How you can evaluate what the proposed Census Bureau criteria on Urbanized Areas means for your area.

This paper explains how to construct urban clusters and estimate urbanized areas using the proposed definition of the Census Bureau (posted at www.census.gov/geo/www/ua/ua_2k.html) For explanation purposes, we used Danville, IL as an example.

First, please read the Federal Register notice. Second, you will need a GIS to read in TIGER/Line files and Census 2000 population counts using the PL-94-171 data for the areas you are interested in examining. For guidance on how to obtain these files, please read a note posted at http://www.mcs.net/~berwyned/census/products/pl2gis.html. In our example, we used Arcview 3.2 as our tool. You will need to know how to use your GIS to complete this process.

Population density by block group (BG) and block is the key factor in the selection of areas to be included in the Urbanized area. Place (or city) boundaries are not used. A summary of the process is shown on page 2.

I. Add Data to GIS:

We created four layers of information:

1. A layer containing 2000 population counts by block. The attribute table for the layer contained the following attributes derived from the redistricting (PL-94-171) files:
   a. Land area of the block as identified in the "Arealand" field of the geography file from PL-94-171. The "Arealand" field contains land area of the block group in square meters. Land Area was converted to square miles using the conversion factor 0.3861×10^{-6} square meters = 1 square mile.
   b. Tract, Block group, and block fields from the geographic header file.
   c. Total population counts from the data files.
   d. Population density of the block (Total population divided by land area in square miles)
2. Transportation (roads) layer from TIGER/Line 2000, and
3. A polygon layer containing the water polygons from TIGER/Line 2000.
4. A polygon layer containing National Parks, Monuments, and Military installations.

II. Create Block Group Layer

The final step in the data set creation process is to aggregate the block data into block group data. Using the block data (in layer 1 above), we created a layer aggregating information from blocks to block groups. The attribute table for the BG layer contained total population, area in square miles, and population density (total population / area in sqmiles) of the block group.

III. Evaluation and Selection process

		Find potential geographic units.	Then, determine which to add to qualifying urbanized area
Step 1		Find all Block Groups (BGs) that have an area $\leq$ 2 square miles, and contain a population density $\geq$ 1000 people per square mile (ppsm). If no BGs of 1000 ppsm density are available, use blocks of 1000 ppsm to create the cores.	Select all contiguous BGs to form the core. Note that many cores can be simultaneously formed. (See page 3 for details)
Step 2		Find All BGs with area $\leq$ 2 square miles, population density $\geq$ 500 ppsm and < 1000 ppsm	Of these BGs, select those immediately adjacent to the cores identified in step 1 (See page 4).
Step 3		Find all blocks with population density $\geq$ 500 ppsm.	Select: **A**. Those blocks that connect to the core. **B**. Select all blocks that are adjacent to those blocks selected in Step A. **C**. Continue this process until all possible blocks are selected. See page 5 for more details.
Complete steps 1 to 3 for all densely populated areas in your region before proceeding to step 4.			
Step 4		"Hop" Criteria: Find all blocks or other "cores" that are within 0.5 miles of the "core" area identified after step 3.	**A.** Select all the blocks based on two additional criteria explained on pages 6 and 7. **B.** Find the next set of blocks or "core" within 0.5 miles of the "core" area identified after step A. **C.** Continue this process until all possible hops in all the densely populated areas are completed.
Step 5		**A.** Examine all donut holes, and **B.** Examine all indentations in the "core" area obtained after step 5A.	**A.** Select all donut hole areas $\leq$ 5 sq miles and add them to the "core". **B.** Select all indentations where the gap is less than a mile, and the length of the indentation is more than three times the gap. See page 8 for more details.
Step 6		"Jump" Criteria: Find all high-density blocks or "other cores" that are within 2.5 miles of the "core" area (with the largest population) obtained after step 5. **Exception:** The distance can be 5 miles if you have military installations, National monuments, or National parks along your "jump"	Select all the blocks or other densely populated cores based on two additional criteria explained for the "hop criteria" on pages 6 and 7. See page 9, and 10 for more details, and examples.
Step 7		Find the population of your Urban cluster/Urbanized area	Add up the population in the selected areas.

Step 1: Examine high-density block groups

From the Block Group layer, find all the Block Groups (BGs) that have an area ≤ 2 square miles, and contain a population density ≥ 1000 people per square mile (ppsm). One or more of these BGs constitute a "core" of densely populated area that will be further built upon in the later steps. If there is no BG core in your area, you can use blocks with population density ≥ 1000 people per square mile (ppsm) as the starting point.

