

A CENTURY OF DELINEATING A CHANGING LANDSCAPE: THE CENSUS BUREAU'S URBAN AND RURAL CLASSIFICATION, 1910 TO 2010¹

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Introduction

The Census Bureau has officially defined urban territory, population, and housing since the 1910 Census. From the inception of the classification, the Census Bureau has attempted to identify the extent of the urban landscape; the residual then constituted the rural landscape. Over the course of a century defining urban, the Census Bureau has introduced conceptual and methodological changes to ensure that the urban-rural classification keeps pace with changes in settlement patterns and with changes in theoretical approaches to interpreting and understanding the growth of urban areas.

The Census Bureau's urban-rural classification provides an important baseline set of urban and rural areas for tabulation and presentation of statistical data. These areas are used to analyze changes in the distribution and characteristics of urban and rural populations. The Census Bureau's urban areas also form the cores of metropolitan and micropolitan statistical areas, as defined by the Office of Management and Budget. In addition, the Census Bureau's urban and rural area definitions provide the basis for other agencies' and organizations' urban-rural classifications. The Census Bureau defines urban and rural areas for statistical purposes only; nevertheless, various federal programs use these areas to determine eligibility for participation as well as funding levels.

In the 100 years of classification, the urban population has increased from 45 percent of the nation's total in 1910 to nearly 81 percent in 2010. During this period, the structure of the urban landscape also has changed, from a close relationship to the boundaries of cities and towns, to increased growth of unincorporated suburbs adjacent to larger cities, to diffusion of urban- and suburban-style development across the landscape, particularly within metropolitan areas. Periodic review of the urban-rural classification and criteria ensures its continued usefulness and relevance for statistical data tabulation and analysis, and ensures that the delineation process utilizes the best possible data, procedures, and methodologies.

¹ This paper reports the results of work undertaken by Census Bureau staff. This paper is released to inform interested parties and to encourage discussion.

Background and History²

Throughout its history, the Census Bureau's definition of urban has been based primarily on decennial census counts of residential population. Starting with the introduction of urbanized areas with the 1950 Census, measures of density also have been used: housing unit density in 1950, and from 1960 on, residential population density. Prior to the 1950 Census, settlement patterns and densities were taken into consideration within the urban area definition, but were not measured directly. Special rules for the identification of minor civil divisions (towns and townships) in selected states were adopted to account for the existence of densely settled populations, similar to the settlement patterns found within incorporated places. Although the definition process has relied upon residential population collected via the decennial census, the intent has been to define areas that also included non-residential urban land uses, thus representing the urban landscape.

The Census Bureau first identified and presented data for the urban population following the 1870 Census, in conjunction with publication of the *Statistical Atlas of 1874*, using a minimum population threshold of 8,000 to distinguish urban cities and towns from rural territory. The 8,000-person threshold remained in use through the 1900 Census; however, this threshold was considered too high, leading the Census Bureau to also adopt a 4,000-person threshold to identify urban cities and towns starting with the 1880 Census. This dual approach to identifying urban cities and towns persisted in Census Bureau publications through the 1900 Census. Further refinements to the urban-rural classification were made for the 1900 Census, with incorporated cities of less than 4,000 people classified as semi-urban and population outside incorporated places classified as rural. The 2,500-person threshold with which we are familiar first appeared in supplementary analysis published in 1906.³ The 2,500 person threshold was carried forward to the 1910 Census, and from 1910 through the 1940 Census, the Census Bureau officially defined urban as any population, housing, and territory located within incorporated places of 2,500 or more population (with special rules for towns and townships in the Northeast). The population- and place-based approach to defining urban in effect through the 1940 Census was relatively straightforward to implement, with no need to calculate population density, account for actual settlement patterns on the ground, or consider densely settled populations existing outside incorporated municipalities. For much of the first half of the 20th century, that definition was adequate for defining urban and rural in the United States, but by no means fully accurate.

Increasing suburbanization, particularly outside the boundaries of large incorporated municipalities, led to the adoption of the urbanized area concept for the 1950 Census. In adopting this concept, Census Bureau geographers and demographers formally recognized that densely settled communities existed outside the boundaries of large

² For a detailed discussion of the development of the Census Bureau's urban-rural classification from 1874 through the 1940 Census, see Leon Truesdell's "The Development of the Urban-Rural Classification in the United States: 1874 to 1949," published in Current Population Reports, Population Characteristics, Series P-23, Number 1.

