HOUSING NEEDS ANALYSIS (HNA)

HNA Framework

The Urban Growth Report (UGR) and its supporting analytics examine need for housing at the regional scale across three main dimensions:

- Tenure (own or rent)
- Type (single-family or SF, and multi-family or MF)
- Effects on households in different income categories (HH Income Group)

UGR Appendix 3 discusses likely future effects on type and tenure of no-expansion vs. expansion scenarios. This appendix applies those findings in summary to the question of need and adds findings about need from the point of view of households at different income levels.

As noted in Appendix 3, the forecasts tend to illustrate that while consumers are probably willing to substitute MF for SF to a certain extent, that substitutability has limits: single-family and ownership opportunities will continue to be in strong demand.

Tenure Discussion

With respect to housing tenure, all of the scenario results presented in Appendix 3 indicate that average monthly housing costs for both owners and renters will continue to increase above historical levels, with the projected increases being particularly acute for owners. In addition, because household incomes are not projected to increase as fast as housing costs, this means that the percentage of income spent on housing will also increase beyond historical levels, with owners experiencing more significant increases than renters. These results suggest that the need for additional owner housing will continue to be strong. The specific data underlying these findings can be found in Table 12 of Appendix 3.

Type Discussion

With respect to housing type, all of the scenario results presented in Appendix 3 reveal an indication of demand for both single- and multi-family housing types, but particularly a regional need for additional single-family housing. The projected price increases for single-family housing, whether expressed in relative or annualized terms, meets or exceed historical rates in 3 of the 4 scenarios, while the remaining inventory of single family units drops to levels that would create upward pressure on prices. The specific data underlying these findings can be found in Table 12 of Appendix 3.

Development Density Discussion

Background

A projection of future development densities expands on previous housing type and tenure discussions in this UGR. Potential development densities in the future depend on characteristics of households, families and the housing supply forecasts. In terms of demand, the characteristics of a household or family will impact the desire to own or rent, which may impact development density. Census data show that families or households with multiple people tend to own and live in single family residences. Life cycle also matters; households headed by a younger person are more likely to rent and live in an

apartment while a family in its "root-setting" years is more likely to live in a single family house they own. The same socio-economic characteristics of households that drive type and tenure also drive development densities.

On the production / supply-side, the quantity of different types of residential supply has a material impact on development densities in the future. A region with a large store of capacity designated for multifamily development is more likely to produce more apartments and condos than single family housing units in the long-run. Zoning, redevelopment potential and incentives, infill opportunities and the market readiness of vacant tax lots will have an impact on development densities. In the past, government organizations have had a responsibility to make vacant lots market ready by zoning land appropriate to the market and statewide building codes, building roadway infrastructure to support new development, and to provide public utilities such as sewer and water.

Government regulations, the market readiness of buildable land, and consumer demand ultimately blend together to make up the real estate decisions and market outcomes to be expected. In order to simulate the ability of real estate markets to produce needed housing, a MetroScope growth scenario has been formulated to project the expected outcomes. The scenario results show housing production at various development densities as well as market price points, tenure and structure type.

Methodology & Assumptions

The development density findings derive from a MetroScope growth scenario that draw from the Metro Chief Operating Officer (COO) urban growth management (UGM) recommendations. The assumptions underpinning this scenario incorporate the following set of economic conditions: (1) medium-growth forecast of population and job growth; (2) medium supply forecast of land capacity inside the Metro UGB; (3) all four UGB expansions proposed in 2018; (4) and additional UGB expansions after 2025.

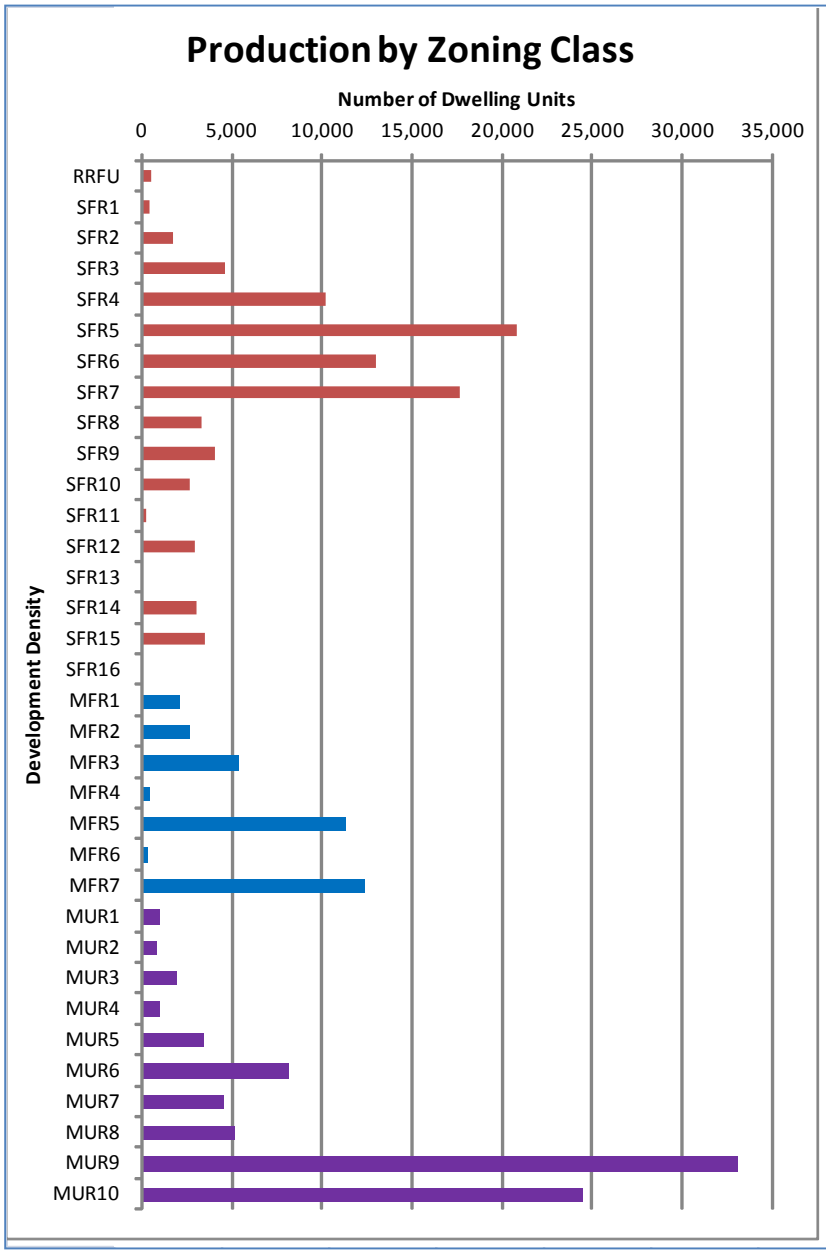
Development Density Findings

The Metro region is estimated to have a need to build 205,100 new dwelling units between 2018 and 2038 in order to house the projected growth in population. Assuming all mixed-use residential development is constructed as apartments or condo units, the Metro region is expected to build 57% of its new housing as multifamily units and 43% as single family (attached / detached) residences over the 20-year planning period.

