



# Certified and Standard Estimates of Total Population of Municipalities in North Carolina as of July 1, 2020

*Technical Document*

September 29, 2021

Demographic and Economic Analysis Section  
NC Office of State Budget & Management  
116 West Jones Street  
Raleigh, NC 27603  
[www.osbm.nc.gov](http://www.osbm.nc.gov)

---

## Methods Used to Produce the Certified Estimates of the Total Population of North Carolina Municipalities for July 1, 2020

### Introduction

This document provides an overview of the methods the Office of State Budget and Management (OSBM) used to produce the standard and certified population estimates for the 551 municipalities of North Carolina.<sup>1</sup> OSBM published these estimates in September 2021. These population estimates replace those produced by this office in September 2020. These population estimates were based, in part, on the [July 1, 2020 population estimates for North Carolina and North Carolina counties](#).

Both the certified and standard estimates report the July 1, 2020 estimated population. The difference between the two is the reference data for municipal boundaries. The standard population estimates assume that the municipal boundaries were those in place as of that same date for the estimates: July 1, 2020. The certified population estimates incorporate reported boundary changes to municipalities through July 1, 2021. So, the certified estimates include (or remove) population living within areas annexed (or de-annexed) by a municipality between July 1, 2020, and July 1, 2021. The certified population estimates are used in statutory-defined funding formulas, while the standard population estimates may be used in planning. Except for the differences in municipal boundaries that may result in differences in the reported estimated population, in all other ways the standard and certified population estimates are the same. The following sections describe the methods used to derive these population estimates.

### Methods

The July 1, 2020, population estimates represent three months of population change since the April 1, 2020, Census counts. This is only a quarter of a year of population change and was also a period with limited migration at the beginning of the COVID-19 pandemic. ***The 2020 Census results for municipalities, which the US Census Bureau first reported on August 12, 2021, form the foundations of the OSBM 2020 population estimates.*** First, OSBM removed the group quarters populations for each municipality and unincorporated area from the total population.<sup>2</sup> Then, the office estimated the household population for July 1, 2020, ***using Method I*** as outlined in the next section. OSBM then added back the group quarters population to the household population to derive the initial estimates of the total population. OSBM controlled the initial population estimates for each municipality to the July 1, 2020, population estimate for the county or counties for which a municipality was located.<sup>3</sup>

Between 2010 and 2019, and again beginning with the population estimates that OSBM will produce next year, this office used three different methods to derive three separate population estimates for each municipality. This technical document outlines the three different methods below. Over the course

---

<sup>1</sup> Since 2010, Centerville and Spencer Mountain officially dissolved and are no longer incorporated municipalities.

<sup>2</sup> In most cases, the 2020 Census counts for Group Quarters populations were assumed to be the same as the population for July 1, 2020. The State Demographer collects group quarters population counts from state agencies, military installations, and local communities on an annual basis.

<sup>3</sup> See the *Certified Estimates of the Total Populations of Counties in North Carolina Counties for July 1, 2020 and Intercensal Estimates of the Total Population of Counties in North Carolina for July 1, 2010 through July 1, 2019*.

---

of the next year, OSBM will evaluate these models and the model weights it uses for each municipality in comparison to the 2020 Census results and adjust them for subsequent municipal population estimates.

#### Method I. Constant Share

This method assumes that the household population of a municipality changes at the same rate as the household population of the county in which it is located. The method assumes the population of each individual area annexed from January 2, 2020, through July 1, 2020 (or July 1, 2021 for the certified estimates) changes from its effective annexation date to July 1, 2020 at this same rate. ***This was the only method used for the July 1, 2020, population estimates.***<sup>4</sup>

#### Method II. Partitioned Change

Each municipality is divided into up to three geographical areas: the core city (areas enclosed by the corporate limits as defined two censuses ago), the inner edge (all areas annexed between the previous census and the last census), and the outer edge (areas annexed after the last census). This method assumes that areas more recently incorporated into the city limits of a municipality may change at different rates from that of the core city.

This method assumes that the household population within the core city changes from the previous census at a rate that is a function of its previous decade rate of change for the municipality.

Method II assumes the area in the inner edge changes at a rate that is a function of the rate of change for the core city, the rate of change of the less urban part of the county (the household population of the county minus all of the population living within its core cities), the population density of the area in the inner edge, the population density of the core city, and the population density of the less urban part of the county.

This method assumes the household population in the areas in the outer edge changes from its effective annexation date to the population estimates date at a rate that is a function of the rate of change for the municipality as it existed in the last census (the core city plus the area in the inner edge), the rate of change of the less urban part of the county, the population density of the area in the outer edge, the population density of the municipality at the last census, and the population density of the less urban part of the county.