Figure 1 illustrates these BGs for Danville, Ill
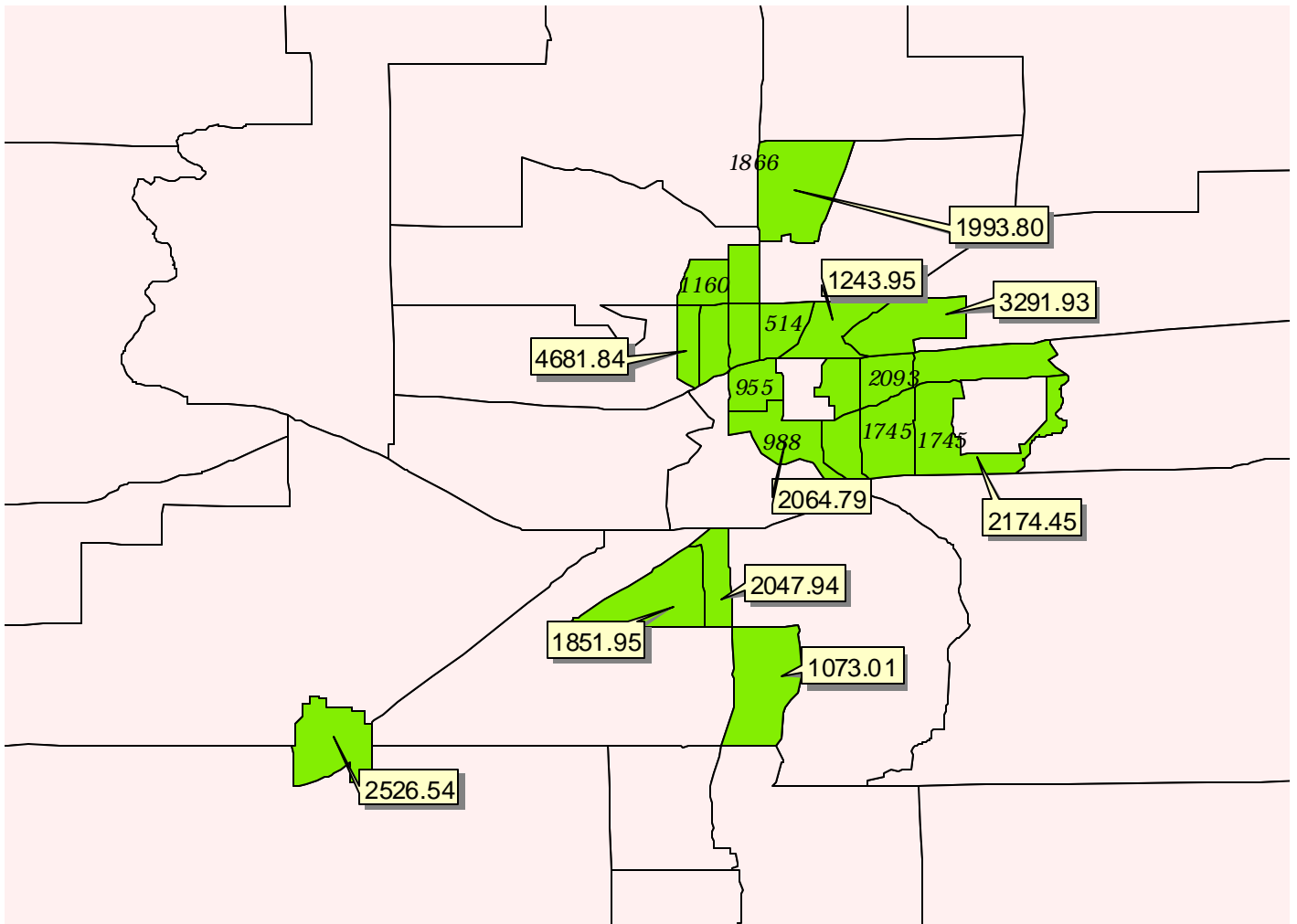
Figure 1: Eligible BGs (≥ 1000 ppsm) in the Danville area. The numbers in the boxes indicate population density. The numbers in italics represent population in the block group.