Table 1: Metro UGB Residential Final Demand Projections, 2018 to 2038

Development Form	Units	Percent	Avg. Density (units / gross buildable acre)
Rural Residential	500	< 1%	0.2
Single family	88,100	43%	6.7
Multifamily	33,900	17%	45.6
Mixed Use	82,600	40%	124.4
Total:	205,100	100%	60.5

More detailed density information is shown in Figure 1. The figure summarizes the projected development by Metro RLIS (Regional Land Information System) zone class.



Zone Class	Description	Units/Acre
RRFU	Rur. Res.	0.2
SFR1	Single family	1
SFR2	Single family	2
SFR3	Single family	3
SFR4	Single family	4
SFR5	Single family	5
SFR6	Single family	6
SFR7	Single family	7
SFR8	Single family	8
SFR9	Single family	9
SFR10	Single family	10
SFR11	Single family	11
SFR12	Single family	12
SFR13	Single family	13
SFR14	Single family	14
SFR15	Single family	15
SFR16	Single family	16
MFR1	Multifamily	15
MFR2	Multifamily	20
MFR3	Multifamily	25
MFR4	Multifamily	30
MFR5	Multifamily	35
MFR6	Multifamily	40
MFR7	Multifamily	75
MUR1	Mixed Use	10
MUR2	Mixed Use	20
MUR3	Mixed Use	25
MUR4	Mixed Use	30
MUR5	Mixed Use	35
MUR6	Mixed Use	40
MUR7	Mixed Use	55
MUR8	Mixed Use	75
MUR9	Mixed Use	110
MUR10	Mixed Use	225

Figure 1: Detailed Development Forms by RLIS Zone Class, Metro UGB

The COO recommendation assumed a projected SF rate of 50%. This rate recommendation is based on a combination of policy intent, regulatory mandate that applies to cities and counties in the region (i.e., the state's Metropolitan Housing Rule) and the scientific results derived from the scenarios. The results of this scenario are based on input from the COO recommendations and run through the MetroScope

model to determine the final demand. The final demand of SF production is estimated to be 43%. The final demand is a function of the regional forecast, the regional BLI forecast and COO recommendations. With this given, the projection of the region's real estate needs reflects a final housing mix that consumers are able and willing to afford.

Household Income Group Discussion

Background

Potential affects by income group require some preliminary explanation of the methods Metro staff use to estimate income-group-related outcomes. Monthly housing cost estimates for owners and renters were derived with data from a growth scenario produced by the MetroScope land use model. This scenario draws from the COO's recommendations. The scenario assumed the following set of economic conditions: (1) medium-growth forecast of population and job growth; (2) medium supply forecast of land capacity inside the Metro UGB; (3) all four UGB expansions proposed in 2018; (4) and additional UGB expansions after 2025.

Methodology & Assumptions

This housing needs analysis relies on forecast data derived from a MetroScope land use scenario that incorporates key assumptions from the 2018 Urban Growth Management decision. The UGB decision was informed by (1) a range forecast of population and job growth; (2) a range forecast of land supply/capacity inside the UGB; (3) all four UGB expansions proposed in 2018 by local governments. For modeling and forecasting purposes, a "medium" setting was assumed to represent the range forecasts. The scenario also includes a 4th assumption that incorporates future UGB expansions. This assumption is consistent with the expectation that the regional BLI (buildable land inventory) capacity will be updated at regular intervals in order to maintain an orderly succession of a 20 year supply balance for future review cycles.

For every scenario modeled, MetroScope projects the price (or rent) of housing by tenure and type. These projections form the basis for estimating monthly housing costs and the associated cost burden of owning or renting. The cost burden is the ratio of monthly housing cost divided by monthly household income. Housing costs and housing burden calculations are derived from 2018 and 2038 projections of household income, construction costs, land supply forecasts, redevelopment forecast, and current zoning and other economic data. MetroScope utilizes this information to estimate the rents and housing prices that will be needed to balance the demand and supply of housing by tenure and structure type. This means that the real estate markets "clear" and developers will build housing at various price points to match what households can or are willing to pay for housing. The rent and housing price levels represent final demand prices.

MetroScope projections are used to determine the monthly income homeowners spend for housing and the sales price of homes in the region. We assert loan agreement terms that were typical as of 2010 to

2015 to estimate monthly mortgage costs of owners. For renters, the monthly rent is based on an investor's purchase price per multifamily unit so that rents include the cost of construction, a typical return on investment, and the cost of maintenance and utilities to each unit.

Calculation of Owner Costs, Single Family (OSF) and Multi Family (OMF):

Monthly Cost =
-PMT [Annual Interest Rate/12, Loan Years * 12, Cost per Unit * (1 - Down Payment)]

(PMT is an Excel function which calculates periodic loan payments)

Typical loan agreement terms for a 30-year conventional fixed rate mortgage:

- Annual Interest Rate = 4%
- Loan Years = 30 years
- Down Payment = 14%

For example, given a modeled cost per unit of $300,000, the monthly mortgage cost would be $1,338 for the homeowner.

Calculation of Renter Costs, Single Family (RSF):

Monthly Cost =
-PMT [Annual Interest Rate/12, Loan Years * 12, Cost per Unit * (1 - Down Payment)]
* (1+ Operating Expense Rate) + Utilities

(PMT is an Excel function which calculates periodic loan payments)

Assumptions:

- Annual Interest Rate = 4%
- Loan Years = 30 years
- Down Payment = 14%
- Operating Expense Rate = 22% for RSF
- Utilities = $324/month for median income

Given a cost per unit of $300,000 and a median income, the monthly housing cost would be $1,991.

Calculation of Renter Costs, Multi Family (RMF):

Monthly Cost =
Cost per Unit * Cap. Rate * (1 + Operating Expense Rate) / 12 + Utilities

Assumptions:

- Cap. Rate = 6.5%
- Operating Expense Rate = 33% for RMF

- Utilities = $324/month for median income

Given a cost per unit of $100,000 and a median income, the monthly housing cost would be $1,135.

Income Categories

The income categories used for this analysis are those defined by the U.S. Department of Housing and Urban Development (HUD), as a percentage of median family income (MFI). "Extremely Low" is 30% of MFI; "Very Low" is 50% of MFI; "Low" is 80% of MFI. MetroScope works with median household income (MHI) rather than median family income (i.e., not all households are families). This analysis uses the MFI income distribution, but applied to the MHI. The MHI for the Portland-Vancouver area was $50,100 in 2010 (MetroScope operates with year 2010 dollars). [Source: U.S. Census, Demographic Profile, Table DP03, 2010 American Community Survey 1-Year Estimates, downloaded 1/20/2015]. The eight native MetroScope income categories were grouped into the HUD categories as follows in Table 2.