³ Twelfth Census of the United States—1900, Supplementary Analysis. Available at <http://www2.census.gov/prod2/decennial/documents/00186079ch01.pdf>, (see specifically page 19).

incorporated municipalities, and were just as urban as densely settled population inside incorporated place boundaries. Given the nature of available technology for calculating and mapping density (planimeters and paper maps), delineation of urbanized areas was limited to cities of 50,000 or more population and their surrounding territory. The geographic units used to analyze settlement patterns were enumeration districts, but to facilitate and ease the delineation process, Census Bureau geographers analyzed each place as a single unit. If the overall density of the place was 1,000 persons per square mile (ppsm) or greater, and it was adjacent to other qualifying territory, the place was included in its entirety in the urbanized area. Urban outside urbanized areas continued to be defined as any place with a population of at least 2,500. Unincorporated places, later referred to as census designated places, were now included along with incorporated places.

Starting with the 1960 Census and continuing through the 1990 Census, the Census Bureau made a number of enhancements to the methodology and criteria for defining urbanized areas. The basic definition of urban, though, remained in place: urbanized areas of 50,000 or more population defined based on population density (with some exceptions); and urban places of 2,500 or more population located outside urbanized areas. Enhancements included:

- 1) Relaxation, and eventual elimination, of minimum population criteria for places that formed the “starting point” for delineation of an urbanized area. Initial criteria required a single city of 50,000 or more population. This was changed to allow twin central cities with an aggregate population of 50,000 to provide the basis for defining an urbanized area, recognizing that the two cities together might provide the same functions as a single city of the same size. The elimination of minimum population criteria for a place forming the starting point for delineation fully recognized the increasingly polycentric nature of urban landscapes.
- 2) Identification of incorporated places containing substantial amounts of very low-density territory (less than 100 ppsm), which were divided into urban and rural components. This extended city concept recognized the disjuncture between the geographic extent of cities that had annexed vast amounts of low-density territory (overbounding) and the extent of urbanization, but limited application of this concept to cities that were substantially overbounded. The concept was not applied to unincorporated census designated places.
- 3) For the 1990 Census, interactive analysis of population density patterns at the census block-level, or by groups of blocks (known as analysis units, and not to be confused with block groups) using Census Bureau-developed delineation software. This allowed greater flexibility when analyzing and defining urbanized areas, as opposed to using enumeration districts and other measurement units defined prior to data tabulation.
- 4) Qualification of places for inclusion (or exclusion) in an urbanized area based on the existence of a densely populated core containing at least 50 percent of the place’s population. From 1950 through the 1980 Census, places qualified for inclusion in an urbanized area based on overall population density. The ability to display and assess population densities at the census block-level for the 1990

Census provided the opportunity to identify the settlement core of a place and evaluate its location relative to other qualifying territory within an urbanized area.

Census 2000: Conceptual and Methodological Changes

The development of digital spatial data such as the TIGER⁴ database, and increased use of geographic information system (GIS) software that facilitated the interactive block-level delineation for the 1990 Census also made possible further changes for Census 2000 to enhance and improve the identification and delineation of urban areas. As a result, changes to the urban-rural classification for Census 2000 were the most substantial since the introduction of the urbanized area concept for the 1950 Census.⁵ According to Census 2000, 79 percent of the U.S. population resided in urban areas. This represented an increase of four percentage points from the 1990 Census level of 75 percent, and suggested a substantial increase in the population of urban areas in the United States. The conceptual and criteria changes adopted for Census 2000 explain some of this increase. When the Census 2000 criteria were applied with 1990 Census data, 78 percent of the population in 1990 was classified as urban and the percentage point increase from 1990 to 2000 is reduced to one.

Changes adopted for Census 2000 not only affected the basic concept, introducing the urban cluster as a replacement for urban places outside urbanized areas, but also building blocks for analysis, the criteria for delineating individual areas, and rules governing the merger or continued separation of contiguous urbanized areas. The impact of these changes differed from region-to-region, state-to-state, and even between individual urban areas. Changes included:

- Defining urban clusters of at least 2,500 and less than 50,000 people using the same residential population density-based criteria as applied to urbanized areas. Because of this change, the Census Bureau no longer identified urban places located outside urbanized areas.
- A decreased role for incorporated place and census designated place boundaries when defining urbanized areas and urban clusters.
- Use of census blocks and block groups as the building blocks for urban areas. This changed the scale of analysis from previous decades' use of enumeration areas and analysis units.
- The minimum density threshold for inclusion in an urban area was lowered from 1,000 ppsm to 500 ppsm.
- Increase in the maximum "jump" distance for including non-contiguous densely settled qualifying territory from 1.5 miles to 2.5 miles, and introduction of the "hop" concept to link across short spaces (up to one-half mile) of low-density territory to qualify non-contiguous densely settled blocks.