Step 2:
Find all BGs with area $\leq$ 2 square miles, population density is between 500 ppsm and 1000 ppsm. Figure 2 illustrates these BGs for Danville, Ill. There are 4 eligible BGs for the Danville area. These are numbered 1 through 4 in the figure. However, only BGs 1,2, and 3 are immediately adjacent to the "core" selected in Step 1. BG 4 is not adjacent to the densely populated area. Thus, using criteria I.A.3, only 1,2, and 3 can be combined to the area obtained from step 1.
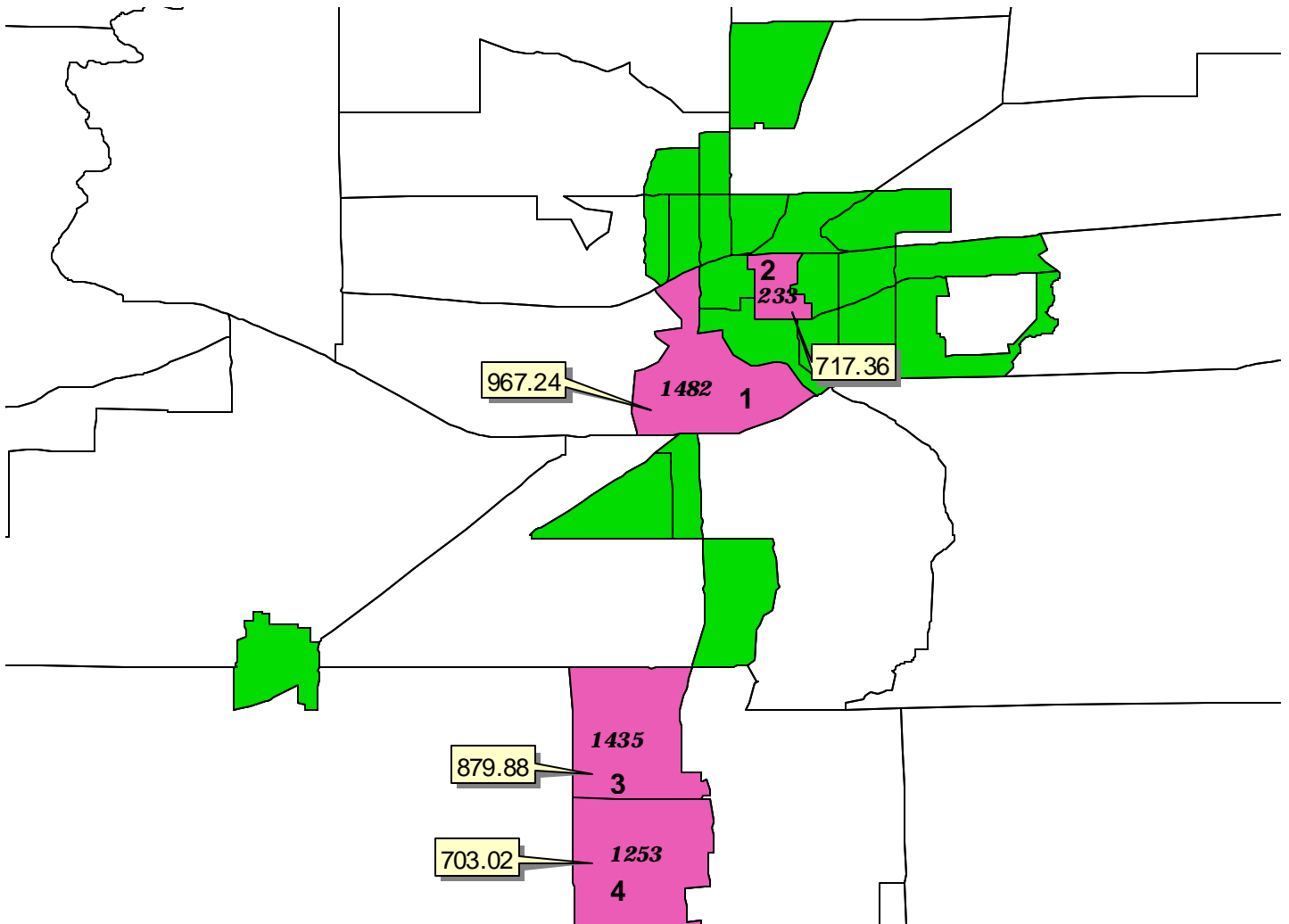

Figure 2: BGs 1,2,and 3 are BGs contiguous to the core. BG 4 is not contiguous to the "core" obtained from Step 1.

Step 3: Find all blocks with population density $\geq$ 500 ppsm. The eligible blocks are shown in figure 3, along with the "core" obtained in step 2.
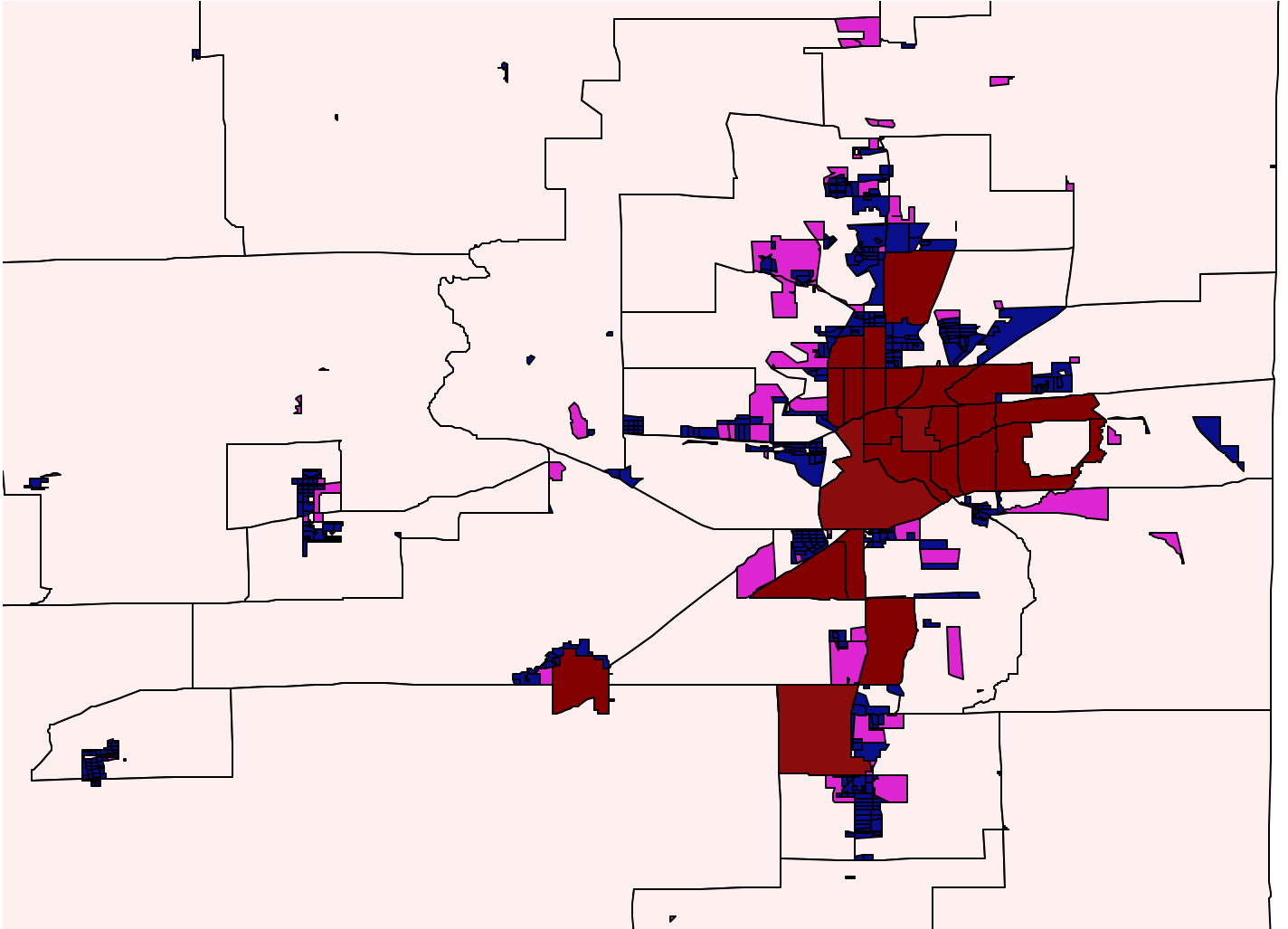

