

2018 and 2045 Land Use for the Greater Thurston Region Transportation Demand Model

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Introduction

Thurston Regional Planning Council's (TRPC's) EMME transportation demand model was updated in 2020 to include Grays Harbor County. The new Greater Thurston Regional Model (GTRM) model was expanded to include detailed population and employment estimates and forecasts for Grays Harbor, Lewis, and Thurston Counties, and parts of Mason and Pierce Counties. This report documents the methodology used for land use data development.

Ten land use categories are used in the model:

- Residential Estimates
 1. Households
 2. Population in Dorms or Barracks
- Employment Estimates
 3. Construction; Agriculture, Forestry and Fishing; Mining
 4. Manufacturing; Wholesale Trade; Transportation and Warehousing; Utilities
 5. Retail Trade, Accommodation and Food Services
 6. Finance and Insurance; Services
 7. Government (excluding K-12 education)
 8. K-12 Education
- School Enrollment Estimates
 9. K12 Student Enrollment
 10. Full-time Equivalent (FTE) College Enrollment

Land use estimates were developed for two planning horizons: current year (2017) and baseline forecast (2045). In addition to the standard weekday model, a seasonal land use scenario was also developed to represent summer weekend conditions.

Land use was developed separately for Joint Base Lewis-McChord (JBLM), the American Lake Veterans Administration Hospital, and Camp Murray by staff at the three institutions.

Residential Estimates

Grays Harbor, Lewis, and Mason Counties

2017 Baseline

Transportation Analysis Zone (TAZ) level estimates of households in Mason, Lewis, and Grays Harbor Counties were provided by the Office of Financial Management's (OFM) Small Area Estimates Program [1]. There are no dorms or barracks in these counties.

2045 Forecast

The Office of Financial Management's Population Forecast [2] was the starting point for Grays Harbor and Mason's household forecast. The number of households in both counties was calculated by subtracting the population in group quarters from the population forecast, then dividing by the average household size.

$$\text{Households} = \frac{\text{Population} \times (1 - \% \text{ of Population in Group Quarters})}{\text{Average Household Size}}$$

The 2045 group quarters population was estimated by calculating the average change in the percent of the population in group quarters between 2017 and 2045 for Thurston County [3, 4], and adding this number (0.20%) to the 2010 estimates for Lewis, Mason, and Grays Harbor Counties (Table 1).

Table 1: Group Quarters as a Percent of Total Population

	Grays Harbor	Lewis	Mason	Thurston
2010	3.8%	1.2%	3.8%	1.7%
2017	3.7%	1.2%	4.2%	1.5%
2045	4.0%	1.5%	4.1%	1.9%
change, 2010-2045*	0.2%	0.2%	0.2%	0.2%
<i>Source: U.S. Census Bureau: 2010 Decennial Census, Office of Financial Management</i>				
<i>Note: *0.2% is the projected increase in the percent of Thurston County's population in a group quarters.</i>				

2045 average household size was estimated by calculating the percent decrease in average household size in Thurston County between 2010 and 2045 (-7.2%) and using that factor to estimate the change in Mason and Grays Harbor Counties (Table 2).

Table 2: Average Household Size

	Grays Harbor	Lewis	Mason	Thurston
2010 (Census)	2.45	2.51	2.45	2.46
2017	2.43	2.51	2.46	2.50
2045	2.28	2.33	2.27	2.29
Percent change, 2010-45*	-0.2%	-7.2%	-7.2%	-7.2%
<i>Source: U.S. Census Bureau: 2010 Decennial Census, Office of Financial Management</i> <i>Note: *-7.2% is the projected percent change in household size in Thurston and Pierce County between 2010 and 2045.</i>				

Once the countywide household estimates (UGA/rural estimates for Lewis County) were calculated, TRPC worked with staff from Grays Harbor and Lewis Counties to allocate growth to TAZs based on their knowledge of development trends and land capacity. 2040 allocations were used for Lewis County, with some adjustments for a small number of TAZs where the observed growth between 2014 and 2017 was greater than the 2040 projections. Growth in Mason County was allocated proportional to 2017 households.