⁴ Topologically Integrated Geographic Encoding and Referencing. The TIGER database was the first national digital geographic database in the United States, developed by the Census Bureau to support the 1990 Census.

⁵ The metropolitan statistical area concept and standards received a similarly comprehensive review, also resulting in the most substantive changes since 1950.

- Rules for splitting large urban agglomerations to form smaller urbanized areas were adopted, replacing previous decades' criteria for merging urbanized areas.

Because changes to the urban-rural classification and delineation criteria for Census 2000 were the most substantial since 1950, I discuss each of these in additional detail.

Urban Clusters and Elimination of Dependence on Place Boundaries

The ability to see census block-level density patterns as part of the 1990 urbanized area delineation process highlighted the existence of densely settled unincorporated communities adjacent to urban places outside urbanized areas. This precipitated the review of the urban classification after the 1990 Census leading to adoption of the urban cluster concept for Census 2000. Ability to view density patterns also highlighted the impact of place-based decision-making with regard to cities that tended to annex large amounts of low-density territory, raising concern about the inclusion of otherwise rural territory within urbanized areas and urban places outside urbanized areas. In general, the adoption of the urban cluster concept and the decision to ignore place boundaries had a greater effect on urban and rural population totals than other changes adopted for Census 2000. The impacts of these changes largely related to historical patterns of development and patterns of annexation and incorporation. States in which incorporated places tended to annex larger amounts of sparsely settled territory saw little change in urban population from 1990 to 2000, and in certain urbanized areas, populations decreased. For example, changes in criteria contributed in large part to changes to the delineation of the Montgomery, Alabama urbanized area, resulting in a decline in its population from 210,007 in 1990 to 196,892 in 2000. In states in which annexation activity tended to lag behind population growth and development, urban areas increased substantially due to adoption of the urban cluster concept. For example, in Pennsylvania, the urban population grew from 8,188,295 in 1990 to 9,464,101 in 2000. Much of this increase, however, is attributable to changes in the urban concept and criteria, evidenced by an urban population of 9.1 million for Pennsylvania when Census 2000 criteria were applied to 1990 Census data.⁶

Automated Delineation, Change in Building Blocks, and Lowered Density Thresholds

Given the lack of resources to interactively review and delineate potentially thousands of areas, adoption of a density-based approach for defining urban at all levels required a change in methodology, with automation of the delineation process providing the solution. Development of automated software that replicated the work of geographers and resulted in definitions that were reasonably consistent with previous decades' definitions was a complicated and complex task. Automation, however, offered the advantage of consistency and the ability to produce objective results within the allotted delineation and

⁶ For a more detailed and complete review of the effect of changing concepts and criteria on urban areas and urban population "The Effect of Changing Concepts and Criteria on the Identification of Urban Areas and Urban Population, 1990 to 2000," prepared for and presented at the Western Regional Science Association annual meeting, Santa Fe, New Mexico, February 2006. Available at http://cttp.transportation.org/Documents/Change_in_Urban_Areas1990_to_2000.pdf (accessed 12/1/2016).

data tabulation and dissemination schedule after the 2010 Census. Compared to previous decades in which individual geographers interpreted and applied delineation criteria when analyzing and defining urbanized areas in the portions of the country assigned to them, sometimes with different results, the automated delineation software applied criteria evenly and consistently throughout the United States, Puerto Rico, and the Island Areas.

Hops and Jumps

“Hops” and “jumps” are aspects of the urban area criteria that draw considerable comment, but whose purpose tends not to be understood. Urban development is not always a continuous and contiguous process across the landscape. The presence of small parcels of undeveloped land or rural uses may be insignificant when viewing the urban landscape at larger scales. The urbanized area delineation methodology for each decade starting with 1950 provided for the inclusion of densely settled territory separated from the main body of the urbanized area by intervening low-density territory, whether non-residential urban land uses, undeveloped land, or small amounts of rural uses. These “jumps” provided a process for recognizing and accounting for the presence of these types of land uses in the absence of land use/land cover data. The maximum jump distance of 1.5 miles, with only one jump allowed along a road corridor, was formalized in criteria for the 1990 Census. While criteria specified the maximum distance for a jump, there was no specified minimum distance and individual geographers interpreted small gaps in settlement differently. One geographer might interpret alternating patterns of low-density and high-density blocks as a logical outgrowth of the planning and zoning process and group blocks to form a larger analysis unit that met minimum density thresholds. Another geographer, however, might define a jump across the first low-density block or cluster of blocks to reach the first set of non-contiguous high-density blocks and then leave the remaining high-density blocks out of the urbanized area. Review of the criteria and delineation methodology after the 1990 Census delineation led to the decision to adopt the concept of “hops” of up to a half mile, with an unlimited number of hops allowed. This effectively set the minimum distance for a jump at a half mile. At the same time, the jump distance for the Census 2000 criteria increased to 2.5 miles, recognizing the prospect for larger clusters of non-residential urban uses and increased diffusion of urban and suburban development into the rural landscape.