Figure 3: All eligible blocks, and BGs. Blocks are in dark blue if density > 1000 ppsm, and violet if density $\geq$ 500 ppsm and density < 1000 ppsm

Select only those eligible blocks that are connected to the core either directly or via other blocks, and include them in the "core".

Step 4: Using the "hop" criteria.

Find all the blocks/densely populated areas within 0.5 miles of the "core" obtained in step 4. Distance should be measured along the shortest road connection.

There are two conditions where you can "hop" and connect to eligible block(s) or other unconnected densely populated areas (BG cores + blocks) not contiguous to the "core".

> **Case A:** When the unconnected densely populated area has more than 1000 people
> In this case add the area to the core, along with other "connecting" blocks such that the density is the greatest along the shortest road path (See figure 4).

Case A

Distance = 0.4 miles

CORE

Population = 2400

Area A

i   ii   iii
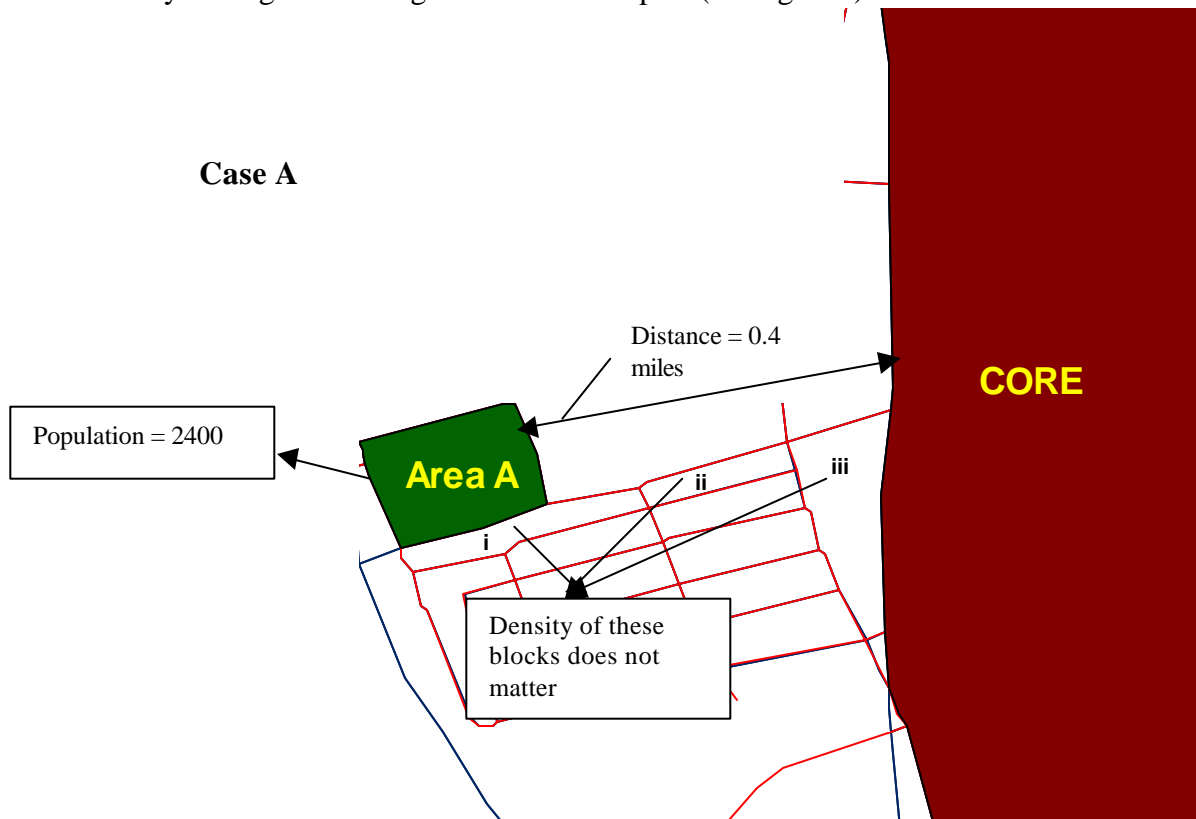
Density of these blocks does not matter

Figure 4: Illustration for case A.