Pierce County

2017 Baseline

TAZ-level estimates of households in Pierce County were provided by the Office of Financial Management's Small Area Estimates Program [1]. Population in dorms and barracks was provided by Puget Sound Regional Council (PSRC) from their Land Use Baseline [4]. 2020 household and dorm/barrack population estimates for Joint Base Lewis-McChord (including the Veterans Administration hospital) and Camp Murray were provided by base staff. These estimates were used in place of PSRC estimates in these TAZs.

2045 Forecast

TAZ-level estimates of households and dorm/barrack population were provided by Puget Sound Regional Council from their Land Use Baseline [4]. Since these estimates were for 2040, a linear trend between 2010 and 2040 was used to project out to 2045.

2020 household and dorm/barrack population estimates for Joint Base Lewis-McChord (including the Veterans Administration Hospital) and Camp Murray were provided by base staff. These estimates were used in place of PSRC estimates in these TAZs. It was assumed that there would be no growth in JBLM households or dorm/barrack population between 2020 and 2045.

Thurston County

2017 Baseline

Household estimates for TAZs in Thurston County were derived from Thurston Regional Planning Council's (TRPC) Annual Population Estimates Work Program [6]. Since TRPC estimates dwelling units, TAZ-level vacancy rates provided by OFM [1] were used to estimate households.

2045 Forecast

Household estimates for TAZs in Thurston County were derived from Thurston Regional Planning Council's Population and Employment Forecast [3]. Since TRPC estimates dwelling units, the 2045 countywide vacancy rate (4.8%) from the TRPC Forecast was used to estimate households.

Seasonal Estimates

TRPC used small-area estimates from OFM and data on vacancy to estimate the number of households in each TAZ on a summer weekend. The OFM data provided estimates of vacant dwelling units. The tract-level Census data provided information on the percent of vacant dwellings that are seasonally occupied.

For 2045 seasonal households, the same assumptions for vacancy rates and seasonally occupied vacant units were applied to the 2017 to 2045 increase in households.

Table 3: Seasonal Household Estimates

Year	Scenario	Grays Harbor	Lewis	Mason	Pierce	Thurston
2017	Weekday	28,895	30,454	24,568	320,463	109,041
2017	Seasonal	32,838	32,353	31,858	336,575	110,609
	Increase	3,943	1,899	7,290	16,112	1,568
2045	Weekday	31,764	40,543	37,075	446,317	167,270
2045	Seasonal	36,992	42,883	49,070	469,313	169,550
	Increase	5,228	2,340	11,995	22,996	2,280

School Enrollment Estimates

K-12 School Enrollment

2018 K-12 school enrollment for schools in the model area was obtained from the Washington State Office of Superintendent of Public Instruction (OSPI). TRPC staff geolocated school sites using addresses provided by OSPI.

School enrollment in 2045 was forecasted using the growth rate in the school-aged population (ages 5-19) between 2017 and 2045 (Table 4). 2017 School-age population came from OFM’s Small Area Demographic Estimates [7]. 2045 school-age population estimates for Grays Harbor, Lewis, Mason, Pierce, and Thurston Counties came from OFM’s State Population Forecast (Medium Series). For Lewis County, the adopted 2030 population [5] was multiplied by the percent of the population age 5-19 from OFM.

Table 4: K-12 School Enrollment Estimates

	Grays Harbor	Lewis	Mason	Pierce	Thurston
School-age Population					
2017	12,559	14,002	10,294	167,126	51,734
2045	13,014	18,769	14,968	200,656	62,774
K-12 School Enrollment					
2017	10,753	12,300	9,291	139,558	42,967
2045	11,491	16,897	13,407	182,129	77,850
% Increase	6.9%	37.4%	44.3%	30.5%	81.2%

College Enrollment

2017 and 2045 full-time equivalent (FTE) college enrollment for Pierce County was obtained from the PSRC Transportation Model Land Use. Estimates were interpolated from 2010 and 2040 estimates. For the remaining counties, recent FTE enrollment was obtained by surveying colleges in the study area (Table 5):

TRPC staff estimated FTE enrollment for 2045.