Table 2: Income Categories – a crosswalk of MetroScope Income Bins and HUD Income Categories

Portland-Vancouver-Hillsboro, OR-WA MSA
2010 Median Household Income (MHI)

EXTREMELY LOW (30% MHI)	$15,030
VERY LOW (50% MHI)	$25,050
LOW (80% MHI)	$40,080
MEDIAN (100% MHI)	$50,100

MetroScope Income	HUD Categories
Less than $14,999	EXTREMELY LOW
$15,000 to $24,999	VERY LOW
$25,000 to $34,999	LOW
$35,000 to $49,999	1/3 LOW, 2/3 MEDIAN
$50,000 to $74,999	GREATER THAN MEDIAN
$75,000 to $99,999	GREATER THAN MEDIAN
$100,000 to $149,999	GREATER THAN MEDIAN
$150,000 or more	GREATER THAN MEDIAN

Household Income Group Findings

This analysis divides household types by owner and renters. It also stratifies the household incomes of renters and owners into 5 income levels. Each income level references a median income value within each bracket to represent household income. (It should be noted that using average values for housing costs and household incomes may limit an understanding of housing affordability in the region because it obscures the distribution of income and the costs incurred by different kinds of households). Housing costs and rents are projected into 21 rent or housing cost categories. The cost categories have

increments of $50 for rents and housing costs below $800 a month, and increments of $100 and more for rents and housing costs above $800 per month.

The chart of the left side of Figure 2, below, shows the percentage of cost burdened owner households in the region based on income level. There are 5 income levels: (1) extreme low, (2) very low, (3) low, (4) median, and (5) greater than median. The percentage of cost burdened owner households declines in the 2018 data (blue bars) as income levels increase. The percentage of cost burdened households still decreases in 2038 as income levels increase (red bars), but not to the same degree. By 2038, a majority of households in the "greater than median" income category become cost burdened. The cost burden threshold is deemed to be 30% of income according to HUD.

The chart on the right side of Figure 2 shows what the average housing cost burden is for each income level. For example, the households in the extremely low income category have a cost burden estimate of 84%, in other words, the average household in this category is spending 84% of household income to cover housing costs. The degree of cost burden falls with rising income levels in both 2018 and 2038. However, for all income levels, the housing cost burden jumps between 11 to 16 percentage points higher from 2018 to 2038, meaning owners are projected to pay more of household income for housing.

Figure 2: Share of Cost Burdened Owners and the Average Cost Burden by Income Level

Monthly housing costs of owners are forecasted by an equilibrium pricing mechanism in the MetroScope land use model. This approach may overstate the final housing costs associated for some owner households. The data reveal more about the change in owner cost burdens rather than a forecast of actual counts of cost burdened household. The model forecasts the housing cost for owners that move and determines a purchase price based on regional economic forecast factors. This approach likely overestimates the cost to homeowners that did not move in the period. In reality, many homeowners are non-movers until a life event causes them to choose to live elsewhere, e.g., an acute illness, a change in job by the householder or spouse, addition of a new family member, or for other economic reasons. Householders that did not move likely have lower housing costs than current home buyers

because their nominal costs are likely less than the current market sales price. Therefore, the percentage of cost burdened owners and their corresponding average costs as percentage of household income may be exaggerated for the segment of non-movers. Thus, a more meaningful finding from the owner analysis may not be actual counts of cost burdened households, but rather the magnitude and direction of changes in housing costs.

The findings in this scenario show that owner costs will rise at the margin as evidenced by the increase in the average cost as a percentage of income of owners in each income bracket. Regionally, new owners in 2018 spend an aggregate of 41% of household income on housing. New owners in 2038 are projected to spend on average 56% of household income on housing costs. These figures express the monthly housing costs if they purchased a house and had a typical 30-year mortgage payment. (The estimates do not include property taxes or other tax burdens nor do they add maintenance and upkeep to the cost estimates.) Households without a monthly mortgage payment likely have much lower monthly housing costs.

Figure 3: Share of Cost Burdened Renters and the Average Cost Burden by Income Level

The rent cost estimates in the MetroScope calculations represent gross rent. Gross rent is the contract rent plus the estimated average monthly cost of utilities (electricity, gas, and water and sewer) and fuels (oil, coal, kerosene, wood, etc.) if these are paid for by the renter (or paid for the renter by someone else). Contract rent is the monthly rent agreed to or contracted for, regardless of any furnishings, utilities, fees, meals, or services that may be included.

As shown in the on the left side of Figure 3, the share of cost burdened renters is nearly 100% for the extremely low and very low income levels. This is the case for both 2018 and 2038. The proportion of households that are cost burdened decrease with rising income levels in both 2018 and 2038 projections. The share of cost burdened renters by income level increases between 2 to 7 percentage points from 2018 to 2038. The threshold for housing cost burdened renters is 30% of income.

The average renter cost burden is much higher for extremely low income renters and falls at higher income levels. The extremely low income level households spend on average about 93% of income on rent in 2018 and projections for 2038 anticipate it edging up to 96% of income. Median renters in 2018 spend about 53% of income and by 2038, they spend up to 58%. Renters in the above median income level exhibit an average close to 35% of income in 2018 and 38% in 2038. This information is displayed in the chart on the right side of Figure 3 for all income levels.

Below median income renters (and owners) exhibit fairly extreme cost burdens. However, lower income households may be eligible to receive other income assistance and subsidies, such as supplemental nutrition assistance program (SNAP – i.e., food stamps), Women, Infants, Children program (WIC – promotes nutritional health of low-income women, infants and children), federal earned income tax credits (EITC). These programs provide additional income supports which are not included in the household income estimates. Also, some low income renters may be eligible for Section 8 housing, or qualify to reside in low income tax credit apartments, or subject to other below market rents. Therefore, the estimates of average housing cost as a percentage of income in this report may be slightly overstating the cost burden's of lower income households due to the exclusion of supplemental incomes and other rental subsidies.

Similar to the owner price projections, rent forecasts are derived based on market clearing prices for the forecast period. If some renters are non-movers in the forecast period and have rents locked-in by long term lease arrangements, then these renters may be spending less than what is predicted to be prevailing rental rates and the resulting cost burdens would be less. MetroScope calculates the rents needed to clear the market given the projected regional forecast factors, but it does not factor in non-movers. Therefore, the number of cost burdened renter households likely represents a high-end of a range.

Summary tables of the final demand forecast of owner and renter housing for years 2018 and 2038 are displayed in Table 6 and 7. Table 6 shows the number of owners by monthly housing costs and income bracket. Table 7 shows the number of renters by monthly rent and income bracket. Dollar figures are expressed in constant 2010 purchasing power. The geographic extent for each table is the Metro UGB. Please refer to Tables 6 and 7 at the end of this report for more detail about housing costs for households of different income groups.

Findings of Need (Gap Analysis)

As shown in Appendix 3 (see pp. 13-18) and as summarized in the "Tenure" and "Type" sections above, all forecast scenarios demonstrate strong upward price pressure. Those findings provide a general signal that the region needs more housing. The analytical findings in particular point to a need for additional production of single family units (attached and detached) over the 20-year forecast period. The expansion proposals from all 4 local governments present opportunities to provide more of the single family housing choices reflected in the HNA report findings.

