SMALL AREA POPULATION ESTIMATES METHODOLOGY

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METROPOLITAN COUNCIL

Small Area Population Estimates Methodology

The Metropolitan Council prepares household and population estimates for small areas (such as census tracts and Transportation Analysis Zones) in the Twin Cities seven-county area. We do this to inform our planning efforts, publicize the region's main demographic trends, and assist local governments in analyzing their communities.

Since the 1970s, the Metropolitan Council has used a housing-stock-based model to estimate households and population for cities and townships.[1] We use this method as well for small areas.

In reduced form, the Council's model determines housing units, households and population as follows:

Housing Units $_{2019}$ = Housing Units $_{2010}$ + Σ(Housing Changes $_{Since2010}$)

Households $_{2019}$ = Housing Units $_{2019}$ X Occupancy Rates

Total Population $_{2019}$ = (Households $_{2019}$ X Persons Per Household) + Group Quarters Pop$_{2019}$

We carry out these calculations for census blocks, raking to the city and township estimates that local governments have reviewed to ensure that all our estimates are consistent. These block-level estimates are only an intermediate step; their primary purpose is to create estimates for higher levels of geography, like census tracts. As such, we do not publish them.

Some cities—in particular more populous ones—may have more detailed data on their residents, and in smaller communities it would be possible to conduct a detailed census of all housing units to determine the number of residents in each small area. Nevertheless, our estimates are just that—estimates. We take our best guess at the counts in small areas by combining multiple data sources and use a single method to maximize comparability of estimates across different areas.

Estimation of housing units

We first estimate housing unit counts for each census block. Our model starts with base year (2010) housing units, drawn from the 2010 Census. We then add (or subtract) the following changes to housing stock:

- Housing units permitted in our annual survey of residential construction
- Other changes to housing found in our survey of residential construction (conversions from non-residential to residential uses and the addition of more units to multifamily stock)[2]
- Changes in the number of manufactured homes recorded by our annual survey of manufactured home parks[3]

For consistency with our city/township estimates, our model assumes that not all housing units permitted will be built in the year permitted. In crediting the most recent year of permitting and construction, the Council assumes:

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[1] The methodology is available online at: *https://metrocouncil.org/Data-and-Maps/Publications-And-Resources/Files-and-reports/Population-Estimates-Methodology.aspx*

[2] Other kinds of changes, such as demolitions, cannot be geocoded to census blocks for all years.

[3] Manufactured home parks typically span multiple census blocks; the total unit counts in each year are apportioned to census blocks using aerial imagery and (where possible) parcel data.

- 95% same-year completion for single-family detached; 5% later completion
- 90% same-year completion for townhomes, duplexes, 3- and 4-unit buildings; 10% later completion

See our city/township estimates methodology for more information about how these multipliers were developed. Assumptions differ for multifamily permits, which often take longer to build than other developments. These are counted only if they received a certificate of occupancy by April 1, 2019.

Adding the above changes to the 2010 housing unit count yields the unraked housing unit estimate. We then rake these block-level estimates to cities and townships.[4]

Estimation of households

Following the completion of housing unit estimation, we estimate households by applying occupancy rates to housing units. The number of households is equivalent to occupied, non-institutional housing units.

The primary source of data on occupancy rates is the 2010 Census, aged with U.S. Postal Service (USPS) data. These are census tract-level summarizations of residential addresses (total and vacant) made available by the U.S. Department of Housing and Urban Development.[5] Testing revealed that the occupancy rates in the USPS data are not consistent with the 2010 Census occupancy rates. Accordingly, we measure the *trend* in the USPS tract-level occupancy rates and apply that trend to each block's occupancy rate in the 2010 Census:[6]

$$\textbf{OccRate}_{\textbf{2019}} = \text{OccRate}_{\text{Census2010}} + (\text{OccRate}_{\text{USPS 2019}} - \text{OccRate}_{\text{USPS 2010}})$$

Blocks in tracts where USPS data show an **increase** in the occupancy rate will have an estimated occupancy rate that is **higher** than the 2010 Census rate. Blocks in tracts where USPS data show a **decrease** in the occupancy rate will have an estimated occupancy rate that is **lower** than the 2010 Census rate.

Multiplying the raked housing unit estimate in each block by the estimated occupancy rate yields the unraked household estimate. We then rake these block-level estimates to cities and townships, ensuring that no block has more households than housing units.

Population in group quarters

Metropolitan Council Research enumerates known group quarters in order to account for persons living in institutional or non-household settings. The list is refreshed annually to include licensed group homes known to the Minnesota Department of Human Services (DHS). Small group homes (less than 10 beds)

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[4] Some blocks have been annexed into different communities since 2010; we account for this in our raking.

[5] See https://www.huduser.gov/portal/datasets/usps.html .

[6] To avoid estimated occupancy rates that exceed 100%, we convert the rates to log-odds first before implementing this formula. A one-unit change in the *log-odds* of occupancy results in the same multiplicative change in the *odds* of occupancy across the continuum of occupancy rates. This makes the log-odds ideal for applying the trend from one set of occupancy rates to another occupancy rate at a different point on the continuum.

are assumed to be occupied at the capacity identified by DHS. Other types of group quarters, as well as medium and larger group homes (at least 10 beds) are surveyed annually.[7]

Facilities are geocoded to census blocks where possible, allowing for the most precise placement of group quarters residents.