Table 5: College and University Enrollment

College	County	2017 FTE Enrollment	2045 FTE Enrollment
Centralia College	Lewis	2,289	2,290
The Evergreen State College	Thurston	4,779	5,000
Grays Harbor College	Grays Harbor	2,140	2,140
Olympic College (Shelton Campus)	Mason	300	300
Saint Martin's University	Thurston	1,122	1,200
S. Puget Sound Comm. College:			
Mottman Campus	Thurston	3,713	3,500
Hawk's Prairie Campus	Thurston	184	0
Woodland District Campus	Thurston	0	1,000
Source: TRPC survey of colleges and universities.			

Seasonal Student Enrollment

K-12 student enrollment was reduced by 90 percent in both the 2017 and 2045 model years. The 10 percent remainder was left to account for summer school, camps, or other activities.

Student enrollment at St. Martin's University and The Evergreen State College was reduced by 67 percent. Enrollment at community colleges and other colleges was left unchanged.

Employment Estimates

Grays Harbor, Lewis, and Mason Counties

2017 Baseline

Countywide employment estimates by industry were obtained from the Bureau of Economic Analysis (BEA) [8]. These estimates include both employees covered under state unemployment insurance laws (“covered employment”) as well as proprietors and self-employed people (“non-covered employment”).

Thurston Regional Planning Council entered into a data sharing agreement with the Washington Employment Securities Department (ESD) for first quarter 2017 covered employment data [9]. The ESD data provided the address and number of employees for covered employment firms during the first three months of 2017.

To get TAZ-level employment estimates, firm-level covered employment data from ESD was geolocated using the coordinates and addresses provided with the data. TRPC staff verified the location of all firms with ten or more employees. Covered employment was converted to total employment using an inflation factor:

$$\text{Inflation Factor} = \frac{\text{Total Employment}}{\text{Covered Employment}}$$

where “Total Employment” is the 2017 estimate from BEA and “Covered Employment” is the total 2017 covered employment ESD for firms whose location could be verified [9]. The government sectors tend to have little or no proprietors and self-employed jobs and were assigned an inflation factor of 1.

ESD firm-level employment data do not include records for individual schools. Instead, all employment is placed at the school district headquarters. To distribute the employment to individual school sites, it was assumed that ten percent of school district employment was located at the district headquarters and the remaining 90 percent was allocated to school sites based on school enrolment.

Self-employment (i.e. non-covered) was allocated to both homes and worksites using the same percentages used in TRPC’s Thurston County forecast [3] (Table 6).

Table 6: Allocation of self-employment in Grays Harbor, Lewis, and Mason Counties.

Industry	Home-Based Distributed based on Population	Worksite-based Distributed based on Employment
1 Agriculture, Forestry & Fishing, Mining	0%	100%
2 Utilities	0%	100%
3 Construction	22%	78%
4 Manufacturing	0%	100%
5 Wholesale Trade	0%	100%
6 Retail Trade	0%	100%
7 Transportation and Warehousing	27%	73%
8 Information	15%	85%
9 Finance and Insurance	24%	76%
10 Real Estate, Rental and Leasing	45%	55%
11 Professional Services	12%	88%
12 Education, Health, & Social Services	13%	87%
13 Arts, Entertainment and Recreation	31%	69%
14 Accommodation and Food Services	0%	100%
15 Other Services	29%	71%
16 Federal	0%	n/a
17 State	0%	n/a
18 State Education	0%	n/a
19 Local and Tribal Government	0%	n/a
20 Tribal Enterprise	0%	n/a
21 Local Schools	0%	n/a

2045 Forecast

An employment forecast for Grays Harbor, Lewis, and Mason Counties was generated for the TRPC transportation model. The forecast is considered adequate for the purposes of use – namely to populate external county Traffic Analysis Zones (TAZs) in the transportation model with land use data. The high-level forecasts were developed in an excel spreadsheet using a series of reasonable relationships, as outlined in Table 7.