#### Method III. Changes in Housing Unit Shares

This method assumes that the municipal share of the county household population within the municipal boundaries used for the last census changes from the last census to the estimate date at the same rate as the municipal share of the total number of county housing units. Housing unit growth is based upon housing unit counts for the last census and the housing unit estimates through the estimate year from the Population Estimates Program of the U. S. Census Bureau,<sup>5</sup> with adjustments made by this office to account for housing units in areas annexed since the last census, and from data submitted directly from

---

<sup>4</sup> With an exception for municipalities located in Wake County where a shift in the share of 2010 to 2020 municipal to county population growth was assumed.

<sup>5</sup> See <https://www.census.gov/programs-surveys/popest.html>.

municipalities and counties via the North Carolina Demographic Information Survey.<sup>6</sup> The Census Bureau housing unit estimates are partially based upon building permit data the Census Bureau obtains through their building permit surveys of permit issuing local governments of North Carolina that are conducted on a monthly or yearly basis. The population of each individual area annexed from the last census through the estimate date is assumed to change from its effective annexation date at the rate computed for Method II.

OSBM then averages these three estimates using locality specific weights. The office determines these weights by comparing population estimates for a census year prepared using these techniques to the actual census count. From this review, each municipality falls into one of three weighting systems based upon how well the models estimated the actual census count: equal weights where all three methods predicted equally well for a municipality, weights of 50%/25%/25% when one method predicted particularly well for a municipality, and 40%/40%/20% when two methods predicted about equally well for a municipality. Literature has shown that the use of a weighted averaging of population estimates, as done by this office, is a robust method for accounting for estimation error (Bryan 2004; Murdock et al. 2006; Murdock and Ellis 1992; Siegel 2002:428–30).

### Comparisons to the U.S. Census Bureau Estimates

OSBM's population estimates differ from the incorporated place estimates [the U.S. Census Bureau published in May 2021](#)<sup>7</sup>. The Census Bureau's estimates are intended for evaluation purposes only and use the April 1, 2010, Census counts as a starting base. ***In contrast, OSBM utilized the recently reported April 1, 2020 Census counts as a starting based for the July 1, 2020 population estimates.***

In a non-census year, these population estimates would also differ due to methodological differences. The U.S. Census Bureau utilizes a component technique with administrative records to estimate county populations and a housing unit method to distribute county populations to the local level. This office uses an average of two methods to estimate county populations (see [the Certified Estimates of the Total Population of Counties in North Carolina Technical Documentation](#) for more information about the methods used) and a weighted average of three methods (as described in this document) to estimate the population for municipalities. In addition to using different techniques to estimate the population, this office's population estimates incorporate more recent data for the group quarters population. Finally, the Census Bureau's population estimates include reported changes to municipal boundaries through January 1, 2020, whereas these population estimates incorporate reported boundary changes through July 1, 2020 (for the standard population estimates) and through July 1, 2021 (for the certified population estimates).

---

<sup>6</sup> Each year the Office of State Budget and Management conducts the North Carolina Demographic Information Survey (<http://ncds.osbm.nc.gov>). This is a survey of local governments that includes three component parts: (1) a Group Quarters Population Survey; (2) a New Residential Construction and Mobile Home Survey; and (3) a Municipal Boundary and Annexation Survey.

<sup>7</sup> See <https://www.census.gov/programs-surveys/popest.html>

## Citations

- Bryan, Thomas. 2004. "Population Estimates." Pp. 523–60 in *The Methods and Materials of Demography*, edited by J. S. Siegel and D. A. Swanson. Amsterdam: Elsevier.
- Murdock, Steve H. and David R. Ellis. 1992. *Applied Demography: An Introduction to Basic Concepts, Methods, and Data*. Boulder, CO: Westview Press.
- Murdock, Steve H., Chris Kelley, Jeffrey Jordan, Beverly Pecotte, and Alvin Luedke. 2006. *Demographics: A Guide to Methods and Data Sources for Media, Business, and Government*. Boulder, CO: Paradigm Publishers.
- Siegel, Jacob S. 2002. *Applied Demography: Applications to Business, Government, Law, and Public Policy*. San Diego, CA: Academic Press.
- Smith, Stanley K., Jeff Tayman, and David A. Swanson. 2002. *State and Local Population Projections : Methodology and Analysis*. New York: Kluwer Academic/Plenum Publishers.
- Swanson, David A. and Jeff Tayman. 2012. *Subnational Population Estimates*. Springer Science+Business Media.