b>	<b>74145</b>	<b>202462</b>	<b>59900</b>	<b>233600</b>	<b>65409</b>
<b>REFILL PERCENT</b>	<b>NA</b>	<b>NA</b>	<b>30.4%</b>	<b>NA</b>	<b>29.6%</b>	<b>NA</b>	<b>28.0%</b>
<b>REFILL PERCENT ADJ.</b>			<b>28.6%</b>		<b>27.8%</b>		<b>26.3%</b>

NOTES: Portland includes Mult UIA and Maywood Park. Clackamas UIA includes Rivergrove & Johnson City. Washington UIA includes Durham & King City.

Adjusted refill percent accounts for the imputation for jurisdictions for which we have no sampling points. Imputation resulted in the refill rate being slightly overstated.