In Figure 4, Area A is an unconnected densely populated area with a population of 2400. In this case, select the blocks with the highest density along the shortest path to connect area A to the core.

Case B: When the unconnected densely populated area has less than 1000 people
In this case, connecting blocks are selected along the shortest possible road
connection such that the combined density of the unconnected area and the
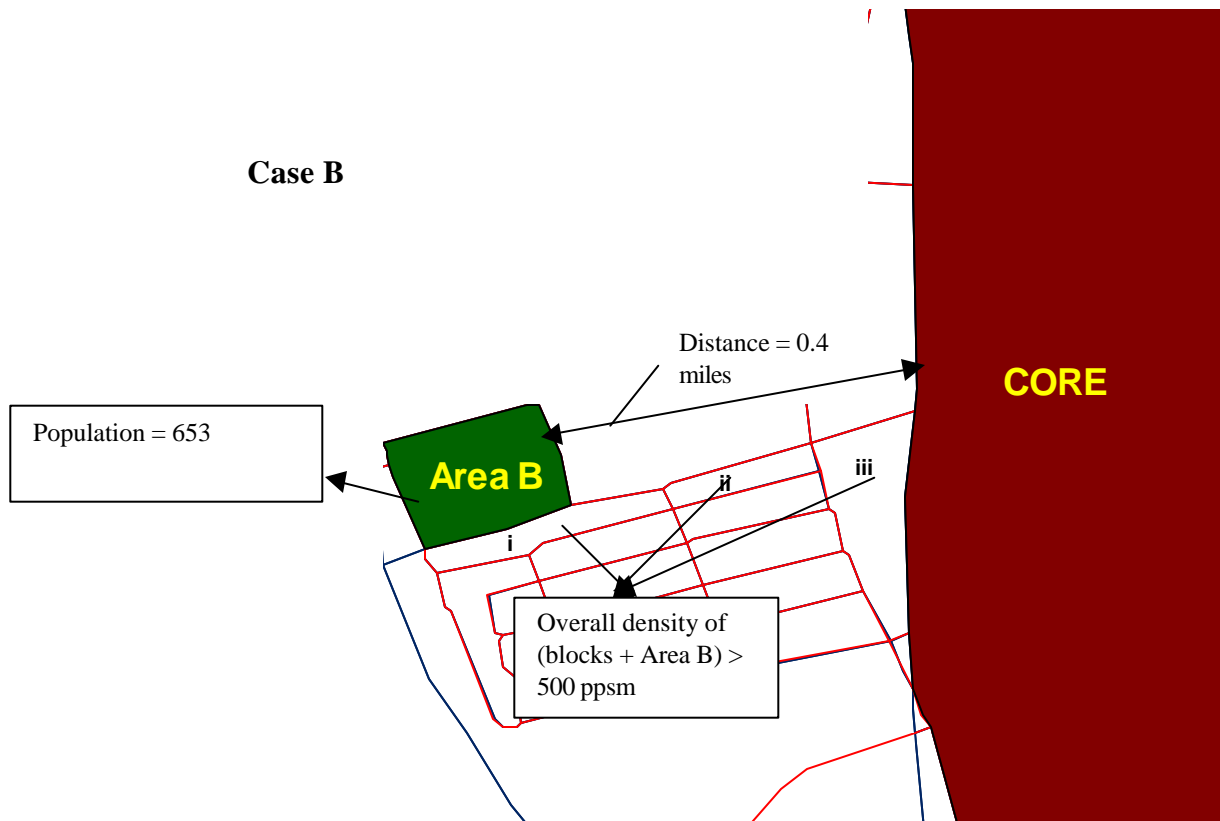connecting blocks is greater than 500 ppsm (See figure 5)

Case B

Distance = 0.4 miles

CORE

Population = 653

Area B

i

ii

iii

Overall density of
(blocks + Area B) >
500 ppsm

Figure 5: Illustration for case B.

In Figure 5, Case B, Area B is an unconnected densely populated area with population of
653 people. In this case, calculate the overall density of the area B and the blocks i,ii,
and iii. If the density of Area B plus blocks i,ii, and iii > 500 ppsm, then they can be
added to the core.

Once an area becomes part of the core, additional "hops" from that area can be performed
using the same rules.

At the end of step 4, all connections using "hops" between dense areas must be
completed.

Step 5: Step A: Closing areas enclosed by the "core"