Based on the amount (range) of multifamily (MF) capacity in the BLI forecasts (136,000 to 271,100 MF units (rounded) supply – see Appendix 2), there is a surplus of MF capacity in the Metro UGB because the supply exceeds demand. MF demand is projected to be 102,500 units. (293,000 households * 70% capture rate * 50% MF rate = 102,500 MF units). The low-end of the MF BLI supply forecast is 136,000 units, which exceeds demand and therefore there is no unmet need.

The findings for "capture rate" and "single family rate" are extracted from the scenarios to calculate potential unmet housing need for single family dwelling units. The capture rate measures the share of future MSA-level growth in population (or households) residing inside the Metro UGB. The single family rate is a measurement of the marginal share of future housing production built as single family; the alternative is multifamily (estimates not shown). More on these findings are discussed in Appendix 3 and the ranges are shown in Table 3, below. The row heading in Table 3 are limited to a plausible range for future capture rates (64% to 70%). The column headings represent a range of single-family housing shares (50% to 70%) derived from plausible growth scenarios. Even increments of 2 and 5 percentage points are added into Table 3 to illustrate other possible capture and single family rate settings, respectively.

Table 3: Housing Needs Analysis Gap Findings

	Single family Rate				
Capture Rate	50%	55%	60%	65%	70%
64% :	**-1,500**	-10,800	-20,200	-29,600	-39,000
66% :	**-4,400**	-14,100	-23,700	-33,400	-43,100
68% :	**-7,300**	-17,300	-27,200	-37,200	-47,200
70% :	**-10,300**	-20,500	-30,800	-41,000	-51,300

Table 3 illustrates potential combinations and resulting gap sensitivity if other alternative settings are sought of future capture and single family rates. Results in the table body show a potential range of unmet need in SF housing for the Metro UGB. The range forecasts provide latitude for policy makers to align forecast expectations with policy intentions.

Table 4: HNA range

Line 1	7-county MSA new households, 2018 to 2038 (midpoint of range):	**279,000**
Line 2	7-county MSA new dwelling units (apply 5% vacancy rate):	**293,000**
Line 3	Metro UGB new dwelling units (capture rate range = 64% to 70%):	**187,500 to 205,000**
Line 4	Metro UGB new single family dwelling units (SF rate = 50%):	**93,800 to 102,600**
Line 5	Metro UGB existing SF capacity (attached and detached units):	**92,300**
Line 6	Unmet SF dwelling unit need:	**1,500 to 10,300**

Table 4 source information and discussion:

Line 1: Metro Growth Forecast (2018 to 2038), Appendix 1. Metro prepared a range forecast that statistically encompasses a plausible span in which the Portland MSA is likely to grow during the next 20 year period. This range approximates a 95% confidence interval, meaning future regional growth has about 95 chances out of 100 of being in the specified growth range. The selection of the midpoint in the range represents the peak likelihood of the range forecast.

The baseline household forecast in 2018 estimates 958,000 (rounded) households in the MSA. The same forecast projects total households rising to 1,237,000 for an increase of 279,000 households in the MSA from 2018 to 2038.

Line 2: source: U.S. Census and Metro. Metro reviewed Census residential vacancy rates for the MSA and selected a rounded estimate of past vacancy rates for the MSA region.

Line 3: MetroScope Growth Scenarios, Appendix 3. A review of the Metro UGB capture rate shows an average reading of 61% based on data from 1979 to present. Swings in the actual capture rate have occurred in history and it has been shown to be correlated with real estate and regional economic business cycles. The historical rates have been between 57% and 64%. In the future, MetroScope scenarios predict a possible capture rate between 61% and 74%, depending on forecast assumptions. Plausible scenarios indicate a narrower range (64% to 70%). Higher capture rates tended to fit with higher growth and higher capacity forecasts. Applying the narrower capture rate range (64% to 70%) to the baseline dwelling unit forecast (293,000) yields a housing unit growth demand range between 187,500 and 205,000 units (rounded).

Line 4: MetroScope Growth Scenarios, Appendix 3. A review of 1970 Census data for the Tri-county area (Clackamas, Multnomah and Washington counties) reveals a single-family (SF) dwelling unit rate of 78%. This rate falls to 70% in the 2010 Census. This means that the marginal SF rate has been on the decline. A decade-by-decade review of the marginal SF rate reveals a rate ranging between 60% and 68% since 1970. In the future, MetroScope scenarios predict a possible SF rate between 24% and 64% that is dependent on growth range assumptions and the ratio of SF capacity made available in the BLI

(Buildable Land Inventory) forecast. A lower SF rate corresponds to a relatively lower quantity of SF capacity assumed in a BLI forecast. Across all scenarios, the innate or latent demand for SF housing units generally exceeds the production of SF units. In all plausible scenarios, demand for SF is projected to exceed SF supply; this is evidenced by the steep increase in marginal SF home prices and corresponding housing cost-burden projections of homeowners. Assuming a SF rate of 50% is consistent with the Metropolitan Housing Rule and the rate falls in the range of tested scenario projections.

Line 5: Buildable Lands Inventory (BLI), Appendix 2. Single family dwelling unit capacity can be found in the "Residential BLI (Threshold and Statistical methods)" tables. BLI tables in Appendix 2 have been revised as of October 2018 to reflect corrections made to the RLIS (Regional Land Information System) zoning layer used in the estimation of the BLI. The tables show SF capacity to be 36,108 units Vacant SF and 56,229 units of Infill SF for a total of 92,337 units (92,300 units rounded).

Line 6: HNA range calculation. Subtracts SF demand of 93,800 up to 102,600 from SF capacity of 92,300 units

The proposed UGB expansions from local governments would provide an approximate supply of 6,100 single family dwelling units and 3,100 units of multifamily apartment units, for a total of 9,200 homes. The proposed 6,100 single family units in the expansion areas falls near the midpoint of the range of unmet SF housing need of 1,500 to 10,300 units.

As shown in Table 5, assuming a UGB capture rate of 67.2% (which is essentially the midpoint of the plausible capture rate range) results in an unmet single-family housing need of 6,100 units, which corresponds to the 6,100 units of single-family housing included in the concept plans for the four city-proposed UGB expansions.

Table 5: Final reconciliation of housing need for the Metro UGB, years 2018 to 2038

Line 1	7-county MSA new households, 2018 to 2038 (midpoint of range):	**279,000**
Line 2	7-county MSA new dwelling units (apply 5% vacancy rate):	**293,000**
Line 3	Metro UGB new dwelling units (capture rate range = 67.2%):	**196,900**
Line 4	Metro UGB new single family dwelling units (SF rate = 50%):	**98,400**
Line 5	Metro UGB existing SF capacity (attached and detached units):	**92,300**
Line 6	Unmet SF dwelling unit need:	**6,100**

Overall, the findings from this analysis indicate the following:

- housing costs will increase faster than household incomes;
- most low-income households will continue to be cost-burdened;
- average housing cost burden will worsen for both owner and renters;
- home-ownership will become increasingly difficult for households across all income ranges;
- the need for additional housing supply will persist through and beyond 2038;
- even assuming potential future UGB expansions there remains a measurable need for housing, especially single-family: this need supports the decision to expand the UGB per the four concept-planned proposals.