Table 7: Forecast Method for Grays Harbor, Lewis, and Mason Counties

Industry	Forecast Method
Agriculture, Forestry and Fishing, Mining	No change from 2017
Construction	Increase over 2017 jobs based on growth in dwelling units
Manufacturing	Increase over 2017 jobs based on Thurston County manufacturing job growth
Wholesale Trade	Increase over 2017 jobs based on Thurston County wholesale trade job growth
Retail Trade, Accommodation and Food Services	Based on ratio of households per jobs in Retail Trade, Accommodation and Food Services in 2017
Transportation and Warehousing, Utilities	Based on ratio of households per jobs in Transportation and Warehousing, Utilities in 2017
Finance and Insurance	Based on ratio of households per jobs in Finance and Insurance in 2017
Services	Based on ratio of households per jobs in Services 2017
Government excluding Schools K-12	Based on ratio of households per jobs in Government in 2017
Schools K-12	Based on ratio of school-aged population per jobs in K-12 Education

2040 allocations developed for the Lewis County model expansion were used for Lewis County TAZs. The allocations were developed in consultation with Lewis County staff. Some adjustments were made on the small number of TAZs where the observed growth between 2014 and 2017 was greater than the 2040 projections. The 2040 allocations included 2,000 jobs added to the Industrial Park at TransAlta (IPAT) site above the baseline forecast, consistent with Lewis County’s Comprehensive Plans for the site.

Employment growth in Grays Harbor County was allocated to TAZs by hand in consultation with County staff.

In Mason Counties, employment growth between 2017 and 2045 was allocated to TAZs using the following criteria:

- Home-based employment was distributed based on population growth.
- Worksite-based employment was distributed based on worksite-based employment patterns in 2017.

Thurston County

Thurston County’s TAZ-level 2017 and 2045 employment estimates were developed using the methodology outlined in the TRPC Population and Employment Forecast [3].

Pierce County

2017 Baseline

TRPC entered into a data sharing agreement with Puget Sound Regional Council (PSRC) to obtain their TAZ-level transportation model land use input files. 2017 estimates were derived using a linear interpolation between the 2010 and 2040 data sets. While Grays Harbor, Lewis, Mason, and Thurston County estimates are calibrated to Bureau of Economic Analysis (BEA) total employment estimates, PSRC uses a different methodology to estimate self-employment. The resulting difference is about 16 percent for Pierce County (Table 8).

Table 8: Comparison of PSRC and BEA 2010 Total Employment

	2010 (PSRC)	2010 (BEA)	Difference
King	1,186,376	1,452,715	-18%
Kitsap	96,303	120,429	-20%
Pierce	317,220	377,606	-16%
Snohomish	265,515	318,160	-17%

2014 employment estimates for Joint Base Lewis-McChord (including the Veterans Administration Hospital) and Camp Murray were provided by base staff, which were used for the 2017 estimates.

2045 Forecast

The Puget Sound Regional Council Land Use Baseline Forecast [4] was used to for the 2040 Pierce County estimates, with the exception of Joint Base Lewis-McChord. Estimates were projected out five years using a liner interpolation, except in cases where this would result in negative employment were an exponential growth rate was used.

Employment estimates for Joint Base Lewis-McChord (including the Veterans Administration Hospital) and Camp Murray were provided by base staff for 2020. These estimates were used for the 2045 model year (Table 9).

Table 9: Joint Base Lewis-McChord, Camp Murray and VA Hospital Employment

	2010	2014	2020
JBLM	55,651	60,939	50,652
VA Hospital	706	706	706
Camp Murray	1,300	1,300	1,300

Seasonal Estimates

TRPC developed seasonal factors for employment industries based on the ratio of June/July/August employment to January/February/March employment. Data were averaged over the 2014-2018 five-year period. Covered employment from ESD were used to develop the factors [9]. Seasonal factors were only applied to private, covered employment sites. Some adjustments were made on the recommendation of Grays Harbor staff.