Splitting Large Agglomerations

Urbanized area delineation from the 1960 through 1990 censuses largely started from the boundary of the previous decade’s delineation. As such, urbanized areas grew outward from decade to decade with the resulting need to determine when and under what conditions to merge urbanized areas. Criteria included whether the two adjoining urbanized areas were in the same metropolitan statistical area or primary metropolitan statistical area (to use terminology in effect in 1990) as well as the length of the line of contiguity (one mile or greater) and the presence of qualifying population densities on both sides of the line of contiguity.

Adoption of an automated approach to delineation resulted in a “clean slate” approach in which blocks and block groups that met density and other criteria were agglomerated until there were no additional qualifying blocks. The process then moved on to the next agglomeration, repeating until all blocks had been accounted for. The result was a number of large urban agglomerations that encompassed multiple areas that had been separate urbanized areas in the previous decade. Criteria were thus needed to determine how and where to split these large agglomerations to form more recognizable and manageable urbanized areas. This was of critical importance since urbanized areas formed the basis for metropolitan statistical areas. The criteria adopted for Census 2000 used metropolitan area boundaries as a guide for identifying the narrowest area along a high-density corridor, with agglomerations split if the corridor narrowed to less than three miles in width. The primary issues with this approach were 1) the metropolitan areas in existence at the time of urban area delineation were those defined based on the 1990 Census and 2) the approach did not take into account place boundaries (for example, the city of Palo Alto, California, was split between the San Francisco and San Jose urbanized areas).

2010 Census: Completing the Process of Change

Despite the substantive changes introduced for Census 2000, several issues remained unresolved or became apparent from the 2000 round of delineations and set the agenda for review of urban area criteria for the 2010 Census:

- The Census Bureau still lacked a nationally consistent method for identifying and accounting for non-residential urban land uses based on application of land use-specific data, rather than application of surrogate criteria and methods.
- Simple application of population density measures at the block-level and the minimum threshold of 2,500 had resulted in identification of a number of urban clusters consisting entirely or mostly of population residing within institutional facilities.
- The rules for determining when and where to split large agglomerations or merge urbanized areas considered settlement patterns, but still were tied to the previous decade’s county-based metropolitan area definitions, with splits occurring along the narrowest corridor nearest to a metropolitan statistical area boundary.
- Residential densities in rural areas of Puerto Rico and the Island Areas were substantially higher than in the United States, suggesting that a different density threshold should be used to define the extent of urban areas in those locations.

Use of Impervious Surface Data to Identify Non-residential Urban Land Use

The years between the 2000 and 2010 censuses saw increased production and availability of national land use/land cover datasets. These presented the opportunity to use this kind of information to help delineate the urban landscape. After conducting a review of available datasets and content, the Census Bureau decided to use the impervious surface layer from the National Land Cover Dataset (NLCD) as a surrogate measure for non-residential urban land uses. The NLCD utilizes Landsat imagery to classify 30-meter pixels according to their predominant land use or land cover. Impervious surface pixels

were aggregated by census block to provide a measure of the amount of pavement and other hard surfaces typically found in urban landscapes, but not rural areas. This provided a satisfactory measure of non-residential urban land uses, providing for a more complete delineation, particularly in locations in which residential density-based criteria were insufficient.

Requirement for Minimum Population Residing Outside Institutional Group Quarters

The Census 2000 urban area delineation criteria made no distinction between institutional and non-institutional population when applying the minimum threshold of 2,500 people. Research prior to Census 2000 indicated the potential for defining “prison urban clusters” and subsequent discussions regarding final criteria included whether the concept of an urban area implies the ability for residents to move freely within and through the urban landscape. The issue was raised again for the 2010 Census, resulting in the requirement that, in addition to the 2,500 person minimum population, at least 1,500 people must reside outside institutional group quarters.