Cost Burden Validation of MetroScope 2018 data using 2016 ACS 5-year data

A precise comparison of MetroScope data against actual observed data is difficult. The Census American Community Survey (ACS) reports housing cost estimates that closely approximate the desirable validation comparison. But in order to make a more comparable comparison, ACS data are adjusted.

Because the MetroScope and ACS income brackets do not match the 5 HUD income categories, the income brackets in MetroScope and ACS data tables are adjusted to approximately align with the HUD data. Although the re-alignment of the income brackets is imperfect and subject to possible distribution errors, it is necessary in order to harmonize (to the extent possible) the 3 data sets for validation comparison purposes. Realignment of MetroScope income brackets to HUD income levels are the same as those shown in Table 2. The realignment of ACS to HUD is shown in Table 5, below.

Table 6: Income Categories – a crosswalk of ACS Income Brackets and HUD Income Categories

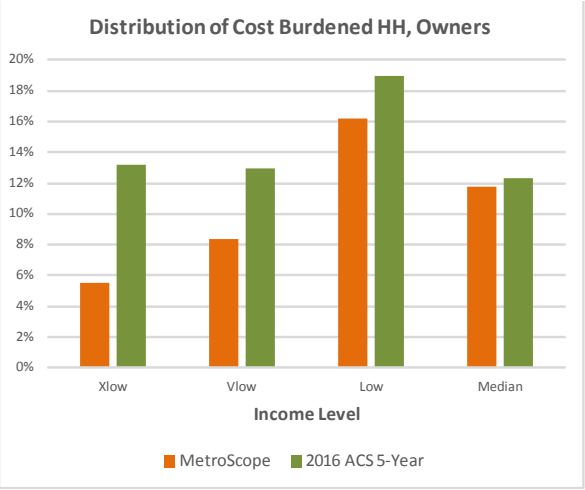
ACS Income Brackets	HUD income categories	
Less than $19,999	2/3 EXTR LOW	1/3 VERY LOW
$20,000 to $34,999	1/3 VERY LOW	2/3 LOW
$35,000 to $49,999	1/3 LOW	2/3 MEDIAN
$50,000 to $74,999	GT MEDIAN	
$75,000 or more	GT MEDIAN	

For this comparison, the estimates from 2016 5-Year ACS Table B25106, “Tenure by Housing Costs as a Percentage of Household Income in the Past 12 Months” are compared against MetroScope forecast data. To control for different years, the results are “normalized” by comparing the distribution as percentages of regional totals.

The comparison of the ACS and MetroScope owner and renter cost burden data are shown in Figures 4 and 5, respectively.

The distribution of cost burdened owners (see Figure 3) from the ACS reveals (green bars) a slightly higher proportion of householders below the median category. MetroScope (orange bars) predicts proportionally fewer lower income households as burdened by housing costs. On the other end (not charted), MetroScope predicts that a higher share of above-median income householders will be cost burdened.

The second chart in Figure 4 reveals the degree of cost burden by showing the percentage of households in each income category to be cost burdened. In the case of MetroScope (orange bars), the model predicts that a greater share of households across the entire income spectrum will be cost burdened as compared to ACS estimates of the same. The greatest proportional discrepancy can be found with households of above the median income. MetroScope predicts almost half of these households are cost burdened; the ACS estimates only 16%. In sum, the distribution of cost burdened owner households appears similar between ACS and MetroScope forecast findings. MetroScope tends to over predict the share of cost burdened owners in each income range. This is consistent with earlier explanations of the differences that stem from the cost burdens of movers and non-movers.



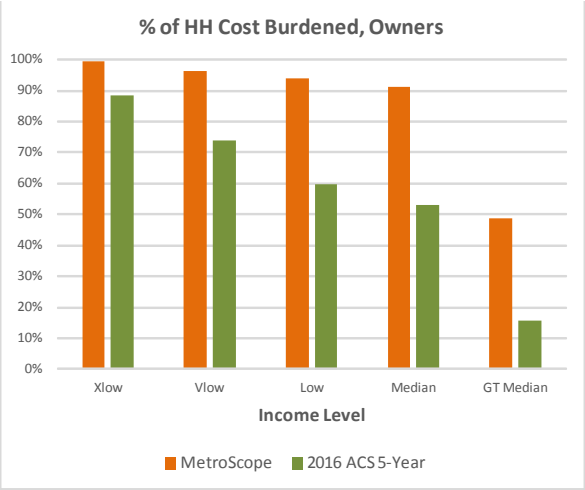
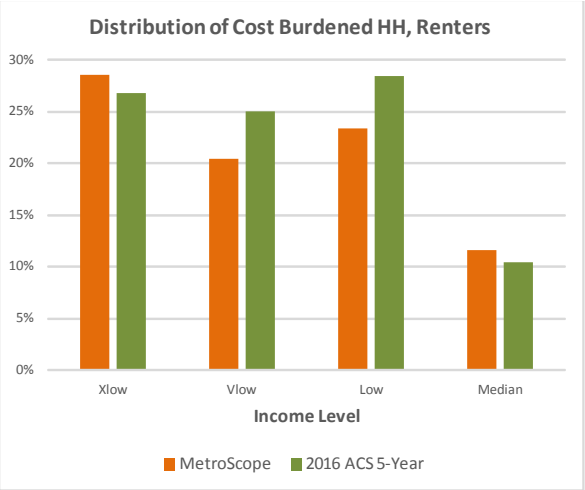


Figure 4: Comparison of Owner Cost Burdened Households – MetroScope vs. ACS

A similar comparison is made with renters, shown in Figure 5, below. It appears that the distribution of cost burdened households relative to all renters broken down by income levels for the ACS and MetroScope reveal roughly the same distribution. Again, because of the differences between the cost burdens of movers and non-movers, MetroScope tends to over predict the share of renters who are cost burdened. Although for lower income brackets, the comparison of values appear closer together.



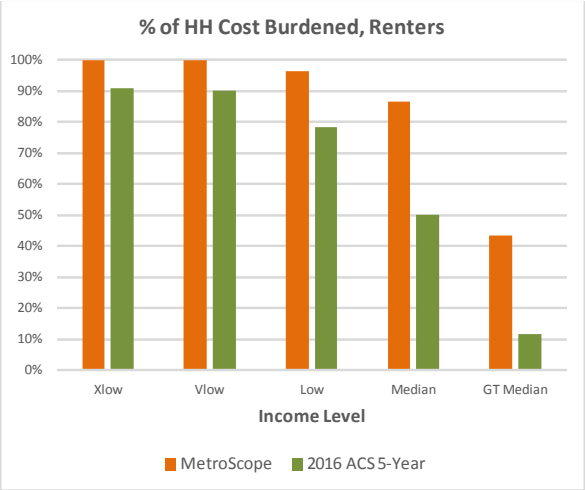


Figure 5: Comparison of Renter Cost Burdened Households – MetroScope vs. ACS

The differences in the distributions between owners and renters in the ACS estimates and the MetroScope forecasts are likely attributable to the different housing costs associated with movers and non-movers as well as some distribution misalignments caused by our efforts to harmonize HUD, ACS, and MetroScope income brackets. The validation of the model helps reinforce our understanding of forecast results. The distribution of cost burdened renters and owners relative to the subtotals of each appear reasonable in this model validation exercise. However, MetroScope tends to over predict the number of cost-burdened households because it assumes prevailing forecast costs on housing across all households without regard to differences in non-movers who likely are not experiencing to the same degree the rising cost of housing at the margin.