The next step is to close donuts in the area obtained in step 4.   Figure 6 illustrates the conditions for closing donuts for a portion of Danville.
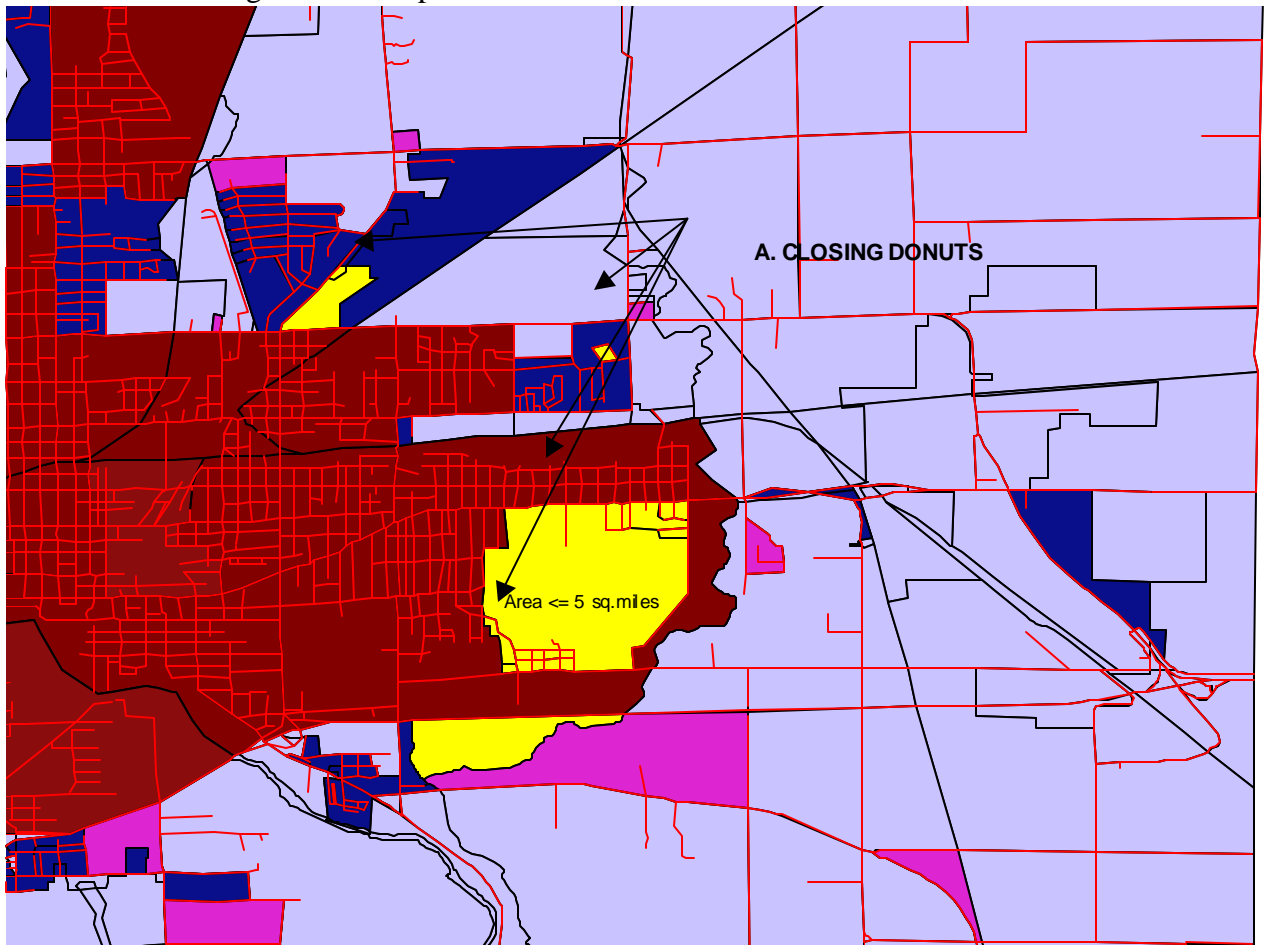

A. CLOSING DONUTS

Area <= 5 sq.miles

Figure 6: Closing indentations and donuts.

Step B: Closing indentations.

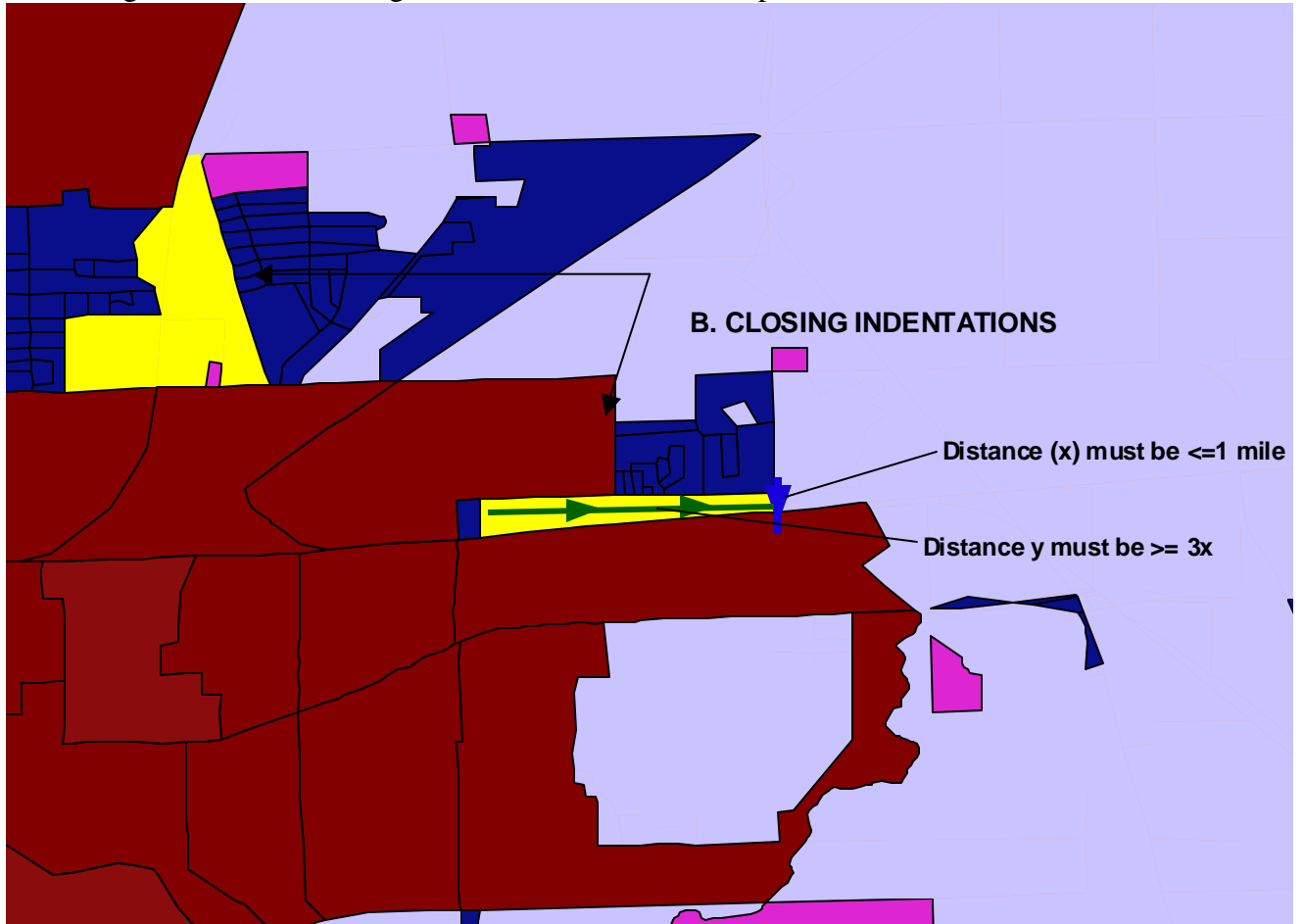Figure 7 illustrates closing indentations or enclaves for a portion of Danville.