Estimation of population in households

The final step in the Council's model is calculating the population in households by applying the estimated average household size to the raked household estimate.

To estimate average household sizes, we primarily use the 2010 Census average household size, adjusting it for any new development. Essentially, this calculation is a weighted average based on the current housing stock mix, assuming:

- The 2010 Census number of persons per household for all occupied units existing in 2010;
- The 2010 Census number of persons per household for all newly added manufactured homes; and
- The typical number of persons per household for newly developed, occupied units of the following types:[8]
    - Single-family detached units in the block's Public Use Microdata Area (PUMA);
    - Townhome units in the block's Public Use Microdata Area (PUMA);
    - Duplex/triplex/quadplex units in the region; and
    - Multifamily units in the block's Public Use Microdata Area (PUMA).[9]

This provides an estimated average household size that is tailored to the block's current housing stock mix. In the following example, the addition of new multifamily units, which tend to house fewer people than other units, brings the estimated average household size below the 2010 level:

	(A) Number of occupied units	(B) Average household size	(C) Population in households (A × B)
Units existing in 2010	500	2.50	1,250
Change in manufactured homes	30	2.50	75
New single-family detached units	100	3.00	300
New townhome units	50	3.00	150
New duplex/triplex/quadplex units	20	2.00	40
New multifamily units	300	1.75	525
Total	**1,000**		**2,340**
Estimated average household size (total (C) ÷ total (D))		**2.34**	

[7] If a survey for a facility is not returned and field follow-up does not result in participation, Council Research carries over the group quarters population from the previous annual survey.

[8] To calculate occupied units, we apply the 2010 Census occupancy rate to housing unit estimates.

[9] These average household sizes come from the 2014-2018 American Community Survey five-year Public Use Microdata Sample (PUMS). To maximize reliability, we treat all units built in or after 2000 as "newly developed." In some areas around the University of Minnesota campus, newly developed multifamily units are primarily 2-, 3-, or 4-bedroom student apartments. For these areas, we assume 2.25 persons per household for each new multifamily unit. For the unorganized territory of Fort Snelling, where much of the new multifamily construction is for unsheltered veterans, we assume 1.1 persons per household.

If a block has experienced no new housing development, the calculation reduces to the 2010 Census average household size.

Multiplying the raked household estimate by the estimated average household size yields the unraked estimate of population in households.[10]

Total population

To arrive at the unraked total population estimate, we add the unraked population in households and the unraked population in group quarters. We then rake these total population estimates to the official city/township population estimates.

Ideally, the unraked estimates of population in households and population in group quarters would sum *within* blocks to the raked total population estimate, as well as *across* blocks to the official city/township estimates of household population and group quarters populations. While satisfying both conditions is impossible, we employ iterative proportional fitting to minimize discrepancies. This involves raking to the total block population, then to the total city/township household population and group quarters population estimates—repeating multiple times until the change in the block-level household population and group quarters population estimates is negligible.

We incorporate a final clean-up step to prioritize consistency within census blocks. This ensures that the household population and group quarters population estimates sum to the total population in each block, and that the estimated population in households never falls below the estimated number of households. While these final estimates for population in households and population in group quarters may not precisely add up "vertically" to control totals for cities and townships, we want to ensure that they precisely add up "horizontally" to the total population.

Rolling up to higher levels of geography

The block-level estimates are fractional; we do not round them. This is to emphasize that they are only an intermediate step towards estimates for higher levels of geography, and to avoid the compounding of rounding error as blocks are aggregated into those higher geographic levels.

Our general procedure for creating estimates for higher levels of geography is to assign each block to one and only one higher-order geography, then add up the unrounded housing unit, household, and/or population estimates for each block. We then round the totals.

These rounded totals themselves may not add up precisely to higher levels; for example, *rounded* tract-level estimates may not add up precisely to a given city or township estimate, even though the constituent block *unrounded* estimates do. In some cases, it is necessary to adjust the resulting housing unit, household, and/or population estimates so that they are consistent with other estimates.

Transportation Analysis Zones (TAZs) require another step because they extend to all counties surrounding the "core" seven-county Twin Cities region. To assist transportation planners, we also develop small area estimates for TAZs in those surrounding counties.[11]

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[10] Although the actual population in households appears to have been calculated already via the estimation of average household size, keep in mind that this estimation was not based on the raked estimate of households.

[11] These are: Chisago, Goodhue, Isanti, McLeod, Rice, Sherburne, Sibley and Wright Counties in Minnesota and Pierce, Polk, and St. Croix Counties in Wisconsin.

We develop estimates for these “collar” TAZs directly, rather than developing estimates at the block level first. The same general method and formulas apply, but some data inputs differ:

- Data on permitted housing units comes from the U.S. Department of Commerce for cities and townships, apportioned to TAZs using the 2010 Census share of the city/township’s housing units located in the TAZ.
- We lack data on other changes in the housing stock for these communities.
- City/township totals for raking come from the Minnesota State Demographic Center and Wisconsin’s Demographic Services Center.
    - Housing unit totals are not available for Minnesota cities and townships outside the seven-county Twin Cities region
    - Only population totals are available for Wisconsin cities and townships.

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