Splitting Large Agglomerations

The Census Bureau conducted research to attempt to find a more suitable method for splitting large agglomerations based on either functional relationships (commuting patterns) or settlement patterns. Research into the latter focused primarily on identifying the point at which residential densities reached their lowest levels before increasing again; in other words, mapping density gradients and splitting agglomerations at the lowest points. Computational complexities and uncertainty about how best to deal with non-residential urban areas led to the decision not to pursue this line of research further. In the end, the Census Bureau decided to use the previous decade’s urbanized area boundaries as a guide when splitting large agglomerations, with the result that Census 2000 urbanized areas would continue to be recognized for the 2010 Census, as long as the 50,000-person minimum was still met.

Identifying Urban and Rural in Puerto Rico

Early in the delineation of urbanized areas for Puerto Rico for the 1990 Census it became clear that residential densities were high enough throughout most of the island that grouping census blocks into analysis units would result in most of the island qualifying for inclusion in urbanized areas. It was decided, then, that only census blocks with residential densities of 1,000 ppsm or more would be added to urbanized areas (with the exception of jump corridors to reach non-contiguous qualifying blocks). The result was a modest increase in the urban population from 1980 to 1990. The Census 2000 delineation program applied the same automated delineation methodology as applied in the United States, resulting in 94 percent of Puerto Rico’s population classified as urban. Research conducted within Geography Division indicated that the increase in urban population was not explained by rural-to-urban migration or other demographic processes, but was directly attributable to changes to the minimum density threshold and delineation

methodology.⁷ Review of aerial imagery in comparison to residential densities at the census block-level suggested that rural densities in Puerto Rico were substantially higher than in the United States. The Census Bureau proposed adoption of higher residential density thresholds for Puerto Rico, but local officials preferred continued application of the same criteria as applied in the United States.

Considerations for the Future

Over the course of a century, the Census Bureau's urban area classification has changed in response to changes in the structure of the urban landscape, changes in technology and data with which to measure and delineate urban areas. Further technological improvements can make the delineation process more efficient, and more precise data can be applied at increasingly finer levels of spatial resolution, but these enhancements would be mere polishing of the existing concept.

Nearly 81 percent of the U.S. population is urban; 71 percent lives within urbanized areas of 50,000 or more people. We are an urban nation. Yet, as the nation becomes increasingly more urban, and as urban areas reach further into rural territory, the notion of what constitutes urban and rural is changing. Economic and demographic changes in suburban communities and the recognition that suburban is no longer a singular category; exurban development and urban sprawl; and different levels of rurality are of increasing interest to researchers and policy makers as our nation's population and landscape changes. In some areas of our nation, a sharp dichotomy between urban and rural areas no longer exists, and instead, the observer sees a continuum of development and settlement patterns. The question of what is urban and what is rural drives many discussions among those concerned with such classifications. Likewise, questions about thresholds often are raised:

- Is 2,500 still an appropriate minimum threshold for defining urban areas? Places of 2,500 or more population may have provided a typical array of urban functions and services in 1910 or even the first half of the 20th century, but is that still true in the 21st? This may still be a meaningful threshold in more rural areas of the nation, but are such places more appropriately classified as rural entrepôts? If 2,500 is too low a threshold for defining urban, what is the correct threshold?
- Similar questions can be raised relative to the 50,000 minimum population threshold for urbanized areas.
- What is the appropriate residential density threshold? Large-lot housing subdivisions, which can be found throughout larger metropolitan areas and often constitute what observers would consider urban sprawl, typically have densities well below the minimum for inclusion in an urbanized area. Are these communities urban, suburban, or rural? Should we lower the minimum threshold to account for these communities? Or, do we need additional landscape categories?

⁷ Mei-Ling Freeman, "Rural-Urban Population Change in Puerto Rico, 1990 to 2000." Paper presented at the Western Regional Science Association annual meeting, Santa Fe, New Mexico, February 2006.

Now that we can measure and define urban and rural landscapes with great precision and relative efficiency, the questions we need to consider relate to purpose: what are we trying to achieve with our classifications? What analysis and decision-making are we trying to facilitate?

I conclude with one more thought. Looking back over the previous 100 years, we observe that the United States progressed from a majority rural nation to one in which the vast majority of people live in urban and suburban settings and the nature of our urban landscapes changed substantially. As we move forward into the next 100 years of urban-rural classification, should the focus be on the changing rural landscape? As we assess the structural and functional landscapes at this point still early in the 21st century, it is the rural landscape that seems to be changing the most, challenging our perceptions and understanding of what is rural in a predominantly urban era.