B. CLOSING INDENTATIONS

Distance (x) must be <=1 mile

Distance y must be >= 3x

Figure 7: Closing indentations.

At the end of step 5, all possible indentations and donuts must be included to the "core".

Step 6: Using the "Jump" Criteria.

The "jump" criteria are the same as the hop criteria, except that the distance between the core and the other densely populated area can be 2.5 miles.

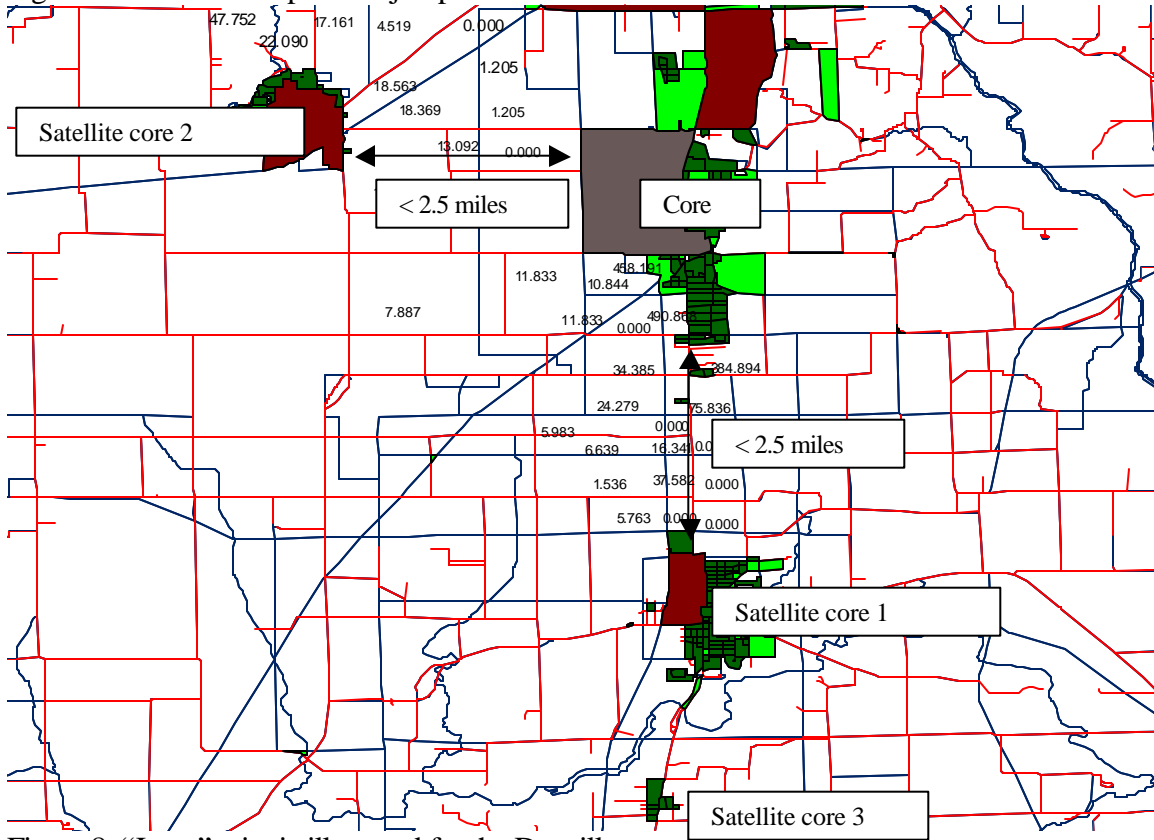Figure 8 illustrates two possible jumps for the Danville area.