Owner Housing Cost by Income Bracket

Table 7: 2018 and 2038 Owner Housing Forecasts (Metro UGB)

Scenario #1851

Forecast: MEDIUM | Capacity: MEDIUM | 2018 Expansions: ALL | Future Expansions: ALL

Owners, 2018

All HH

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	0	0	0	0	0	0
$100 to $149	0	0	0	0	0	0
$150 to $199	0	0	0	0	0	0
$200 to $249	58	0	0	0	0	58
$250 to $299	158	0	0	0	0	158
$300 to $349	332	14	0	0	0	347
$350 to $399	383	50	28	0	0	461
$400 to $449	382	107	50	13	0	552
$450 to $499	467	162	137	38	0	804
$500 to $549	1,740	219	153	68	7	2,187
$550 to $599	1,805	217	207	104	19	2,351
$600 to $649	1,885	122	227	160	26	2,419
$650 to $699	2,633	152	199	183	51	3,219
$700 to $749	2,806	89	161	217	70	3,343
$750 to $799	2,452	136	151	237	90	3,068
$800 to $899	4,766	1,704	249	332	299	7,350
$900 to $999	5,148	3,040	1,001	250	320	9,759
$1,000 to $1,249	5,682	9,753	9,961	2,110	756	28,262
$1,250 to $1,499	2,036	5,670	13,907	11,590	1,838	35,041
$1,500 to $1,999	656	3,530	14,301	32,501	20,617	71,605
$2,000 or more	19	358	4,431	28,848	180,341	213,997
Total	33,408	25,324	45,163	76,650	204,435	384,980

Cost Burdened HH (> 30% of income spend on housing)

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	-	-	-	-	-	0
$100 to $149	-	-	-	-	-	0
$150 to $199	-	-	-	-	-	0
$200 to $249	-	0	-	-	-	0
$250 to $299	135	-	-	-	-	135
$300 to $349	271	-	-	-	-	271
$350 to $399	227	0	-	-	-	227
$400 to $449	151	0	0	0	-	151
$450 to $499	190	0	0	0	-	190
$500 to $549	1,740	0	0	0	0	1,740
$550 to $599	1,805	0	0	0	0	1,805
$600 to $649	1,885	0	0	0	0	1,885
$650 to $699	2,633	0	0	0	0	2,633
$700 to $749	2,806	0	0	0	0	2,806
$750 to $799	2,452	136	0	0	0	2,589
$800 to $899	4,766	1,704	0	0	0	6,470
$900 to $999	5,148	3,040	0	0	0	8,188
$1,000 to $1,249	5,682	9,753	8,646	0	0	24,081
$1,250 to $1,499	2,036	5,670	13,907	0	0	21,613
$1,500 to $1,999	656	3,530	14,301	26,993	0	45,480
$2,000 or more	19	358	4,431	28,848	80,633	114,290
Total	32,603	24,191	41,285	55,841	80,633	234,553

% of HH Cost Burdened

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	-	-	-	-	-	-
$100 to $149	-	-	-	-	-	-
$150 to $199	-	-	-	-	-	-
$200 to $249	-	-	-	-	-	-
$250 to $299	0%	-	-	-	-	0%
$300 to $349	86%	-	-	-	-	86%
$350 to $399	59%	0%	0%	-	-	49%
$400 to $449	40%	0%	0%	0%	-	27%
$450 to $499	41%	0%	0%	0%	-	24%
$500 to $549	100%	0%	0%	0%	0%	80%
$550 to $599	100%	0%	0%	0%	0%	77%
$600 to $649	100%	0%	0%	0%	0%	78%
$650 to $699	100%	0%	0%	0%	0%	82%
$700 to $749	100%	0%	0%	0%	0%	84%
$750 to $799	100%	100%	0%	0%	0%	84%
$800 to $899	100%	100%	0%	0%	0%	88%
$900 to $999	100%	100%	0%	0%	0%	84%
$1,000 to $1,249	100%	100%	87%	0%	0%	85%
$1,250 to $1,499	100%	100%	100%	0%	0%	62%
$1,500 to $1,999	100%	100%	100%	83%	0%	64%
$2,000 or more	100%	100%	100%	100%	45%	53%
Total	98%	96%	91%	73%	39%	61%

Avg. Housing Cost as % of Income

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	-	-	-	-	-	-
$100 to $149	-	-	-	-	-	-
$150 to $199	-	-	-	-	-	-
$200 to $249	-	-	-	-	-	-
$250 to $299	30%	-	-	-	-	30%
$300 to $349	37%	-	-	-	-	37%
$350 to $399	40%	20%	-	-	-	40%
$400 to $449	42%	20%	20%	-	-	42%
$450 to $499	41%	20%	20%	10%	-	-
$500 to $549	42%	20%	20%	10%	-	32%
$550 to $599	67%	30%	20%	17%	10%	58%
$600 to $649	71%	30%	20%	20%	10%	60%
$650 to $699	77%	30%	20%	20%	10%	65%
$700 to $749	78%	30%	20%	20%	10%	68%
$750 to $799	71%	30%	29%	20%	13%	63%
$800 to $899	68%	40%	30%	20%	19%	60%
$900 to $999	67%	40%	30%	20%	18%	55%
$1,000 to $1,249	67%	40%	30%	20%	17%	52%
$1,250 to $1,499	76%	50%	39%	29%	19%	49%
$1,500 to $1,999	86%	60%	43%	30%	23%	43%
$2,000 or more	100%	73%	53%	38%	28%	41%
Total	100%	93%	68%	51%	35%	38%

Owners, 2038

All HH

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	0	0	0	0	0	0
$100 to $149	4	0	0	0	0	4
$150 to $199	37	3	0	0	0	40
$200 to $249	82	9	1	0	0	91
$250 to $299	138	20	8	0	0	166
$300 to $349	257	35	27	5	0	324
$350 to $399	346	41	29	12	1	429
$400 to $449	411	65	33	15	3	528
$450 to $499	733	93	70	19	6	922
$500 to $549	584	176	110	28	7	905
$550 to $599	802	245	85	52	10	1,193
$600 to $649	740	218	199	93	13	1,264
$650 to $699	492	305	342	69	16	1,224
$700 to $749	1,359	429	277	143	43	2,250
$750 to $799	2,467	258	378	232	39	3,374
$800 to $899	3,817	897	678	586	184	6,162
$900 to $999	4,385	350	603	654	334	6,327
$1,000 to $1,249	13,322	2,234	1,105	1,638	1,265	19,562
$1,250 to $1,499	9,937	7,649	2,178	963	1,297	22,024
$1,500 to $1,999	5,524	15,570	21,799	7,040	2,113	52,046
$2,000 or more	877	6,464	27,658	73,964	259,367	368,330
Total	46,314	35,060	55,580	85,513	264,695	487,163