Table 10: Employment Factors Used to Calculate Seasonal Employment

NAICS	Industry	Grays Harbor	Lewis	Mason	Pierce	Thurston
11-21	Agriculture, Forestry and Fishing, Mining	0.99	1.12	1.07	1.12	1.14
22	Utilities	1.00	1.00	1.02	1.01	1.04
23	Construction	1.12	1.12	1.15	1.09	1.13
31-33	Manufacturing	1.11	1.03	1.01	1.02	1.03
42	Wholesale Trade	1.03	1.06	0.93	1.02	1.04
44-45	Retail Trade	1.05	1.03	1.08	1.05	1.03
48-49	Transportation and Warehousing	1.06	1.05	1.12	1.00	1.01
51	Information	1.02	1.02	1.27	1.01	1.04
52	Finance and Insurance	0.98	1.00	1.01	1.01	1.00
53	Real Estate, Rental & Leasing	1.14	1.09	1.06	1.05	1.03
54-56	Professional Services	1.14	1.01	1.05	1.04	1.04
61	Education Services	1.13	1.42	1.10	0.94	0.97
62	Health Care and Social Assistance	0.99	1.00	0.99	1.01	1.01
71	Arts, Entertainment and Recreation	1.56	1.13	1.38	1.07	1.19
72	Accommodation and Food Services	1.19	1.10	1.15	1.07	1.06
81	Other Services	1.02	1.05	1.28	1.05	1.04
Note: Factors equal to the average 2014-2018 June/July/August covered employment divided by January/February/March covered employment from ESD [9].						

K-12 school employment was reduced by 90 percent. Ten percent of school employment was added to the service employment industry to account for summer camps and other activities that are common at schools during the summer months.

Sources

- [1] Office of Financial Management, "Small Area Estimates Program," [Online]. Available: <http://www.ofm.wa.gov/pop/smallarea/>. [Accessed 10 3 2017].
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- [3] Thurston Regional Planning Council, "Population and Employment Forecasting," [Online]. Available: <http://www.trpc.org/236/Population-Employment-Forecasting>. [Accessed 10 3 2017].
- [4] Puget Sound Regional Council, "Land Use Baseline," [Online]. Available: <http://www.psrc.org/data/forecasts/GrowProject/LandUseBaseline/>. [Accessed 10 3 2017].
- [5] Lewis County, "Comprehensive Plan: Appendix A: Economic Profile," 2010. [Online]. Available: <http://lewiscountywa.gov/communitydevelopment/comprehensive-plan>. [Accessed 10 3 2017].
- [6] Thurston Regional Planning Council, "Annual Population Estimates," [Online]. Available: <http://www.trpc.org/221/Population-Housing-Estimates>. [Accessed 10 3 2014].
- [7] Office of Financial Management, "Small Area Demographic Estimates," [Online]. Available: <http://www.ofm.wa.gov/pop/asr/default.asp>. [Accessed 10 3 2017].
- [8] Bureau of Economic Analysis, "Regional Economic Accounts: Table CA25N: Total full-time and part-time employment by industry," [Online]. Available: <https://bea.gov/regional/>. [Accessed 10 3 2017].
- [9] Employment Securities Department, "Quarterly Census of Employment and Wages," [Online]. Available: <https://fortress.wa.gov/esd/employmentdata/reports-publications/industry-reports/quarterly-census-of-employment-and-wages>. [Accessed 10 3 2017].
- [10] U.S. Census Bureau: American Community Survey Table 25004 <https://data.census.gov/cedsci/table?g=0400000US53.140000&tid=ACSDT5Y2018.B25004>

Appendix A:

GTLC Land Use Summary

2017 LAND USE					
	Grays Harbor	Lewis	Mason	Pierce	Thurston
Residential					
Households	28,900	30,450	24,570	320,460	109,040
Dorm and Barrack Population	0	0	0	13,050	1,270
School Enrollment					
K-12	10,750	12,300	9,290	139,560	42,970
College & University (FTE)	2,140	2,660	300	35,400	10,120
Employment					
Construction, Natural Resources	3,250	5,090	2,290	21,370	11,190
Manufacturing, Wholesale Trade	4,150	5,910	2,160	40,640	11,060
Retail and Food Services	6,140	7,540	3,720	59,270	25,770
Other Services (FIRES)	10,720	11,870	7,300	125,660	61,270
Government & Higher Education	4,210	3,220	3,490	91,820	32,990
K-12 Government Employment	2,060	2,260	1,450	22,110	6,460