Figure 8: "Jump" criteria illustrated for the Danville area.

For the Danville area, Satellite cores 1 and 2 qualify to be added to the "main core" because their distances from the core is less than 2.5 miles, and their populations exceed 1000 people. However satellite core 3 does not qualify, because only one "Jump" is allowed. The method used to select connecting blocks to the core is the same as that for the hop criteria as explained in Step 4.

 "Jumps" of up to 5 miles are allowed in special cases, when there is a water body, National Monument, National Park, or Military installation; which creates a gap between the densely populated areas.

Wetlands and other land areas that may be uninhabitable cannot be used for the 5 mile jump criteria because TIGER/Line file does not distinguish these areas from developable land.

One of the examples we found is Brunswick, GA. Examining the Brunswick, GA area using 2000 data, it appears that the distance between the Brunswick core and the densely populated St. Simons Island area is 3.15 miles (3.8 miles - .65 miles of water). Thus, under the proposed criteria the two areas would not be joined for the urbanized area. This is illustrated in figure 9.
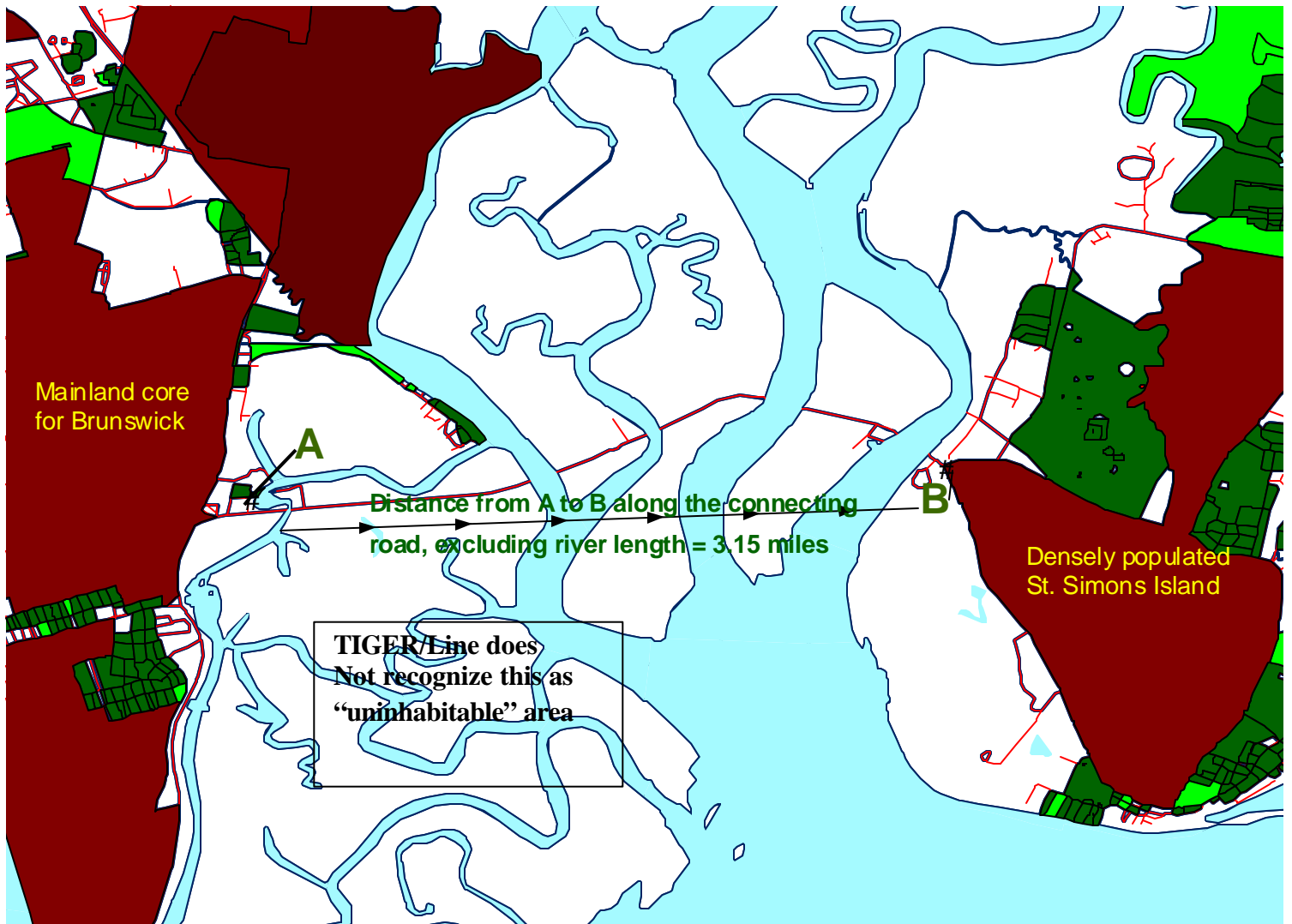
Figure 9: The blue areas represent water polygons

For additional assistance on "jump" criteria, please contact the Census Bureau Geography Division at 301-457-1099, ua@geo.census.gov