Cost Burdened HH (> 30% of income spend on housing)

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	-	-	-	-	-	0
$100 to $149	-	-	-	-	-	0
$150 to $199	-	0	-	-	-	0
$200 to $249	-	0	-	-	-	0
$250 to $299	94	0	0	-	-	94
$300 to $349	171	0	0	0	-	171
$350 to $399	256	0	0	0	0	256
$400 to $449	279	0	0	0	0	279
$450 to $499	437	0	0	0	0	437
$500 to $549	584	0	0	0	0	584
$550 to $599	802	0	0	0	0	802
$600 to $649	740	0	0	0	0	740
$650 to $699	492	0	0	0	0	492
$700 to $749	1,359	0	0	0	0	1,359
$750 to $799	2,467	258	0	0	0	2,725
$800 to $899	3,817	897	0	0	0	4,714
$900 to $999	4,385	350	0	0	0	4,735
$1,000 to $1,249	13,322	2,234	668	0	0	16,224
$1,250 to $1,499	9,937	7,649	2,178	0	0	19,764
$1,500 to $1,999	5,524	15,570	21,799	6,917	0	49,810
$2,000 or more	877	6,464	27,658	73,964	239,710	348,672
Total	45,544	33,422	52,303	80,881	239,710	451,859

% of HH Cost Burdened

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	-	-	-	-	-	-
$100 to $149	-	-	-	-	-	-
$150 to $199	0%	-	-	-	-	0%
$200 to $249	0%	0%	-	-	-	0%
$250 to $299	68%	0%	0%	-	-	57%
$300 to $349	67%	0%	0%	0%	-	53%
$350 to $399	74%	0%	0%	0%	0%	60%
$400 to $449	68%	0%	0%	0%	0%	53%
$450 to $499	60%	0%	0%	0%	0%	47%
$500 to $549	100%	0%	0%	0%	0%	65%
$550 to $599	100%	0%	0%	0%	0%	67%
$600 to $649	100%	0%	0%	0%	0%	59%
$650 to $699	100%	0%	0%	0%	0%	40%
$700 to $749	100%	0%	0%	0%	0%	60%
$750 to $799	100%	100%	0%	0%	0%	81%
$800 to $899	100%	100%	0%	0%	0%	77%
$900 to $999	100%	100%	0%	0%	0%	75%
$1,000 to $1,249	100%	100%	100%	0%	0%	83%
$1,250 to $1,499	100%	100%	100%	0%	0%	90%
$1,500 to $1,999	100%	100%	100%	0%	0%	96%
$2,000 or more	100%	100%	100%	100%	92%	95%
Total	98%	95%	94%	95%	91%	93%

Avg. Housing Cost as % of Income

Monthly Cost	XlowV	VlowV	LowV	MedianV	GT MedianV	Total
Less than $100	-	-	-	-	-	-
$100 to $149	-	-	-	-	-	-
$150 to $199	20%	-	-	-	-	-
$200 to $249	26%	10%	-	-	-	-
$250 to $299	27%	10%	10%	-	-	-
$300 to $349	34%	20%	10%	10%	-	-
$350 to $399	39%	20%	10%	10%	-	-
$400 to $449	45%	20%	18%	10%	10%	-
$450 to $499	49%	20%	20%	10%	10%	-
$500 to $549	48%	20%	20%	10%	10%	-
$550 to $599	58%	30%	20%	14%	10%	48%
$600 to $649	59%	30%	20%	20%	10%	48%
$650 to $699	49%	30%	20%	20%	10%	39%
$700 to $749	54%	30%	20%	20%	10%	36%
$750 to $799	78%	30%	28%	20%	14%	58%
$800 to $899	92%	40%	30%	20%	19%	75%
$900 to $999	96%	40%	30%	20%	18%	71%
$1,000 to $1,249	94%	40%	30%	20%	19%	73%
$1,250 to $1,499	81%	50%	36%	28%	20%	67%
$1,500 to $1,999	87%	60%	46%	30%	21%	67%
$2,000 or more	100%	74%	55%	40%	26%	62%
Total	85%	69%	62%	56%	48%	56%

Renter Housing Cost by Income Bracket

Table 8: 2018 and 2038 Renter Housing Forecasts (Metro UGB)

Scenario #1851

Forecast: MEDIUM | Capacity: MEDIUM | 2018 Expansions: ALL | Future Expansions: ALL

Renters, 2018

All HH

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	0	0	0	0	0
$100 to $149	0	0	0	0	0
$150 to $199	0	0	0	0	0
$200 to $249	0	0	0	0	0
$250 to $299	0	0	0	0	0
$300 to $349	0	0	0	0	0
$350 to $399	0	0	0	0	0
$400 to $449	2	0	0	0	2
$450 to $499	26	0	0	0	26
$500 to $549	753	0	0	0	753
$550 to $599	4,759	0	0	0	4,759
$600 to $649	6,802	1	0	0	6,803
$650 to $699	12,058	3	0	0	12,061
$700 to $749	9,763	13	0	0	9,776
$750 to $799	9,348	165	18	0	9,530
$800 to $899	21,170	2,829	626	7	24,630
$900 to $999	11,722	5,826	2,554	102	20,204
$1,000 to $1,249	24,289	14,572	14,834	5,031	59,252
$1,250 to $1,499	6,876	7,920	11,623	12,564	43,150
$1,500 to $1,999	2,403	6,882	11,022	15,170	48,749
$2,000 or more	176	1,230	4,745	12,614	38,165
	110,146	39,441	45,422	45,488	277,861

Cost Burdened HH (> 30% of income spend on housing)

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	0	0	0	0	0
$100 to $149	0	0	0	0	0
$150 to $199	0	0	0	0	0
$200 to $249	0	0	0	0	0
$250 to $299	0	0	0	0	0
$300 to $349	0	0	0	0	0
$350 to $399	0	0	0	0	0
$400 to $449	2	0	0	0	2
$450 to $499	26	0	0	0	26
$500 to $549	753	0	0	0	753
$550 to $599	4,759	0	0	0	4,759
$600 to $649	6,802	0	0	0	6,802
$650 to $699	12,058	0	0	0	12,058
$700 to $749	9,763	0	0	0	9,763
$750 to $799	9,348	165	0	0	9,512
$800 to $899	21,170	2,829	0	0	23,998
$900 to $999	11,722	5,826	0	0	17,548
$1,000 to $1,249	24,289	14,572	11,972	0	50,833
$1,250 to $1,499	6,876	7,920	11,623	0	26,419
$1,500 to $1,999	2,403	6,882	11,022	12,714	33,021
$2,000 or more	176	1,230	4,745	12,614	29,376
	110,146	39,424	39,362	25,329	224,870