2045 LAND USE					
	Grays Harbor	Lewis	Mason	Pierce	Thurston
Residential					
Households	31,760	40,540	37,080	446,320	167,270
Dorm and Barrack Population	0	0	0	13,820	1,580
School Enrollment					
K-12	11,490	16,900	13,410	182,130	77,850
College & University (FTE)	2,140	2,660	300	39,800	10,700
Employment					
Construction, Natural Resources	3,370	5,760	2,880	26,490	12,300
Manufacturing, Wholesale Trade	5,170	7,710	2,940	51,050	14,400
Retail and Food Services	6,750	10,460	5,620	79,920	35,000
Other Services (FIRES)	11,860	16,460	11,020	214,230	101,600
Government & Higher Education	4,590	4,300	5,190	106,200	41,790
K-12 Government Employment	2,130	3,030	2,070	27,200	9,010

2017 SEASONAL LAND USE					
	Grays Harbor	Lewis	Mason	Pierce	Thurston
Residential					
Households	32,840	32,350	31,860	336,580	110,610
Dorm and Barrack Population	0	0	0	13,050	420
School Enrollment					
K-12	1,080	1,230	930	16,500	4,300
College & University (FTE)	2,140	2,660	300	35,400	6,170
Employment					
Construction, Natural Resources	3,350	5,350	2,370	21,790	11,290
Manufacturing, Wholesale Trade	4,360	6,080	2,180	40,740	11,080
Retail and Food Services	6,650	7,880	3,880	59,920	25,720
Other Services (FIRES)	11,180	12,230	7,520	128,150	61,730
Government & Higher Education	4,210	3,220	3,490	91,820	32,410
K-12 Government Employment	210	230	150	3,100	650

2045 SEASONAL LAND USE					
	Grays Harbor	Lewis	Mason	Pierce	Thurston
Residential					
Households	36,990	42,880	49,070	469,310	169,550
Dorm and Barrack Population	0	0	0	13,820	520
School Enrollment					
K-12	1,150	1,690	1,340	18,210	7,790
College & University (FTE)	2,140	2,660	300	39,800	6,550
Employment					
Construction, Natural Resources	3,450	6,020	2,960	26,880	12,430
Manufacturing, Wholesale Trade	5,410	7,850	2,950	51,120	14,410
Retail and Food Services	7,300	10,870	5,840	80,570	34,920
Other Services (FIRES)	12,570	17,280	11,550	221,070	103,450
Government & Higher Education	4,590	4,300	5,190	106,200	41,060
K-12 Government Employment	210	300	210	2,720	900

Appendix B:

Databases and Worksheets

Q:\Transportation\GTRM\Land Use\Land_Use_GTRM.accdb

Database used to estimate 201 baseline and 204 forecast land use for Greater Thurston-Lewis County Travel Demand Model.

Q:\Transportation\GTRM\Land Use\Worksheets\2045 Employment.xlsx

Worksheet used to calculate countywide residential and employment estimates for Grays Harbor and Mason Counties, and UGA estimates for Lewis County.

Q:\Transportation\GTRM\Land Use\Worksheets\HH X-Classes.xlsx

Worksheet used to estimate number of households in each household type (household size, number of workers, number of vehicles categories) using U.S. Census Bureau's American Community Survey data.

Q:\Transportation\GTRM\Land Use\Worksheets\School Employment.xlsx

Worksheet used to allocate school-district level employment estimates to school sites.

Q:\Transportation\GTRM\Land Use\Worksheets\Seasonal Covered Employment Factors.xlsx

Worksheet with monthly QCEW employment data used to estimate seasonal employment inflation factors.

Q:\Transportation\GTRM\Land Use\Worksheets\Seasonal HH Factors.xlsx

Worksheet with vacancy rates and seasonal occupancy rates used to develop seasonal household inflation factors

Q:\Employment\Employment18\Worksheets\BEA Employment Totals 2017.xlsx

Worksheet with 201 Bureau of Economic Analysis employment estimates for Grays Harbor, Lewis, and Mason Counties.