% of HH Cost Burdened

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	-	-	-	-	-
$100 to $149	-	-	-	-	-
$150 to $199	-	-	-	-	-
$200 to $249	-	-	-	-	-
$250 to $299	-	-	-	-	-
$300 to $349	-	-	-	-	-
$350 to $399	-	-	-	-	-
$400 to $449	100%	-	-	-	100%
$450 to $499	100%	-	-	-	100%
$500 to $549	100%	-	-	-	100%
$550 to $599	100%	-	-	-	100%
$600 to $649	100%	0%	-	-	100%
$650 to $699	100%	0%	-	-	100%
$700 to $749	100%	0%	-	-	100%
$750 to $799	100%	100%	0%	-	97%
$800 to $899	100%	100%	0%	0%	97%
$900 to $999	100%	100%	0%	0%	87%
$1,000 to $1,249	100%	100%	81%	0%	86%
$1,250 to $1,499	100%	100%	100%	0%	61%
$1,500 to $1,999	100%	100%	100%	84%	68%
$2,000 or more	100%	100%	100%	100%	77%
	100%	100%	87%	56%	81%

Avg. Housing Cost as % of Income

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	-	-	-	-	-
$100 to $149	-	-	-	-	-
$150 to $199	-	-	-	-	-
$200 to $249	-	-	-	-	-
$250 to $299	-	-	-	-	-
$300 to $349	-	-	-	-	-
$350 to $399	-	-	-	-	-
$400 to $449	-	-	-	-	-
$450 to $499	-	-	-	-	-
$500 to $549	60%	-	-	-	60%
$550 to $599	72%	-	-	-	72%
$600 to $649	79%	30%	-	-	79%
$650 to $699	79%	30%	-	-	79%
$700 to $749	78%	30%	-	-	78%
$750 to $799	80%	40%	30%	-	79%
$800 to $899	80%	40%	30%	20%	74%
$900 to $999	74%	40%	30%	20%	58%
$1,000 to $1,249	87%	50%	38%	30%	60%
$1,250 to $1,499	89%	60%	43%	30%	48%
$1,500 to $1,999	100%	74%	54%	38%	47%
$2,000 or more	100%	93%	69%	52%	48%
	81%	55%	46%	39%	58%

Renters, 2038

All HH

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	0	0	0	0	0
$100 to $149	0	0	0	0	0
$150 to $199	0	0	0	0	0
$200 to $249	0	0	0	0	0
$250 to $299	0	0	0	0	0
$300 to $349	0	0	0	0	0
$350 to $399	0	0	0	0	0
$400 to $449	0	0	0	0	0
$450 to $499	4	6	0	0	10
$500 to $549	2	5	0	0	7
$550 to $599	2	5	0	0	7
$600 to $649	9	2	0	0	11
$650 to $699	4	2	5	0	11
$700 to $749	8	3	6	0	17
$750 to $799	23	4	3	3	33
$800 to $899	455	51	14	9	529
$900 to $999	3,926	418	15	6	4,365
$1,000 to $1,249	19,730	12,338	1,946	126	34,140
$1,250 to $1,499	15,554	17,882	10,399	2,476	46,311
$1,500 to $1,999	12,052	17,817	24,094	18,008	71,971
$2,000 or more	3,981	10,766	19,410	26,880	61,037
	55,750	59,293	55,892	47,507	373,000

Cost Burdened HH (> 30% of income spend on housing)

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	0	0	0	0	0
$100 to $149	0	0	0	0	0
$150 to $199	0	0	0	0	0
$200 to $249	0	0	0	0	0
$250 to $299	0	0	0	0	0
$300 to $349	0	0	0	0	0
$350 to $399	0	0	0	0	0
$400 to $449	0	0	0	0	0
$450 to $499	10	0	0	0	10
$500 to $549	84	0	0	0	84
$550 to $599	859	0	0	0	859
$600 to $649	5,538	0	0	0	5,538
$650 to $699	7,676	0	0	0	7,676
$700 to $749	10,496	0	0	0	10,496
$750 to $799	16,190	23	0	0	16,212
$800 to $899	24,733	455	0	0	25,189
$900 to $999	25,290	3,926	0	0	29,215
$1,000 to $1,249	41,620	19,730	10,520	0	71,870
$1,250 to $1,499	11,994	15,554	17,882	0	45,430
$1,500 to $1,999	9,629	12,052	17,817	19,999	59,437
$2,000 or more	381	3,981	10,766	19,410	50,487
	154,538	55,721	56,985	39,350	322,542

% of HH Cost Burdened

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	-	-	-	-	-
$100 to $149	-	-	-	-	-
$150 to $199	-	-	-	-	-
$200 to $249	-	-	-	-	-
$250 to $299	-	-	-	-	-
$300 to $349	-	-	-	-	-
$350 to $399	-	-	-	-	-
$400 to $449	100%	-	-	-	100%
$450 to $499	52%	0%	0%	-	44%
$500 to $549	100%	0%	0%	-	90%
$550 to $599	100%	0%	0%	-	99%
$600 to $649	100%	0%	0%	-	100%
$650 to $699	100%	0%	0%	0%	100%
$700 to $749	100%	0%	0%	0%	100%
$750 to $799	100%	0%	0%	0%	100%
$800 to $899	100%	0%	0%	0%	100%
$900 to $999	100%	100%	0%	0%	99%
$1,000 to $1,249	100%	100%	85%	0%	95%
$1,250 to $1,499	100%	100%	100%	0%	78%
$1,500 to $1,999	100%	100%	100%	100%	82%
$2,000 or more	100%	100%	100%	100%	82%
	100%	100%	96%	70%	86%

Avg. Housing Cost as % of Income

Monthly Rent	VLow	Low	Median	GT Median	Total
Less than $100	-	-	-	-	-
$100 to $149	-	-	-	-	-
$150 to $199	-	-	-	-	-
$200 to $249	-	-	-	-	-
$250 to $299	-	-	-	-	-
$300 to $349	-	-	-	-	-
$350 to $399	-	-	-	-	-
$400 to $449	-	-	-	-	-
$450 to $499	-	-	-	-	-
$500 to $549	46%	20%	-	-	63%
$550 to $599	68%	30%	20%	-	75%
$600 to $649	75%	30%	20%	-	80%
$650 to $699	80%	30%	20%	-	86%
$700 to $749	86%	30%	20%	20%	86%
$750 to $799	86%	30%	25%	20%	88%
$800 to $899	86%	40%	30%	20%	85%
$900 to $999	88%	40%	30%	20%	88%
$1,000 to $1,249	86%	40%	30%	20%	17%
$1,250 to $1,499	80%	40%	30%	20%	17%
$1,500 to $1,999	80%	40%	30%	20%	74%
$2,000 or more	85%	50%	39%	30%	67%
	86%	60%	50%	42%	63%